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Fowler, Penelope Ann

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ACQUISITION OF SYNTAX IN A MINIATURE ARTIFICIAL LANGUAGE: EFFECTS OF INPUT AND INSTRUCTION.

by

PENELOPE ANN FOWLER

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This thesis is dedicated to the memory of dear Mummy

and

to my dear Daddy whose love and support has been, as always, unfailing.

Acquisition of Syntax in a Miniature Artificial Language: Effects of Input and Instruction.

Penelope Ann Fowler

Abstract

The goal of the research was to discover which type of input and instruction best facilitates the acquisition of syntax in adult learners. An artificial miniature language was used to model real second language to control precisely the type of input, conditions of exposure and instruction accompanying that input. Performance of learners under four input conditions was compared and analogies were drawn between these conditions and those experienced by adult second language learners (L2 learners). "Instructed" learners like formally instructed L2 learners were systematically taught the rules of the language. "Exposure" learners saw example sentences and were asked to search for rules, the conditions of their input analogous to that of "naturalistic" L2 learners who receive no formal instruction but who make conscious efforts to search for rules. "Memorisation" learners received the same input as that presented to the exposure learners but were asked to memorise the sentences. They were seen as analogous to naturalistic L2 learners who do not search for the rules and the conditions of input were modelled on those claimed to induce implicit learning. "Cued" learners received input which contained cross-sentential cues to underlying phrasal structure. They were modelled on naturalistic learners whose input contains such cues and who make efforts to search for rules. Performance was compared on both grammaticality judgement and free production tasks.

No overall superiority in performance was observed for any of the input conditions. An interaction between input type and rule complexity was evident in which the amount of information received regarding the rules related positively to performance on the less salient, more complex rules. It was proposed that the findings could be explained in terms of a "noticing" hypothesis, in which noticing of features is considered a pre-requisite for acquisition. Theories of second and artificial language learning which have stipulated that complex rules can only be learned implicitly were not supported.

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AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award.

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Preface

Background to the thesis: the author's perspective.

My original interest in embarking on a doctoral thesis was triggered by my experience in the field of adult second language learning. I had been teaching English to foreign students in a classroom setting for almost ten years. During this time I had noticed that whilst students might appear to have grasped a particular structure during a formal lesson, immediately after the lesson they frequently appeared to "revert" to their previous less accurate production of the same structure. I became more and more uncertain about the extent to which formal instruction was actually "working".

A review of the literature which examined the role of instruction, revealed an unclear picture. Long (1983) reviewed twelve studies of which six produced either ambiguous results or found no positive effects of formal instruction over exposure. Despite these findings, Long concluded that "there is considerable evidence that SL (second language) instruction does make a difference". Research after the review continued to tentatively support the notion that formal instruction could be effective but that facilitatory effects were limited to the success and rate of acquisition and not to the process of acquisition.

This led to a related question: to what extent do adult learners learn without conscious awareness in the same way that it is argued, by some, that children acquire much of their first language? It appeared to me intuitively that some kind of unconscious, implicit process was involved over which the second language learner had little control and that possibly some kind of natural order of acquisition appeared to determine the accuracy of production of structures despite my best efforts to force them in consciously. Examination of the research supported my intuitions: the research indicated that the order in which structures are acquired tends to be impervious to formal instruction. Was it then that the learners I taught were simply not "ready" for the structure that they had been taught and that they would have to wait until they were naturally "ready"? This led to further questions: did adults still have access to Chomsky's innate Language Acquisition Device? Does such a device exist? How much of their first language was "interfering" with their production? What role did instruction play in all this?

I was aware that a number of theorists had attempted to account for the role of instruction in the acquisition of a second language. Krashen's (1984) "monitor model" stood out as being one which appeared to address most directly some of the questions I had posed. Krashen distinguished between "acquisition", a subconscious process in which the adult is hypothesised to acquire language without any conscious effort and "learning" which he described as a "conscious process that results in 'knowing about' language". Formal instruction, the product of which he equated with "learning," was relegated to the relatively minor role of acting as a monitor of the output of the unconsciously acquired system. Although Krashen's theory was subsequently heavily criticised in the literature (most notably due to claims that the theory was unfalsifiable (McLaughlin, 1987)), Krashen's theory had mapped onto my own and other practitioners' observations and intuitions (albeit perhaps a little too neatly). I felt strongly that the instruction I was giving in my classroom practice was of only limited value and that some kind of unconscious learning was taking place over which instruction would have little impact.

The research which followed from these initial thoughts focuses on the role of formal instruction in learning a miniature language by adult learners. An artificial methodology was used to examine these issues in order to exert as much control as possible over the actual language taught and the conditions of its exposure. The thesis examines the extent to which different types of input impact on the learning of syntax.

Chapter One
Introduction

The goal of this research project was to investigate adult acquisition of an artificial miniature language. Specifically, the research examined the effect of manipulating type of input and type of instruction on the acquisition of syntax with special focus on the role of formal instruction. The artificial language was used as a model of real second language and consequently the theory and empirical work underpinning the research is based largely upon the second language literature, an overview of which is presented in the first part of this chapter. The latter half of the chapter describes the artificial language literature and discusses the relative merits of using such an approach to model real language.

Overview of Chapter One:

This chapter is divided into five sections. The first section reviews the literature which investigates the role played by instruction in the learning of a real second language. The second section outlines a set of key questions which were posed in the light of this review. The third section introduces the artificial methodology to be used in the study to address those questions and section four reviews the literature underpinning that methodology. The final section overviews the main themes of each chapter in the thesis.

1.1 Second language learning and the role of instruction: the literature

1.1.1 Introduction

The investigation of the effects of instruction on second language acquisition is, as Harley (1988) noted, a "fascinating, but formidable task." (Harley, 1988, p165.) Any investigation of the role instruction plays must also attempt to address the question of how learning takes place in the absence of instruction. Researchers frequently imply that learning in the presence of instruction occurs explicitly and learning in the absence of instruction takes place implicitly. Consequently, any attempt to address the specific role instruction plays in second language acquisition is automatically drawn into an even larger debate concerning questions of consciousness and the interface between different levels of consciousness.

Added to this, attempts to ascertain the effects of instruction are frequently confounded due to the complex nature of the language input and of the context of learning. For example, in real second language learning contexts it is very difficult to control the exact type of input that learners receive. A sizeable literature exists in which comparisons have been made between the performance of learners who have been formally taught a second language and those who have received no instruction but have learned "naturalistically", perhaps through immersion in the language in the second language country. A common problem with such research is that the "instructed" learners might have also received a certain amount of natural exposure to the language and equally the "naturalistic" learners might have had some degree of formal training.

A second and possibly even greater problem is in the use of the term "instruction" itself. It is rare to find any clear description of the form or type of instruction that learners have received. Second language instruction in the classroom can take a multitude of forms: learners might listen to a tape of a spoken dialogue, study a complex grammatical rule, sing along to a Beatles song, produce the rules for reporting speech, read a newspaper article for gist or have a discussion on the perils of nuclear power, the list is endless. Which of the above constitutes formal instruction? Perhaps the lay usage of the term is associated with the teaching of rules of grammar but this is rarely clarified in the literature.

A third problem exists when researchers have attempted to obtain a measurement of the "amount" of instruction learners have received: for example in secondary schools in Britain, one might report that French is studied for five years but how does this "five years" compare for example, to a child's first five years learning their first language, where learning the language is virtually continuous. Despite these difficulties, a large body of research has been conducted which will be reviewed below.

In the following section the literature which examines the role of instruction in real second language acquisition will be reviewed Firstly, an historical overview will be provided, charting the role of instruction in language teaching pedagogy over the last forty to fifty years, relating its role in different periods to the theoretical position prevailing at the time. This history will be followed by a review of the research which has compared performance of second language learners under differing conditions of input. Finally, a number of different theoretical perspectives will be presented and the extent to which the theories can explain the results of the research will be discussed.

1. 1. 2 An historical overview of the role of instruction in second language teaching.

One of the earliest methods adopted in the teaching of second language was the "grammar translation" method where the role of what was termed "formal instruction" was central: teachers made explicit reference to the underlying grammar and rule system of the second language through formal explanations. In the 1950's and 1960's, in the wake of behaviourist learning theory, the audio-lingual method replaced grammar translation, especially in American classrooms: language was regarded as a subject area no different from any other; language learning was a matter of forming habits and the explicit teaching of grammar was virtually "outlawed". Learners were thought to learn through the mimicry and memorisation of structures.

After Chomsky's (1959) review of Skinner' s (1957) "Verbal Behavior", the tide against instruction began to turn. Chomsky argued that language was not the product of habit formation but that it constituted a set of abstract rules of which, he claimed, humans have innate knowledge. He asserted that children must have this knowledge because they produce sentences which they can never have heard before. Habit formation could not be used as an explanation for the creation of such novel utterances. Behaviourism had been dealt a heavy blow and this attack, coupled with others, was to impact upon the pedagogical methodologies which had been based upon it. The decline of behaviourism was eventually to lead to the demise (albeit gradual) of the audio-lingual method and language teachers were left with no clear direction.

Two new approaches to teaching second language emerged in the light of Chomsky's cognitive theory of first language learning. The first of these was the "cognitive anti-method" (Newmark and Reibel, 1968) and the second the "cognitive code method" (Chastain, 1971). R. Ellis (1990) reviewed these two approaches and concluded that neither had much real effect on classroom practice. However, the two approaches were interesting in that they both drew upon the same theory yet they differed in their view of the importance of instruction. Proponents of the cognitive anti-method saw second language learning in the classroom as equivalent to first language learning. They argued that formal instruction had no more of a role to play in second language learning than in first, as it would only interfere with the natural acquisition process (Chomsky, 1965).

Proponents of the cognitive code method based their methodology on Chomsky's notion of competence. They stipulated that in order to achieve the ultimate goal of language learning: competence, learners must "engage in the conscious 'analysis' of linguistic forms" (R. Ellis, 1990). However, Chomsky's definition of the term competence had been misunderstood by the cognitive code proponents. For Chomsky, competence referred to the speaker's knowledge of language in an abstract sense and certainly did not relate to conscious knowledge of pedagogical rules as interpreted by the cognitive code proponents. The latter's subsequent efforts to underpin their practice with this cognitive theory were therefore somewhat misguided.

Chomsky (1966) himself expressed doubts about the extent to which linguistic theory was ready to underpin language teaching methodology as linguistic theory was still in the process of development itself. However, in all the above methodologies, applied linguists had not only looked to linguistic theories on which to base methodologies for teaching second language but had looked to those theories which related to *first* language acquisition. In doing so, the implication was that second language acquisition was in some way equivalent to first. This was referred to as the L1 = L2 hypothesis. However, there were some strong arguments which were used to oppose this generalisation. Two of the main arguments were those concerned with "first language transfer" and those concerning a hypothesised "critical period" for acquisition. These arguments are presented below.

It had long been presumed that second language (L2) and first language (L1) were unlikely to involve similar processes because of the phenomenon of "language transfer" (Prator, 1969) whereby learners were hypothesised to transfer first language rules into the second language. Possible evidence of language transfer could be found in errors produced by L2 learners: for example, native French speakers learning English might incorrectly produce "I have 12 years old". It was argued that this error was the result of transferring from French where the verb "to have" is used when referring to age rather than the verb "to be". It was argued that the underlying processes involved in L2 could not be the same as those involved in L1 because L1 did not contain transferred items: the system underlying L1 was considered to be autonomous whereas the L2 system was not.

However, studies examining errors produced by second language learners (Dulay and Burt, 1974a) revealed that the majority of errors were not the result of L1 transfer but were due to other factors, for example over-generalisations of L2 rules. An example of this would be the production by an L2 learner of the sentence "I goed there yesterday" whereby the learner has learned the regular past tense ending "-ed" and has incorrectly applied it to the irregular verb "to go." It was argued that such errors, which could not be attributed to first language transfer, were similar in type to those made by children learning a first language and that therefore the production of such errors might indicate that similar processing was taking place in L1 and L2. Whilst it was acknowledged that transfer did take place in L2, it was argued that the language transfer argument no longer provided sufficiently strong evidence against the L1 = L2 hypothesis.

Secondly, it had been suggested that adult learners were 'too old' to learn a second language 'naturally' because they no longer had access to a language acquisition device. Neurophysiological evidence was put forward to support this claim: Penfield and Roberts (1959) linked cerebral plasticity with the ability to learn language naturally without effort, and reported that plasticity declined with age. They referred to a "critical period" for language acquisition during the period of plasticity. However, studies were to reveal a common order of acquisition of morphemes and grammatical structure (see section 1.1.3) for learners similar, though not identical, to that of first language acquisition. It was argued that the existence of such an order indicated that second language learners might also have access to some kind of language device which determined the order in which features were acquired. The question of whether adults have access to a language acquisition device is still in debate, (Lightbown, 1985, Newport, 1990). However, the discovery of a naturally occurring order of acquisition of some features encouraged the view at the time, that L2 acquisition was a natural process not dissimilar to the process of L1 acquisition and that adults were constrained by this natural process.

Doubt had been cast upon two of the major arguments used to claim that second language was not equivalent to first language. However, there followed strong debate regarding the validity of the results of some of the empirical studies (in particular the morpheme studies) which had been used to claim that there existed a common L1 and L2 order of acquisition. Some claimed that "accuracy of use" had been measured in these studies and not the "acquisition sequence" of morphemes (McLaughlin, 1987). A theory of second language termed "interlanguage theory" emerged from this debate. The term "interlanguage" was originally introduced by Selinker (1972) and different formulations of the interlanguage theory have been developed since (Adjemian, 1976; Heubner, 1983; Tarone, 1983). Selinker proposed that five central cognitive processes were involved in learning a second language. Whilst he acknowledged that the transfer of the L1 might be involved in *one* of these processes, he stated that learners also use other processes, for example, overgeneralising L2 language rules (as described in the "I goed" example above). A separate linguistic system which Selinker described as "interlanguage" was constructed through the learner's efforts to produce the correct L2 form and was the product of the five central processes. The grammar that the learner constructed was developed gradually: being initially incomplete, unstable and subject to regular revision. Each stage of development of the system was referred to as "an interlanguage" and reflected the current status of the learner's system. The different stages of development made up the interlanguage "continuum", the starting point was considered (depending on individuals' opinions) to be either the L1 or a simple grammar independent of the L1. Selinker argued that what distinguished interlanguage from the process of first language acquisition was "fossilisation" whereby, on certain features, learners might cease to make any further progress despite continued exposure or teaching.

The essence of interlanguage theory was that the goal of language learning was to convey meaning: it was accepted that learners were active participants in the language learning process and that they would adopt a range of communicative and cognitive strategies to ensure that their message was conveyed and understood. The interlanguage system reflected the operation of these strategies.

The interlanguage phenomenon impacted on classroom practice in a number of ways: there was a focus on the importance of encouraging communication and it was argued that teaching of the code was unnecessary and possibly detrimental as learners followed their own developmental path. Instead it was argued that any syllabus should control only the communicative demands of the task (Corder, 1976).

As R. Ellis pointed out, "Corder was, in fact, recommending a return to a 'natural method'" (R. Ellis, 1990, p56.). The position reached was similar to that proposed by the cognitive anti-method proponents and, as N. Ellis (1993) noted, the pendulum swung back to naturalistic methods.

Whilst early interlanguage theory did not see L1 and L2 as equivalent, the creative construction theory which followed most certainly did. Creative constructionists (Dulay, Burt and Krashen, 1982) believed that L2 acquisition was driven by essentially the same processes as L1 and that the sequence of L2 structures was pre-programmed in an order similar to that found in the native speaker. The acquisition process was hypothesised to be similar to the L1 process: acquisition taking place subconsciously through exposure to the target language. It was argued that adults had the same access as children to Chomsky's "language acquisition device".

The most influential, comprehensive yet controversial theory of second language was the creative construction theory known as the "Monitor Model". Its progenitor, Krashen, described and defended the theory in four books (Krashen, 1981; 1982; 1985; Krashen and Terrell, 1984). The theory, which was later re-named the "Input Hypothesis" (due to a shift in emphasis of importance from the monitor to the input) comprised five hypotheses, these will be described below. The central hypothesis of Krashen's theory was the "acquisition" versus "learning" distinction (see preface). These terms will be explained separately.

Firstly, "acquisition" was described as a sub-conscious process in which linguistic competence developed only through unconscious processing of comprehensible input. Krashen stated that "comprehensible input" must be available for learners for acquisition to take place. This requirement was referred to as the "Input Hypothesis". He claimed that humans could only acquire language by understanding messages, input was then processed by the Language Acquisition Device (LAD). Learners acquired structures in a natural order (the "Natural Order Hypothesis") and progressed along this natural order by understanding messages containing structures just beyond the learner's current level. This level was described as $i + 1$ where i is the current state of knowledge and $i + 1$ is the next level of knowledge. Whilst comprehensible input was described as a necessary condition, it was not a sufficient condition for acquisition to take place: Krashen also postulated the existence of an "affective filter" which could prevent learners from using comprehensible input. When the affective filter was "up", because the learner was unmotivated, stressed or lacking in confidence, the input would not reach the LAD. Only when the affective filter was down could acquisition take place. This was termed the "Affective Filter Hypothesis."

Returning to the central hypothesis and the second part of the distinction "learning" was described as a conscious process, whereby metalinguistic knowledge was developed. The product of learning acted only as a "monitor" of the output of the acquired system. This was described as the "Monitor Hypothesis". Krashen proposed that the use of the monitor was constrained in three ways: learners must have "time" to think about and consciously apply the grammatical rules; they must "focus on the form" (Krashen noted that learners might have time but still not focus on the form of the structure because the learner is "completely involved with the message" (Krashen, 1981, p 3)). Thirdly, the learner must "know the rule". This final point was perhaps the crux of Krashen's anti-instruction stance. Krashen described the requirement of knowing a linguistic rule as a formidable one and pointed out that even linguists have only analysed "fragments" of natural languages. Where pedagogical rules have been formulated, Krashen argued that only a small sub-set of these are learned and only those that are simple "rules of thumb". Complex rules must be acquired. Only highly motivated "optimal users" of the monitor need be taught the structures of language and this more for the sake of the learners' interest in the process rather than as a way of benefiting them in their natural production. Krashen also stipulated that beginners might benefit from instruction, not because of the formal focus on rules but due to the nature of the input they are exposed to in the language classroom environment. He argued that such input is more likely to be comprehensible to the beginner learner than 'real world' input which is too complex. "Language classes are less helpful when (1) learners are already advanced enough to understand some of the input of the outside world, and (2) this input is available to them" (Krashen, 1985, p. 13). The latter point reflects Krashen's view that in "acquisition rich" environments, learners are less likely to profit from instruction.

Finally, with regard to the acquisition/ learning distinction, Krashen contended that there existed no interface between the knowledge bases resulting from the two processes: "acquired knowledge" was stored separately from "learned knowledge" and the latter could not be converted into the former. According to Krashen, conscious knowledge of the rules of a language certainly does not precede acquisition. He (and many others) have made frequent reference to "P", a subject in one of his studies (Krashen and Pon, 1975). "P" has become infamous in academic papers for her inability to produce a particular morpheme, despite years of exposure and "thousands of repetitions" (Krashen, 1981, p113). Added to this, Krashen argued that there are many examples of learners who have acquired structures with "no apparent conscious learning." Krashen used these arguments to support his claim that conscious knowledge of a rule does not necessarily lead to its acquisition and conversely acquisition can take place with no knowledge of conscious rules.

Whilst there followed widespread criticism of Krashen's theory, (McLaughlin, 1978; Sharwood-Smith, 1981; Gregg, 1984) due mainly to the argument that some of the hypotheses were not falsifiable, R. Ellis (1990) concluded that Krashen had at the least done the teaching profession a service and that his work had contributed much to the growth of empirical study of classroom L2 learning itself.

In summary, by the mid 1970s and early 1980s the importance of the role of instruction in L2 acquisition was questioned and this again influenced classroom practice. Krashen and Terrell's (1984) teaching method the "Natural Approach", born out of the proposals presented in the 'monitor model' was adopted in some classrooms. A summary of the principles underlying the natural approach was presented by R. Ellis (1990) who stated that the main focus was on communication; comprehension preceded production (the latter emerging only when the learner was ready), "acquisition activities" were to be readily available and the affective filter should be kept low.

In the author's experience of teaching in the 1980s, these principles were followed fairly closely. There was certainly a focus on communication and meaning based activities; however, pedagogical rules *were* taught, albeit through contextualised and meaningful presentation. The feeling from the practitioners was one of general support for Krashen, but there was still a hankering towards the use of explicit, form focused instruction, even of more complex rules.

In the early 1990s, Ellis reported another swing of the pendulum towards more explicit teaching methods in the light of research showing relatively poor performance of graduates from "grammar-free" foreign language programmes" (N. Ellis, 1993). This research and a substantial body of research undertaken from the late 1960s through to the 1990s investigating the role of instruction in second language acquisition indicated that there *was* potentially a positive role for instruction in second language acquisition, despite the trends in pedagogical practice based on linguistic theories which advocated an anti-instruction stance. This research is described below.

1.1.3 The role of second language instruction: the research.

Investigations into the effects of formal instruction on second language learning have been reviewed by a number of authors (Long, 1983; R. Ellis, 1984c, 1985, 1990; Harley, 1988). Of these, R. Ellis' (1990) review of research on classroom second language learning was the most comprehensive. Ellis categorised the research into three broad areas: "classroom process research", "classroom interaction research" and "formal instruction research". Formal instruction research was divided into two further areas of research and these areas were themselves sub-divided. Because the picture becomes rather complicated, a diagram showing the major areas of the research and the sub-divisions of these areas is presented below (see Figure 1.1).

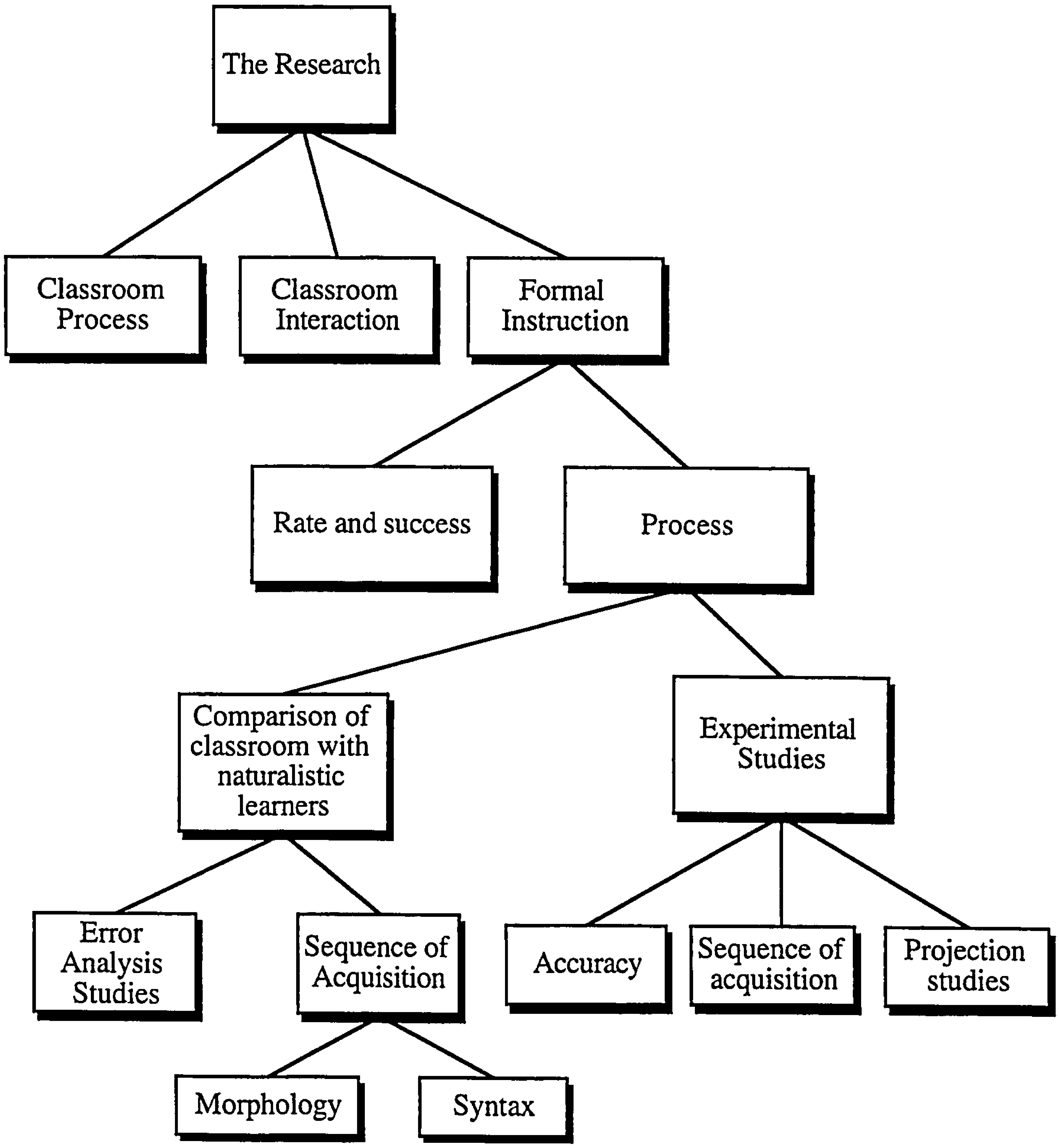


Figure 1.1 Second language research areas as categorised by R. Ellis, 1990.

Whilst the main focus of the current research is on the role of formal instruction, a brief description will first be given of the other two chief research areas (see Figure 1.1 above).

"Classroom process" research attempted to examine what actually takes place in the second language classroom setting; it aimed to describe classroom behaviour, usually in sociological terms, using methods such as interaction analysis, case studies, interviews or action-research. It did not aim to discover how languages are learned and was not concerned directly with the impact of instruction on learning.

"Classroom interaction" research saw teaching and learning as an "interaction" and attempted to understand how such interaction led to learning. Interaction included both that involving authentic communication and that involving formally structured communication, for example, "drills". A number of different hypotheses arose from this research, one of which was the "interaction hypothesis" in which second language acquisition was believed to occur most efficiently if learners have sufficient opportunity to negotiate meaning. The negotiation of meaning ensured learners attended to language which was then incorporated into the learner's grammatical system. Ellis argued that it was difficult to test out such an hypothesis, as it was impossible to determine which aspects of acquisition resulted directly from meaning negotiation. However, others continued to argue that such claims could reasonably be made (Long, 1985). The role of formal instruction was seen to be beneficial only where the form the instruction took encouraged meaningful interaction.

As stated above, the third major category of research reviewed by Ellis was that which examined the role of "formal instruction" in second language learning. In the studies examined under this category, formal instruction was equated with "direct pedagogic intervention" in which learners were presented with a specific feature of the language and were made aware of its correct grammatical form (R. Ellis, 1990, p 130). (In the classroom process research, as described above, instruction was equated with any interaction between teacher and learner or learner and learner.)

Research on formal instruction was sub-divided into studies which examined the effects of instruction on the *rate and success* of acquisition and those which examined the effects of instruction on the *process* of acquisition (see Figure 1.1). The studies on the rate and success of acquisition will be described first.

R. Ellis (1990) referred to a previous review by Long (1983) of twelve studies which had examined the rate and success levels of acquisition of learners who had received differing amounts of "exposure" and "instruction". In four of the studies, a comparison was made between naturalistic learners i.e. those who had been exposed to the second language in a natural setting for a specific period of time but who had received no formal instruction, with a group who had received an equivalent overall amount of both exposure *and* formal instruction (Hale and Budar, 1970; Mason, 1971; Upshur, 1968; Fathman, 1975). The first three studies involved adolescents and/or adults, and the last one, Fathman, 1975, involved younger and older children. The researchers reported finding no positive advantage for those learners who had received both instruction and exposure over those who had received exposure only. The findings from these studies appeared to support Krashen's claim that instruction plays only a minor role in second language proficiency.

Long (1983) suggested that, despite the fact that it appeared instruction was having no facilitative effect, three of the studies (Mason, 1971; Upshur, 1968; Fathman, 1975), contained a "hint of an advantage for instruction". Also, in the fourth study, (Hale and Budar, 1970), Long argued that the results were confounded due to differences, other than those under investigation, between two experimental groups under comparison. Hale and Budar had attempted to compare children in schools in Honolulu who had received ESL (English as a Second Language) instruction with those that had not received this instruction. However, children in the instructed group lived in lower socio-economic areas than those in the exposure group and spoke their mother tongue in the breaks during school time and when they were at home. Those in the non-instructed groups had more access to native speakers of English in their schools and were likely to have had far more exposure to English on a day to day basis than those in the instructed groups. Long argued that in at least three of the four studies, instruction was having a slight yet advantageous effect.

In two further studies conducted by Krashen and his colleagues, (Krashen and Seliger, 1976; Krashen, Seliger and Hartnett, 1974) the findings were more clear cut. The results revealed that more instruction *did* relate to higher second language proficiency. In these studies, learners with equivalent amounts of exposure had been matched into pairs but the individuals in each pair differed in terms of the amount of instruction they had received. Those receiving more instruction were more proficient than those receiving less instruction. Long (1983) argued that this was clear evidence that instruction has a facilitative effect in second language learning. However, Krashen (1982) argued that learners who had received more instruction had more access to "comprehensible input" in the classroom setting and it was this, not the instruction, that had produced the benefits in terms of proficiency,

The same researchers also examined the opposite scenario, whereby learners were matched on instruction but received differing amounts of exposure. No significant differences between learners were found. Varying the amount of exposure did not have a positive effect on proficiency level. This raised certain questions about Krashen's claim that the role of learning is minimal and that of comprehensible input maximal. It is likely that learners who had received more exposure had also received more comprehensible input. According to Krashen they should then show higher levels of proficiency. Krashen later argued that learners in the studies might not have had sufficient exposure to comprehensible input at $i + 1$ due to the nature of their occupations where set scripts might have been used (e.g. a gas station attendant might only hear and respond to a set number of formulaic utterances.) This might be the case, but, as Long remarked and Krashen acknowledged, this was only a post hoc explanation of these results.

Martin (1980) carried out a similar study in which she compared students learning a second language who received the same amount of instruction but differing amounts of exposure. Half of the students lived in dormitories with other students (less exposure), others lived in homestay programs with American families (more exposure). She found a positive effect of exposure on acquisition. However, Long (1983) criticised the study, arguing that the learners had decided for themselves where to live and therefore the composition of the two groups might not have been equivalent.

Finally, Briere (1978), Krashen, Jones, Zelinski and Usprich (1978), Carroll (1967) and Chihara and Oller (1978) examined the correlations between the amount of exposure learners had received and their test scores and the amount of instruction received and test scores. Positive correlations were found for both instruction and exposure, except in the Chihara and Oller study where a positive correlation was found for instruction only. It appeared from these studies that both instruction and exposure were related to higher overall proficiency levels.

In Long's (1983) summary of the studies, he concluded that "there is considerable evidence to indicate that SL instruction does make a difference." However, this claim does seem slightly over-generous in favour of instruction. Only in the studies of Krashen and colleagues was a clear, positive effect of instruction found and Krashen was quick to argue that this was due solely to extra opportunities for instructed learners to obtain more exposure to comprehensible input.

However, Long argued that instruction did appear to be playing a part in improving overall success and proficiency in second language learning. He further extended this point by claiming that the benefits held in children and in adult learners, in advanced, intermediate and beginner learners; in integrative as well as discrete point tests and in acquisition rich and acquisition poor environments.

R. Ellis (1990) reviewed the studies discussed by Long(1983) and reviewed three further studies. The first two of these (Weslander and Stephany, 1983; Ellis and Rathbone, 1987), examined the effects of instruction on English proficiency in children and adults. Results from both studies indicated that the more instruction received, the higher the proficiency level. The effects were strongest in the early years of schooling in the Weslander and Stephany study and after three months of class attendance in the Ellis and Rathbone study. In the third study (Spada, 1986) a more complicated picture emerged. Spada examined the effects of both amount of informal contact with the target language and type of instruction (more grammatical focus compared to more meaning-based focus). Those with high contact performed better on grammar and writing tests than those with low contact but only when they had also received more explicit focus on the grammar in their instruction. Those with higher contact but meaning focused instruction did not differ from those with lower contact and meaning focused instruction on these tests. An interaction between contact and type of instruction existed and indicated that form focused instruction seemed most facilitative when accompanied by more contact opportunities.

R. Ellis (1990), like Long (1983) , concluded that there was evidence that instruction was "working" but acknowledged that this conclusion was tentative. Ellis noted that a number of potential problems existed with the studies in the area: in all but two of the studies described by Long, there was a failure to control for the overall amount of exposure and instruction received, making it impossible to determine whether the apparent positive effects of instruction were in fact due to an overall advantage of extra exposure (either in or out of the classroom). Secondly, learners in the instructed groups sought out the opportunity for second language classes and therefore might have been more motivated generally than learners not receiving instruction. Finally, the measure used to determine the amount of instructed learning undertaken lacked validity The measure used was the number of years spent in the classroom. No information was provided as to what form the actual instruction took, or whether it was form or meaning focused. The term "instruction" was not clearly operationalised: it appears that there was an assumption that the classroom based learning was form-focused and that it was the focus on form that produced the benefits. Any researcher wishing to shed light on the extent to which formal, form-focused instruction can impact on the rate and success of acquisition should measure precisely the amount of instruction and amount of exposure received, randomly allocate learners to instructed and non-instructed conditions and clearly document the kind of instruction and the kind of exposure learners receive.

Ellis concluded that there was some evidence to support the notion that instruction affects the rate and success of acquisition but that certain conditions need to be met. Results of the Ellis and Rathbone study appeared to indicate that the effect of instruction might be delayed, and those of Weslander and Stephany appear to support Krashen's claim that only beginner learners can benefit from instruction. However, according to Long, the studies by Krashen and colleagues (Krashen and Seliger, 1976 and Krashen, Seliger and Hartnett, 1974) showed a positive effect of instruction for both intermediate and advanced learners. Krashen (1985) disputed this and stated that none of the learners in these two studies involved intermediate learners. The picture here is still rather unclear but there is a consensus that at least beginners can benefit from instruction.

More recent studies undertaken in the 1990s will be reviewed in later chapters as they relate directly to the experimental studies in the current research. In 1983, Long concluded that the data on instruction might not be as clear cut as TESOL professionals would like and that there was still a need for further research. He completed his review with four questions: Does SL instruction make a difference? Does type of instruction make a difference? Does type of learners make a difference? Does type of instruction interact with type of learner? He acknowledged that the questions had still to be answered although he suggested that the answer to the first was a "not-so-tentative "Yes."" (Long, 1983, p380).

The second section of R. Ellis' (1990) review of "formal instruction" examined the effect of formal instruction on the *process* of acquisition and sub-divided this research into two areas (see Figure 1.1). The first of these was research which compared classroom learners with naturalistic learners, the second was research based on experimental studies in which instruction was directed at a particular feature in the input.

In the first, where comparisons were made between naturalistic and instructed learners, two types of study were performed: one type investigated learner errors and were known as the "error studies" (Felix, 1981; Felix and Simmet, 1981; Lightbown (1983); the second type examined the sequence of acquisition of morphemes and syntax (Dulay and Burt, 1974b; Larsen and Freeman 1976; Pica, 1983, 1985; R. Ellis, 1982, 1984; Ewbank, 1987) (see Figure 1.1).

The chief finding from the "error" analysis studies was that instruction had no effect on acquisition or it had an initial effect which disappeared after time (Lightbown, 1983). In Lightbown's study instructed learners originally produced "V -ing" (the verb form with an -ing suffix, e.g. watching, waiting, coming, used to form the progressive, for example " I am watching") but their use of it declined as a different form (the simple form, e.g. "I watch") was introduced.

In the sequence of acquisition studies, the research which examined the order of acquisition of morphemes (commonly referred to as the "Morpheme Studies") acquired an infamous reputation as many of the studies were methodologically flawed. However, the chief finding was that in most of the studies, instruction had no effect on the order of acquisition of morphemes compared to the order for non-instructed learners.

R. Ellis (1990) cited Pica's (1985) study as the "most important" of the morpheme studies (R. Ellis, 1990, p140). Pica (1983) found no evidence of accuracy order being disrupted by instruction and, in Pica (1985), reported there was no difference in acquisition order of highly complex structures (for example the article *a*) in her instructed group compared to her naturalistic and mixed (naturalistic and instructed) groups. All three conditions followed the same sequential order. However, whilst learners in her instructed condition supplied more instances of simple morphemes, for example the plural -s inflection, compared to learners in the other two groups, the learners overused the more complex progressive V-ing form (see description above) supplying it in inappropriate contexts. (These findings were similar to those of Lightbown, 1983). Pica concluded that instruction had a "selective impact" on morpheme acquisition (Pica, 1985, p 221). She concluded that complex structures should be excluded from instruction. This opinion supports that of Krashen (1981) that only simple rules can be taught. It also indicates that learners can sometimes be adversely affected by learning certain more complex features, as in the case of V - ing.

Research examining the acquisition orders of syntactic features (Ellis 1982, 1984a; Weinert, 1987) provided further evidence that similar orders of acquisition existed for both instructed and naturalistic learners and, as Ellis stated, "the pervasive finding is that the overall sequence of acquisition is the same in classroom and naturalistic settings." (R. Ellis, 1990, p146.)

The preceding studies examined the process of acquisition by comparing naturalistic and instructed learners. The final set of studies (see Figure 1.1) examined the process of acquisition by experimentally manipulating instruction to enable the effect of instruction to be targeted more closely. The studies involved a pre-test, intervention (instruction of a particular feature) and a post-test and were divided into three different types: the "accuracy studies," the "sequence of acquisition studies" and the "projection studies" (see Figure 1.1) all of which were reviewed by Ellis (1990). Firstly, the "accuracy studies" (Schumann, 1978; Lightbown, Spada and Wallace, 1980; Ellis, 1984b; Kadia, 1988) revealed some positive effects of instruction, but in carefully planned production only. Secondly, in the "sequence of acquisition studies": (Pienemann, 1984, 1985, 1986; Pienemann and Johnston, 1987) it was reported that learners move from stage to stage irrespective of instruction and that the order of acquisition of structures was the same in instructed learners as in naturalistic learners. However, Pienemann also stated that learners did not learn a feature if they were not "developmentally ready" for that feature. This was referred to as the "teachability hypothesis". This hypothesis was an offshoot of Meisel, Clahsen and Pienemann's (1981) "multi-dimensional model" of second language learning which will be described later. The main conclusion reached from these studies was that instruction can be facilitative if it comes at the right time. (This is similar in some respects to Krashen's *i +1* hypothesis, but Pienemann and others argued that Krashen failed to operationalise the constraints which determine where i (the current state) is and also what determines the order in which the structures are learned.)

The final experimental studies reviewed by Ellis were the projection studies (Zobl, 1983, 1985) in which it was claimed that the instruction of one feature can trigger the learning of another feature. The research is based on the assumption of the existence of "implicational universals" in which features are related to one another in some kind of hierarchy: by learning a feature high in the hierarchical structure the features lying further down can be acquired automatically. Linked to this is the concept of markedness, in which the teaching of more marked forms (variously defined as being more difficult, and not universal) facilitates the acquisition of unmarked forms (universal therefore easier to acquire).

Zobl (1983) proposed that learners have a projection device which triggers the acquisition of rules which cluster around the rule being acquired. Zobl's (1985) study provided some support for this hypothesis when he found learners who had been taught more marked possessive adjectives (his/her sister; to do with human entities) acquired the less marked possessive adjectives (his/her car; to do with non-human entities). But learners who had been taught the umarked form did not acquire the marked form. Evidence from the projection studies appeared to provide some support that instruction can have a positive effect on second language learning but equally other types of input could trigger the acquisition of a feature which in turn leads to the acquisition of other features. However, the results cannot be explained in terms of Pienemann's teachability hypothesis because it would appear that learners can go more than one step beyond the stage at which they are developmentally ready in order to "work backwards". Also, the study suggests that learners appear able to acquire more complex forms through instruction which runs counter to Krashen's claims that only simple forms can be taught.

In summary, the review of the literature examining the role of instruction points to the following tentative conclusions: firstly, instruction has some effect on the rate and success of acquisition but not on the sequence of acquisition. Positive effects of instruction have been found for both child and adult learners, for beginners and in both acquisition rich and acquisition poor environments. Instruction can have an immediate effect and then wear off, or a delayed effect. Learners in instructed groups have been found to produce more instances of simple forms compared to naturalistic or mixed learners and there is some disagreement over the extent to which intermediate learners can profit from instruction. Instruction focusing on one feature can lead to acquisition of related, less marked features.

To what extent do the findings of the research support Krashen's "monitor model"? The findings that the sequence of acquisition is largely unaffected by instruction tend to indicate that some kind of natural processing is taking place. This would lend support to Krashen's contention that second language acquisition is a natural, unconscious process. However, it would appear that the role attributed to formal instruction is underrated in Krashen's theory. Instruction does appear to have some effect on the rate and success of acquisition and Krashen's limitation of the role of conscious learning to that of a monitor of the output of the acquired system does not appear to do the role played by instruction full justice. Interestingly, the studies of Krashen and his colleagues appear to provide some of the most convincing evidence that instruction works. However, Krashen argued that learners in the instructed conditions only benefited because they had received more access to comprehensible input. This theory was not supported by the results of their own studies: the results showed that varying the amount of exposure learners received (whilst keeping the level of instruction constant) had no positive effect on proficiency (see above). Spada's (1986) findings were similar in that learners who received more informal contact did not achieve improved performance unless form-focused instruction accompanied it.

In more recent studies Hulstijn (1988) found that learners who focused on form recollected more structural features and those who focused on meaning recollected more content features; Van Patten (1990) reported that conscious attention to form in the input competed with conscious attention to meaning: learners found it very difficult to attend to both at the same time. Particular difficulty was experienced by beginner and intermediate learners. These findings raise the question of how learners go from comprehensible input to intake (the point at which the feature is acquired) within the framework of Krashen's theory. If learners find it difficult to attend to both meaning and structure, then how do they obtain knowledge of underlying structure by comprehending meaning?

Van Patten was very cautious in his conclusions: he suggested that there were alternative possibilities of how input becomes intake. One possibility was that learners process the form of language sub-consciously, leaving sufficient conscious processing capacity to focus on the meaning. A second possibility was that once learners reach a certain level, they can automatically process the meaning and then consciously process the form. A final possibility was that learners consciously attend to both and they become better at this through practice. Krashen argued that learners must first "understand the message" (but he does not say how learners get to this point) and that form is acquired unconsciously as a result of being exposed to comprehensible input just beyond the learner's current level. The problem with his account still remains: that it is impossible to determine whether the form has been unconsciously acquired or consciously learned. The Spada (1986) study indicated that learners do require focus on form in addition to exposure for learning to take place; but how conscious is that focus and is it relevant to talk of consciousness anyway?

Research in the late 1980s and early 1990s has focused more and more on the question of consciousness in second language learning: formal instruction often being equated with "conscious" learning and so-called "naturalistic" learning (where there was an assumed focus on meaning) being equated with "unconscious" learning. Numerous theories of second language acquisition and theories of consciousness in second language acquisition have been developed. All of them have attempted to explain the role of instruction in the acquisition of a second language. A review of these theories and models follows.

1. 1. 4 The effect of formal instruction: the theories.

Krashen's "Monitor Model", the most well known and comprehensive theory of second language learning, has already been discussed in some detail. One of the problems with Krashen's theory was that whilst it could account for the findings of a natural sequence of acquisition it was less able to account for the extent to which instruction impacts on rate and success of acquisition.

Meisel, Clahsen and Pienemann's (1981) "multi-dimensional model", referred to earlier, seemed more able to account for both. They proposed that there existed two types of feature: *developmental* features, which are acquired in a natural sequence and which are constrained by the learner's developing processing mechanisms and *variational* features which are not so constrained: the way in which they are acquired is dependent upon the learner's approach and attitudes to the language learning task.

Rules governing word order are categorised as developmental features and are acquired in order depending upon the mental operations required to process them. Six developmental stages were postulated (Pienemann, Johnston and Brindley, 1988), each describing the level of processing operation available to the learner at each stage. These were summarised by R. Ellis (1990): in the first stage the learner has no knowledge of syntactic categories, the learners producing formulaic type utterances such as "non comprendo" (personal example!). By the third stage the learner is able to identify both beginnings and endings of strings and shift elements to and from these positions. By the fifth stage the learner has begun to identify syntactic categories and by the final stage the learner can move elements from one "sub-string" and attach them to another element, as in question tag formation "You're playing football tomorrow, aren't you?" (Ellis 1990, p. 153). Learners must pass through every stage, they cannot miss out any individual stage, but they can work on the previous stage at the same time as they begin to acquire the next. Not only are word order rules acquired in this way but some morphological features are also thought to be acquired through the same stages (Pienemann, 1987).

According to the multi-dimensional model, variational features are acquired in a different way from developmental features. They depend on socio-psychological factors, thought to play a substantial role in second language acquisition (Gardner and Lambert, 1972; Gardner, Smythe, Kirby and Bramwell, 1974). Factors such as intensity of contact with the target language group, social distance from the target group, attitudes and motivation, are all thought to influence second language acquisition. Meisel, Clahsen and Pienemann hypothesised that use of the copula (the 'linking' use of verb "to be") might be affected by these socio-psychological factors and not by developmental processing constraints. They stated that their intuitions had been supported in Pienemann's (1979a, 1979b, cited in Meisel *et al*, 1981) longitudinal study whereby the use of the copula by two Italian children learning German was examined. The children's development was similar except with respect to the use of the copula, one child systematically deleting it. Meisel *et al* concluded that this child was more interested in getting across her message than attempting accurate usage of the feature. Ellis (1990) described such a difference as indicative of differences in the extent to which a learner wishes to identify with native speakers of the target language community: learners paying more attention to target-like norms (e.g. including the copula in sentences such as "I'm Italian" rather than omitting it as in "I Italian") reflected their desire to "fit in" to the target language community. The more integrative motivations led to more accurate productions.

For developmental features, formal instruction was hypothesised to be effective only when the learner was developmentally ready to acquire the particular feature. Teaching of a feature when the learner was not ready could have deleterious effects, sometimes in the form of avoidance behaviour (Pienemann, 1987). Pienemann's "teachability hypothesis" stated that instruction could only be effective if the learner's interlanguage was at the level where the structure would have been naturally acquired. Lightbown (1985) noted the similarity between Krashen's $i + 1$ notion and Pienemann's hypothesis but she stated that "Pienemann seeks to operationalise the 'next step' and to base instruction upon it". Rather than distinguish between "acquisition" and "learning" and referring to different knowledge bases derived from them, Pienemann sees instruction as a way of speeding up the rate of acquisition by offering material just beyond their current level. All developmental features are hypothesised to be acquired naturally but this natural process will be advanced by instruction coming at the right time in the learner's development.

Instruction can also play a role in the acquisition of variational features by enabling learners to overcome fossilisation (the ceasing of progress on any feature, see section 1.1.2).However, results from some studies indicate that the effects might be short lived (e.g. Lightbown, Spada and Wallace, 1980).

The multi-dimensional model can account for the findings that instruction can be effective on rate and success of acquisition so long as, in the case of the developmental features, the right conditions exist. The model can also account for the results found in studies showing a regular sequence of acquisition of morphemes and structures. However, the model does have some limitations: it is not clear when a structure is actually "acquired" (Hulstijn, 1987) and there is little description in the model of what constitutes a variational feature. However, the model emphasises the multi-dimensional nature of the acquisition process by showing that learners might differ on both developmental and variational dimensions and variability between learners can be charted accordingly. Also, it provides an explanation for the differing impacts of instruction on acquisition.

Whilst Krashen's monitor model and Meisel, Clahsen and Pienemann's multi-dimensional model can account for the 'natural' sequence of acquisition of features, some cognitive theories of second language acquisition struggled to do so. Cognitive theorists (Bialystok, 1988, 1990; McLaughlin, 1987) viewed the process of second language acquisition as the same as the acquisition of any complex, cognitive skill. Bialystok (Bialystok, 1979, 1981, 1982, 1983, 1988, 1990; Bialystok and Sharwood Smith, 1985) proposed a framework consisting of two dimensions: an analysed factor and a control factor. The first concerned the extent to which knowledge has been analysed by the learners. For example, Sharwood Smith (1994) provided an example of unanalysed knowledge: "itsa" ("it is a") which he argued could only be integrated with the rest of the syntactic system when it had been analysed into subject pronoun ("it") plus copula ("is") plus indefinite article ("a"). Bialystok made clear that "level of analysis" did not equate with consciousness or the ability to articulate knowledge: "it is erroneous to equate analyzed knowledge with articulated knowledge, or knowledge of rules" (Bialystok, 1988, p40). Therefore the position of formal instruction (if it is assumed that formal instruction equates with learners having conscious knowledge of rules) within the analysed factor is unclear.

The control factor related to the exploitation of knowledge in actual performance and the access the learner has to the knowledge. With practice, the learner's ability to access knowledge becomes more automatic. Bialystok argued that the ability of learners to perform different tasks was dependent upon the learner's position on the two dimensions described, learners differing both in terms of the automaticity of their performance and the extent to which their knowledge is analysed.

A similar model of L2 acquisition was proposed by McLaughlin (1978, 1990) who used an information processing account of language acquisition based upon Schneider and Shiffrin's (1977) distinction between automatic and controlled processing. Automatisation in language learning was deemed necessary due to the learner's limited processing capacity. McLaughlin proposed that second language acquisition involved the automatisation of "routines" involving the automatic activation of "memory nodes": "initially the execution of these routines requires the allocation of large amounts of mental effort (controlled processing) but repeat performance of the activity leads to the availability of automatized routines in long term memory" (McLaughlin, 1987, p149). Restructuring or re-description (c.f. Karmiloff-Smith, 1986) then takes place in which the learner imposes organisation and structure on the information being acquired. In this way the newly acquired knowledge is incorporated into the existing knowledge system.

McLaughlin's model stood in direct opposition to Krashen's monitor model. McLaughlin argued that Krashen's work was empirically unfalsifiable because it was impossible to determine whether knowledge had been consciously or unconsciously learned. McLaughlin proposed that it was not necessary to distinguish learning according to levels of consciousness nor to distinguish language learning from any other cognitive skill.

Neither McLaughlin's nor Bialystok's accounts of second language acquisition can account for the existence of acquisitional sequences. However, the role of formal instruction in speeding up the rate of acquisition could be attributed, in Bialystok's model, to the extra focus on form increasing the learner's awareness of the analysed factor.

Sharwood Smith (1994) and R. Ellis (1990) concluded that neither theory offers an explanation of the process of acquisition of the knowledge itself but they do provide accounts of how learners develop in terms of proficiency. McLaughlin himself pointed out (McLaughlin, Rossman and McLeod, 1983; McLaughlin, 1987) that cognitive learning theory accounts need to be linked to linguistic theories in order to explain linguistic constraints on second language acquisition. He acknowledged that cognitive theory could not account for the existence of natural sequences in acquisition and speculated that some features are "automatic" when they emerge, but R. Ellis (1990) countered that there is no explanation for why certain features are automatic when they emerge.

Other cognitive theories (Anderson, 1980, 1983, 1985) have much in common with the information processing account proposed by McLaughlin. Anderson's model distinguished between declarative ("knowing that") and procedural ("knowing how") knowledge. R. Ellis (1990) claimed that the distinction was similar to that between controlled (equating with declarative) and automatic (equating with procedural) processing. The difference lay in the extent to which consciousness played a role. In McLaughlin's and Bialystok's account, controlled processing did not equate with consciousness or the ability to verbalise. In Anderson's terms, declarative knowledge equates with both consciousness and the ability to verbalise. When the knowledge changes from declarative to procedural then it becomes unconscious or as R. Ellis (1990) stated: "consciousness disappears" (R. Ellis, 1990, p177).

This difference in weight assigned to the role of consciousness is important in determining the role of instruction in second language learning. For Krashen, the teaching of explicit rules has very little impact on second language acquisition; for Pienemann, instruction could enhance acquisition if it came at the right time; for Bialystok and McLaughlin, the rôle was less clear. Instruction in the form of practice of the target structures might be predicted to facilitate production but their theories were less informative about the roles instruction or explicit knowledge might play in the acquisition process itself.

Others have argued that conscious awareness of rules is vital and must precede acquisition: Schmidt (1988, 1990) reviewed the literature on consciousness in second language acquisition and concluded that "there is no such thing as learning a language subliminally" (Schmidt, 1988, p17). Schmidt argued that whilst unconscious processing might play a part in comprehension and production, conscious awareness at the level of "noticing" is required for language learning to take place. Schmidt's claims were based upon his own experience of learning Portuguese: Schmidt documented in his diary features he had noticed in the input he had obtained from a short course and from time spent with native speakers. He reported a "remarkable correspondence" between his written comments and the linguistic forms he used in his output. On the basis of these observations, Schmidt made far reaching claims that all output is originally consciously noticed. Any failure to recall what is noticed could be because the learner had forgotten that they had noticed the feature in the input or it might be because it is too difficult to verbalise.

There are problems with Schmidt's conclusions: they are mostly based on one research project in which he was the only participant, and the operationalising of the major concept on which his theory rests, namely what constitutes "noticing" is impossible to falsify as it could always be argued that learners simply forgot what they had noticed. Nonetheless, Schmidt raised awareness of the issue of consciousness and in his review of the subject Schmidt made salient some of the issues surrounding definitions of consciousness.

Others' views on the role of consciousness were less extreme but important. Seliger (1979) argued that pedagogical rules act as "acquisition facilitators" because they focus the learner's attention on "critical attributes of the real language concept that must be induced" (Seliger, 1979, p.368). For Seliger, pedagogical rules in themselves are not "turned into" knowledge of language because they do not represent the internal knowledge of rules acquired by the learner. Form-focused instruction simply focuses the learner on the structure and the natural acquisition process does the rest. This view is similar to that of Pienemann.

Sharwood Smith (1980, 1981) referred to "consciousness raising". He argued that it is important to consider the *level* of metalinguistic knowledge provided to the learner; he suggested that it might not be necessary or even useful to teach rules directly if one wishes to impact upon the "subconscious inaccessible system some linguists call 'competence'" (Sharwood Smith, 1994, p.178). Rather Sharwood Smith (1981) argued that a more subtle approach, of making features in the input more "salient", might be equally or even more beneficial. However, he also warned that such an approach might serve to obscure other parts of the input and make the acquisition process more difficult. Sharwood Smith concluded that "consciousness raising" might be necessary to focus the learner on the relevant input so that the brain registers it. The difficulty is that "learners are very good at ignoring what appears to the outside observer to be very obvious. This is natural and there may be good reason for it. This is also why we need to do a great deal more research on the matter to see what works best". (Sharwood Smith, 1994, p181.)

R. Ellis (1990) attempted to integrate the differing theoretical positions which have been described above in his "Integrated Theory of Instructed Second Language Learning". The theory encompassed many of the views already described. A brief description of the theory will be presented below with the main focus on issues relating to the role of formal instruction and conscious knowledge. Ellis' focus was upon an explanatory theory of *classroom* language learning equating the term 'instructed' with learning in the context of a classroom. Central to the theory was the claim that explicit knowledge (which R. Ellis described as conscious and declarative) and implicit knowledge (which he described as subconscious and procedural) are stored separately. In this respect Ellis' view was in accord with the non-interface position adopted by Krashen (1985). However, Ellis differed from Krashen in how he viewed the relative importance of instruction. For Ellis, formal instruction played a major role in second language learning. Ellis distinguished between form and meaning focused instruction. He argued that explicit knowledge derived mostly from form-focused instruction and implicit knowledge derived mostly from meaning-focused instruction (a view again similar to that held by Krashen) but that learners might "respond" to either type of input as "formal instruction" or "interaction". In other words, learners might learn through interaction with the teacher and/or their classroom peers, or because they have focused on the features being formally taught. Ellis emphasised that for learning to take place the learner must "attend to specific linguistic features in the input and be ready to incorporate these into her interlanguage". He argued that explicit knowledge "sensitised the learner to the existence of non-target forms in her interlanguage" and argued, unlike Krashen, that "implicit knowledge can be taught directly if (a) the learner is developmentally 'ready' or (b) the target forms are not subject to developmental constraints." (R. Ellis, 1990, p 195), a proposal similar to that presented in the multi-dimensional model. Ellis argued that instruction cannot *convert* explicit knowledge into implicit knowledge but he suggested that explicit knowledge "helps the learners to notice marked forms" (R. Ellis, 1990, p 196) and thereby facilitates the acquisition of implicit knowledge.

1.1.5 Conclusions

Whilst many of the claims made by differing theorists are still controversial there does seem to be consensus on certain issues. There is general agreement that instruction facilitates the success and rate of L2 acquisition but that it does not impact upon the process of L2 acquisition. Furthermore, there is tenuous agreement that instruction 'works' because it raises the learner's awareness of the form of language so that the learner is more likely to *notice* the form which is presumed essential for acquisition to take place. Some also argue that such noticing must be *conscious*.. It has also been argued that instruction can only be effective for learning of simple forms (perhaps because they are easier to notice).

1.1.6 Problems with past research and an introduction to the current research.

The current research examines the effects of different types of input including "formal instruction" on the successful acquisition of syntax. However, before explaining further the specific aims of the current research, some important points regarding the validity of the findings reported so far will be made. The conclusions described above have been drawn from studies performed with real second language learners in real settings. Two main problem areas exist with this work. Firstly, as is well documented, it is extremely difficult to control for potential confounding variables in real life settings. Long (1983) and Ellis (1990) reported some of the possible confounds. These were: the failure to control for the overall amount of instruction and exposure received, the fact that learners were not randomly allocated to instructed or exposure conditions and problems with producing an accurate measurement of the amount of instruction or exposure received. In the current research attempts to control for all these factors have been made. However, secondly and perhaps most crucially, the central term "instruction" must be properly operationalised.

In the second language literature reviewed above, the terms "instructed" learner and "naturalistic" learner are frequently used. However, there is no clear definition across studies of what the instruction received constitutes nor of what the naturalistic learner is exposed to. An assumption is often made that instructed learners are explicitly taught rules of language whilst naturalistic learners are not; the latter are assumed to have been simply exposed to the L2 but the conditions and content of exposure are very rarely formally described.

In many accounts, theorists also relate the (undefined) terms "formal instruction" or "instruction" to other terms such as "consciousness", "conscious knowledge" and "conscious" and "explicit" learning whilst "naturalistic learning" is often related to "unconscious learning" and its supposed product "unconscious knowledge". Such links are often made but are rarely justified or supported by empirical evidence. Furthermore, some researchers misuse terms: Van Patten (1994) noted that even Krashen confused terms to describe the "process" of learning with those to describe the "product" of learning when Krashen wrote: "We will use the term learning henceforth to refer to conscious knowledge" (Krashen 1982, p 10).

In summary, a major weakness in the literature lies in the way researchers make unsubstantiated assumptions, firstly, regarding the *kind* of information learners receive in their input, secondly, regarding what the learners do with that information and thirdly, regarding the product of learning. For example, researchers commonly imply that "instructed" learners receive some 'explicit' explanation of rules of the second language in a classroom based context. It is assumed that the learner then makes active attempts to learn those rules (this is described as "explicit learning") the product of which is assumed to be "conscious knowledge" (i.e. knowledge which the learner has conscious access to). Similarly, learners referred to as "naturalistic" learners are commonly held to have been only exposed to the language, it is assumed that they have not been given any explicit explanation of the rules of the language, that they do not make active attempts to learn the rules and the knowledge which they derive from this type of input and approach to learning is referred to as "implicit knowledge".

As can be seen from the above description, the terms "instructed" and "naturalistic" learner are concepts laden with unspecified meaning and connotation. However, as previously stated, researchers frequently fail to operationalise these concepts. A researcher cannot 'know' precisely the type of input the learners receive unless the researcher has complete control over that input, a scenario which is rare in studies using real L2 learners in the field. Similarly, researchers cannot know what the learner does with the information they are exposed to (even in the context of a highly controlled environment). In principle, in a controlled environment, learners can at least be encouraged, through instruction, to do certain things with the information they have received but even then one cannot *know* if this is what the learners have done.

In summary, in order to examine the impact of instruction on the rate and success of acquisition (and to compare this to learning under naturalistic conditions) it is vital to define the terms themselves. Researchers have made implicit connections between these terms and the type of information the learner receives and what the learner does with that information. Perhaps the real focus should be on the latter two aspects if it is these aspects which are considered to be the key variables which account for any distinction in the success of acquisition. In the current research attempts have been made to define and control exactly the information provided for learners in the input and the instruction given to learners explaining what to do with that input. Before describing the current research questions in any depth, it is necessary to examine possible kinds of input that could hypothetically be provided for learners.

There are a number of different possible hypothetical scenarios regarding the type of information learners might have or receive about the language, what the learners do with that information and the knowledge which results. Some of these scenarios are shown below (see Table 1.1). It should be noted that in all of these scenarios, reference is made directly to the "rules" of the language. The literature examining "instructed" learning commonly implies that learners are taught "rules". In the scenarios below, the presence or absence of explanations regarding rules will act as a benchmark for categorising the type of information provided to learners.

Table 1.1. Information provided to learners, what learners might do with the information and possible outcomes.

Scenario:	a	b	c	d
Information provided:	Rules are explained	Rules are not explained Learner told rules exist	Rules are not explained Learner not told rules exist	Rules are not explained. Cues in the input available re: rules. Learner told 'patterns' exist in input.
What learners do with the information:	Learner attempts to learn rules/ learner does not attempt to learn rules	Learner attempts to look for rules/ learner does not attempt to look for rules Learner attempts to learn rules/ learner does not attempt to learn rules	Learner attempts to look for rules/ learner does not attempt to look for rules Learner attempts to learn rules/ learner does not attempt to learn rules	Learner notices the cues / Learner does not notice the cues Learner attempts to look for rules/ learner does not attempt to look for rules Learner attempts to learn rules/ learner does not attempt to learn rules
Outcome:	Learner learns rules / does not learn rules Learner learns some of the rules.	Learner learns rules / does not learn rules Learner learns some of the rules.	Learner learns rules / does not learn rules Learner learns some of the rules.	Learner learns rules / does not learn rules Learner learns some of the rules.

In the four scenarios above, categorised as scenarios a, b, c and d, the first level indicates the kind of information learners have available to them. Scenario "a" learners have the rules explained to them whereas none of the learners in the other categories do. The second level concerns what the learner does with this information: learners in scenario "a" might or might not attempt to learn the rules. The third level indicates what results from this process: learners in scenario "a" might or might not have learned (all or some of) the rules.

In scenario "a" it is acknowledged that there is no certainty over whether learners actually attempt to learn the rules or whether they actually learn them. The only thing one can say with certainty in this scenario is that the learners have been explicitly taught the rules. The information provided to the scenario "a" learner could be argued to be similar to that available to the "instructed" learner as described in the L2 literature. However, in the literature it is assumed that such learners *did* attempt to learn (this process was termed "explicit learning") and that the knowledge that resulted was consciously accessible and described as "conscious knowledge". In scenario "a" it is quite possible that learners do not necessarily make conscious efforts to learn (they might make no effort to learn the rules and yet still learn them) and they might or might not acquire knowledge (this might be consciously accessible or not). One cannot assume that because a particular type of information is available, that a particular type of learning and type of knowledge will result. One can say only that the learners were provided with a certain type of information.

In scenario "b", the learner is told that rules of the language exist, but the rules are not explicitly described. Learners might or might not attempt to consciously work out the rules for themselves and might or might not come to learn the rules. The type of information provided to the scenario "b" learner might be similar to that provided to a "naturalistic" learner, as referred to in the L2 literature. Such learners might be aware that the L2 has rules and they might or might not try to work out what the rules are. In the literature, researchers imply that naturalistic learners do not make conscious efforts to learn the rules, rather they suggest that the naturalistic learner "picks up" the language unconsciously. However, as can be seen in hypothetical scenario "b", being exposed to a language without the rules being explained does not imply that learners learn the rules subconsciously or without conscious effort. Equally it does not imply that the resulting knowledge is "implicit".

In scenario "c" learners are not told a rule system exists and the rules are not explained to them. This might be equivalent to the situation of the child learning their first language. It could be argued that such learners would not therefore attempt to work out what the rules are because they do not know a rule system exists. It might be that such a situation could also apply to adult L2 learners who might not be aware that rules of language exist: it is possible that the "naturalistic" learners described in the L2 literature might fit this scenario. L2 researchers often claim that such learners learn implicitly and that the knowledge derived from this learning is implicit. However, the adult learner, even one who is not aware that rules exist, might search for rules consciously in the input they are presented with, trying to make sense of that complex input. Therefore, even when learners are presented with no information about the existence of language rules, it cannot be inferred that the learner adopts a particular learning style (explicit or implicit) nor that a particular knowledge type (whether explicit or implicit) results.

In scenario "d" above, the rules of the language are not explained but the language input to which the learner is exposed contains "cues" to phrasal structure which can be used by the learner to help work out the rules of the language. A body of research has investigated the existence of such cues in natural language and the use of such cues by child first language learners (Morgan, Meier and Newport, 1987, 1989). (A detailed account of this research will be provided in section 1.3 of this chapter and in the introduction to Chapter Two.)

If such cues do exist in natural language, then it is possible that L2 learners exposed to such natural language might attempt to use the cues to help them work out the rules of the language. Then again, they might not: despite being exposed to input containing cues, they might not use the cues, they might not even try to work out the rules or they might try to work out the rules but not use the cues. The only thing one can say with certainty is that the input provided contained cues which might or might not be used. It is possible that if such cues exist in natural language, then the naturalistic learners described in the L2 literature might have been exposed to this kind of input. However, as is clear from scenario "d" it is not possible to infer from this that a particular type of learning takes place or a particular type of knowledge results.

The scenarios presented above are hypothetical. Each scenario specifies precisely the type of the input (or information) the learner receives with reference to the rules of the language. Efforts have been made to equate each scenario with a description of a real life second language learner. Scenario "a" might relate to an instructed learner; scenario "b" to a naturalistic learner who knows rules exist; scenario "c" to a child L1 learner or an adult

L2 learner who does not know rules exist and scenario "d" to an L2 learner who is provided with special cues in the input which might help them learn the rules. In each scenario, only the kind of information learners have been provided with is known. One cannot know what learners will do with the information but efforts can be made in a controlled environment to encourage learners to adopt a particular approach.

In the L2 literature, where "instructed" and "naturalistic" learners are compared to see the effect of "instruction" on acquisition, one *cannot* be certain about the kind of information learners have received. Perhaps researchers rarely specify exactly the type of information that learners have received because they do not know what it is. The environments in which language learning takes place are complex, rich and constantly changing. It is likely that learners in classroom settings are more likely to encounter situations where rules are formally explained and it is less likely that learners in natural settings receive such explanations. However, learners in both settings are exposed to much more than this and they differ in their input in far more ways than this.

If one wishes to examine the role formal instruction plays in language acquisition compared to exposure, one must be clear about what is being compared. If formal instruction means "having rules explained" and exposure means "not having rules explained" then the only way to determine whether formal instruction is successful is to compare learners who have rules explained with those that do not, keeping all else constant. This is precisely what the current research set out to do.

1. 2 The key questions of the thesis

In the current research learners will receive one of the four different types of input as presented in the hypothetical scenarios described above (Table 1.1). The central question of the current research project is, which of these types of input best facilitates syntax acquisition?

Each input differs in terms of the degree to which the rules are either formally explained or are known by the learner to exist. In type "a" input, the learner receives a full description of the rules of the language; in type "b" input, learners receive exposure only to the language and no description of the rules. However, learners are told that rules exist and that they must make efforts to look for the rules. In type "c" input, the learner is exposed to the language but is not told of the existence of the rules and is not encouraged to look for rules. In the final scenario, type "d' input, learners are exposed to language containing a cue to the phrasal structure which indirectly cues the rules and learners are encouraged to look for the rules. With these clearly laid out scenarios where the precise type of input is known, one can make claims about the effect of each type of input on acquisition and can determine the extent to which "instruction" as defined in scenario "a" facilitates syntax acquisition in comparison to other types of "non-instructed" input.

It was stated at the beginning of this section (section 1.1.5) that instruction (in the loosest sense) might "work" because it raises the learner's awareness of the form of language so that the learner might "notice" the form. Conscious noticing of forms is considered by some to be a crucial (Schmidt, 1990) or at least important (R. Ellis, 1990) factor in their acquisition. Others (Sharwood Smith, 1994) have argued that one needs at least to raise consciousness of the existence of features in the input for them to be acquired, perhaps by making them more "salient" in the input. Each of the four scenarios described above differs in the extent to which the features or rules to be learned are made salient in the input. Following from this, one could argue that as a result, the scenarios differ with regard to the likelihood of those features being noticed by learners in the input. It could be argued that the most salient display of the rules of the language is in the type "a" input in which the rules are explicitly presented. The least salient display is in type "c" input where learners are not supposedly aware of the existence of any rules in the input. In type "d" input learners are provided with cues to the phrasal structure (and supposedly indirectly to the rules) and so it could be argued that the rules of the language are made salient to some extent, at least more so than in scenario "b" where, although the learners are aware of the existence of rules, none are explained and no cues provided. If one had to place the scenarios in some kind of order of "salience" one might place them as follows: a, d, b, c. One question that the current study attempts to address is to what extent salience of the syntactic rules in the input facilitates acquisition of syntax.

The key questions following from this question are as follows: Is there a difference in learning outcome when learners have attempted to deduce the rules for themselves (type "b" input) compared to the learning outcome of those who have been formally taught rules (type "a" input? Is formal instruction (type "a" input) only effective for simple rules or can complex rules also be formally taught? Do learners who have good metalinguistic skills and heightened grammatical sensitivity profit more from either one of these two types of input ("a" and "b")? Do learners who have good metalinguistic skills and heightened grammatical sensitivity perform better on the more complex rules? Are complex rules best acquired under conditions designed to induce implicit learning ? Can it be established whether unconscious or implicit learning has actually taken place? Is implicit learning best induced under conditions to memorise (type "c" input) ? Does exposure to cues to phrasal structure (scenario "d"), in the absence of formal explanations of the rules facilitate syntax acquisition compared to exposure without such cues (scenario "b")?

Methodology.

In order to determine the extent to which different types of input affect syntax acquisition, one would ideally randomly allocate learners to each type of input. This would ensure that factors such as levels of motivation, general language learning ability, working memory capacity and other potential confounds were controlled. (Criticisms regarding motivational differences in learners across conditions were made by R. Ellis (1990, see section 1.1.3)).

Secondly, one would ensure that none of the learners had any previous knowledge of the language they were to be taught. This would enable complete control over the amount of exposure received by learners to the language prior to the commencement of the project. In previous studies, even where apparently complete beginners have been used, it is possible learners had received some contact with the language. There is also more agreement by researchers regarding positive effects of instruction on beginner learners than intermediate or advanced (see section 1.1.3 above.)

Thirdly, one would control precisely the type of input received and the precise duration of the instruction or exposure. This has proved to be difficult to achieve in studies on real second language acquisition (as was mentioned in the introduction to this chapter). For example, in trying to isolate the facilitative effects of instructed learning in the classroom compared to learning through exposure in the "outside world", it might not be possible to control for the amount of informal exposure to the language that an "instructed" learner might have received or for any informal instruction an "exposure" learner might have received.

Finally, for practical reasons, there are few (if any) studies which have attempted to teach an entire language under completely controlled conditions of input. Many have focused on specific features or examined a cross section of language at a point in development. If one could take a group of learners, teach them an entire language system from 'beginning to end' but control completely the amount and type of input received, then compare performances of learners in each input condition - it might be possible to answer Long' s (1983) question: "Does SL instruction make a difference?" (assuming the term "instruction" were adequately defined and operationalised!)

The obvious question is how could this be achieved? It was reasoned that one possible solution would be to utilise an artificial language, the adoption of which appeared to overcome many of the problems described above. The language could be taught in its entirety; the conditions under which it would be presented could be fully controlled and monitored. Learners would have no previous knowledge of the language and could be randomly allocated to the specific input types as defined in the four scenarios described above. A large body of research has been carried out using artificial methodologies. A review of this literature follows together with justifications for the final selection of a language used in the current thesis.

1. 3 Artificial languages in language research.

Introduction

The following section is divided into three parts: firstly, a brief review will be made of the ways in which miniature artificial languages have been used in research. Secondly the arguments for and against the use of miniature artificial languages as research tools will be presented and thirdly, in the light of these arguments, the reasons behind the decision to adopt the particular artificial methodology used in this thesis, will be explained.

1.3.1 The uses of Miniature Artificial Languages.

Miniature artificial languages (MALs) (also referred to as miniature artificial grammars (MAGs) miniature artificial systems, miniature linguistic systems (MLS), miniature languages, artificial language systems etc.) were first introduced by Esper in 1925 to examine "associative interference". In the late 1950s, Miller and Chomsky worked together on a study of algebraic systems, systems which Chomsky had named "finite state grammars". Miller later used a finite state system to generate letter strings for a study entitled "Project Grammarama" which examined the general concept of rule learning (Miller, 1958). The finite state system was widely adopted in later studies on rule learning, to generate letter strings, such strings commonly being referred to as MALs, MAGS or MLS. (An example of a finite state system is provided in Chapter Two.)

MALs differ in type and complexity. Most consist of letter or nonsense-syllable strings: some are generated by finite state systems (Miller, 1958; Reber, 1965, 1967, 1969, 1976, 1989; Dulany, Carlson and Dewey, 1984; Perruchet and Pacteau, 1990) others by phrase structure rules (Moeser and Bregman, 1972, 1973; Meier and Bower, 1986) or both (Morgan, Meier and Newport, 1987, 1989). Some consist of single words to which affixes and suffixes are added which, for example, indicate location (MacWhinney, 1983). Some contain no semantic reference field (Braine, 1965, 1971, Reber, 1965, 1989) whilst others provide one, commonly in the form of geometric shapes (Esper, 1925; Morgan *et al*, 1987, 1989).

The standard paradigm used in studies using letter or nonsense-syllable strings is that learners, after studying a limited number of representative exemplars of grammatically correct strings, are asked to categorise new sets of grammatical and non-grammatical letter strings. If participants are able to make accurate grammaticality judgements on novel strings then learning is considered to have taken place.

MALs have been used in three main areas of research: firstly, psycholinguistic research which has used MALs to model first language acquisition (Morgan and Newport, 1981; MacWhinney, 1983; Meier and Bower, 1986; Morgan, Meier and Newport, 1987, 1989); secondly (and far less frequently) psycholinguistic studies which have used MALs to model second language acquisition (DeKeyser, 1995); and thirdly studies which have used MALs (usually described as miniature artificial grammars or MAGs in this research) to examine the concept of implicit learning (reviewed in Reber, 1989). There is some overlap in the research from the three areas but the literature falls most naturally into these three groupings.

All of the above areas of research are of relevance to the experimental studies in the current thesis. The studies modelling first language acquisition are relevant to the first two experimental studies in this thesis; those modelling second language are more relevant to the third and fourth studies and those used to examine the concept of implicit learning are relevant to the final study. Detailed descriptions of the MAL studies relevant to each of the experimental studies in this thesis will be presented in the introduction to each of the corresponding chapters.

The following section will review the arguments for and against the use of MALs as tools in language research.

1. 3. 2 The advantages and disadvantages of MAL use: the MAL as a research tool.

Moeser (1977) argued that due to the highly complex nature of natural language, the isolation of specific variables for systematic inspection and manipulation is virtually impossible to achieve. She further argued that there may be a very high risk of unknown co-occurring variables being responsible for effects which have been wrongly attributed to the variable under manipulation. Moeser proposed that by using miniature artificial languages to model natural language, the number of potential confounding variables could be reduced. Such artificial systems could be designed to be far simpler than natural language and to contain fewer variables. This, Moeser argued, would make it easier for the researcher to examine and manipulate the effects of the individual variables in isolation from other variables. Schlesinger (1977) supported Moeser to an extent but proposed that MALs should *only* be used when they offer an advantage over the use of natural language.

Further support for the use of MALs was proffered by Morgan and Newport (1981) who used a MAL to model first language acquisition. They proposed that their system enabled them to manipulate the input environment in a systematic way and in a way which would not be possible through the use of natural language. They systematically altered the reference field of their language to observe the effects of different field types on subsequent syntax acquisition. They found that reference fields which incorporated some kind of cue to constituent organisation were more effective in enabling learners to induce the underlying grammatical system. Such manipulation would not be possible using natural languages. Similarly, in a study by Valian and Levitt (1996), the role of prosody was examined as a cue to syntactic structure; it was found that its effects were most beneficial in cases where no other cues to syntactic structure were present. It was argued that natural languages contain a variety of potential cues to underlying syntactic structure. The artificial methodology adopted by Valian and Levitt enabled the manipulation of one cue at a time, so isolating the specific effects of each separate cue type.

Meier and Bower (1986) also used a MAL to model first language syntax acquisition and manipulated the reference field. They argued that the use of an artificial system not only enabled the "rigorous" but also the "ethical" manipulation of the input to language learners. Clearly, it would be unethical to manipulate the type of input a first language acquirer received, particularly to the extent required in studies similar to the two described above. Control groups might, for example, be shown a system without a reference field. An equivalent scenario using a real language would be to present the child with meaningless language. This would be obviously unacceptable. Morgan, Meier and Newport (1987) reiterated this point. They argued that in attempting to discover the properties of input crucial to the language learning process, the manipulation of such input to real first language acquirers could not be ethically performed.

In summary, researchers using MALs have justified their use by arguing that the MAL system enables the researcher to manipulate individual factors under controlled conditions, to reduce the risk of confounding and to perform studies which could not be carried out on natural language in the field due to practical or ethical considerations.

However, researchers using MALs have acknowledged that there may be potential problems with using MALs to model first language acquisition processes. Some refer to concern about the extent to which such artificial languages model natural language:

> "although there is general agreement that miniature language research provides important data to the study of human cognitive processes, the linguistic interpretation of the results has been challenged by some linguists and psycholinguists." (Moeser, 1977, p.229.)

Moeser argued that, implicit in this concern, was the assumption that humans possess a specific, specialist language processing ability which is distinct from general cognitive processing abilities. The claim is that the use of MALs taps only into these more general cognitive processes. In answer to this criticism, Moeser (1977) disputed the contention that language learning is any different from any other kind of learning and that tapping into cognitive abilities as is claimed to occur in MAL research, was exactly what was required when modelling language acquisition processing. Moeser (1977) further argued that if this particular objection was removed the only remaining problem with the use of MALs concerned the oversimplification of the language used as input in the MALs. However, she countered that it was essential to simplify the input as such simplification would also have to take place in natural language research:

> "Even the observer in a natural setting must arbitrarily decide what to record and what to ignore." (Moeser, 1977, p.230.)

However, other MAL researchers have intimated that an innate, domain specific language faculty might exist (Morgan *et al,* 1989) but they have not adequately addressed the problem of whether the MAL they are using would tap into this innate system. They have said only that "valid insights might be gained" (Morgan *et al*, 1989) if learning under MAL conditions took place in similar conditions to learning natural languages. Morgan *et al* (1989) do not specify what these conditions are. They have also tended to avoid the question of whether adult learners have access to this faculty and are constrained by this faculty. Interestingly, Chomsky suggested that MALs could be used to assess the extent to which learners are *constrained* by innate linguistic universals:

> "Systems can certainly be invented that fail conditions, formal and substantive that have been proposed as tentative linguistic universals......In principle, one might try to determine whether invented systems that fail these conditions do pose inordinately difficult problems for language learning and do fall beyond the domain for which the language-acquisition system is designed."
>
> (Chomsky, 1965.)

It might be the case that an invented system could be created to *fail* such conditions, (Smith and Tsimpli, 1995) but can systems be invented which *pass* such conditions? I am not aware of any miniature language which has been designed in this way. There is no certain way of knowing whether the MALs currently being used really do 'fool' the brain into "language input" mode (if there is such a thing) or whether all language input, whether artificial or natural, is parsed in the same way using basic cognitive processing.

Linked directly to this issue, is the concern which has been expressed over the use of adult participants in studies modelling first language acquisition. Only a very small minority have used children as participants (MacWhinney, 1983; Byrne and Davidson, 1985; Braine, Brody, Brooks, Sudhalter, Ross, Catalano and Fish, 1990). Researchers who have employed adult participants have acknowledged that there may be a problem of lack of generalisability of the results to child first language acquisition.

> "A potential problem in interpreting results obtained by this technique concerns whether learning by adults in the laboratory is in fact representative of natural language learning .... Our subjects were cognitively much more advanced than are children and had the advantage of already knowing at least one language."
>
> (Morgan, Meier and Newport, 1987, p.542.)

Morgan *et al* (1987) admitted that their concern in employing adult participants was in the extent to which the adult learners were more cognitively *advanced* than their child counterparts. Braine *et al* (1990), on the other hand, who had used child participants in their study, justified their use of children rather than adults because they were concerned about adult learners being *less* able than their child counterparts. They referred to the hypothesised critical period of brain development during which time the child is thought to have special access to certain mechanisms which are employed in language acquisition (Bever, Fodor and Weksel, 1965; Lenneberg, 1967) Adults are hypothesised not to have access to these mechanisms because they have matured beyond the critical period. By using adults rather than child learners, it could be argued that the types of processing underlying learning in the two cases are simply too far removed from one another to enable meaningful generalisations to be made. However, Ellis (1985) and others (Asher and Price, 1967) have argued against a critical period hypothesis, suggesting that there is very little evidence that children are better language learners than adults and that only in the area of pronunciation were learners found to benefit more by an earlier starting age.

Perhaps the more crucial issue is not whether adults can reach the same levels as children, but whether the process experienced by adult learners is similar to that of the child. Whilst there is some evidence to suggest that adult learners acquire a second language in a consistent, seemingly natural order, can justified comparisons be made between an adult learner and child learner? Adult learners have highly sophisticated cognitive skills, are able if they wish to adopt a conscious, problem solving approach to the learning task and have already acquired at least one language. The child, on the other hand, is still undergoing a complex process of brain and related cognitive development, appears to intuitively "pick up" the language without conscious efforts to acquire it and has no prior language learning experience. Can such differences be ignored? Whilst criticisms of this type have been levelled at the researchers using adult participants to model child learners on numerous occasions and whilst the authors themselves seem to acknowledge the problem, a strong defence of this position has never been adequately provided.

Schlesinger (1977) concluded that MALs do have a place in language research but he argued that the use of adult participants was an insurmountable obstacle to the generalisability of such studies to first language acquisition. He referred to this obstacle as the "inherent limitation" of work with MAL. He argued that:

> "The task of the more mature subject in learning a MAL is radically different from that of the child learning his native language, because the former is in effect learning a second language." (Schlesinger, 1977, p 257.)

I will return to Schlesinger's final comment later. To summarise the points made so far, there have been two chief criticisms of the use of MALs in language research. Firstly, the questioning of the extent to which MAL research is generalisable to natural language research mainly due to the claim that it taps only into cognitive processes rather than into linguistic processes and secondly the question of whether adult learners should be used in studies modelling first language acquisition. The use of adult participants to model first language acquisition, has been generally fairly poorly justified in the literature. One reason commonly cited for the use of adult participants is due to researchers being restricted by ethical considerations which limit or prevent experimentation with a child's natural language. Researchers have also used adult participants because they felt it was not possible to teach a young child a MAL system. However, more recently, researchers have begun to study children as young as pre-schoolers (Byrne and Davidson, 1985) and small changes in methodology have enabled comparisons to be made between adults and children between the ages of five and seven in one MAL study (MacWhinney, 1983).

Despite this, I would argue that even in studies with quite young children, a parallel should be drawn not between MAL learning and *first* language learning but between MAL learning and *second* language learning; where adult participants are employed the case is even stronger. I would agree with Schlesinger (1977) that there is an "inherent limitation" with using adult participants but only where this applies to modelling first language learning. Schlesinger himself pointed out that MAL learning by adult learners is "in effect learning a second language" but he did not expand on this. He saw this simply as a weakness of applying the methodology to first language acquisition. However, McLaughlin (1980) did pick up on the importance of Schlesinger's comment for second language research. McLaughlin argued that the "inherent limitation" could be avoided if such generalisation were made from MALs to adult second language acquisition rather than child first language. In fact, McLaughlin went as far as to say that:

> "I would propose that we test the hypothesis that MAL learning is L2 learning writ small." (McLaughlin 1980, p 365).

> "MAL learning is more similar to L2 than to L1 learning, and now that we know more about L2 learning it is time to use MAL methods to generate and explore L2 research hypotheses." (McLaughlin 1980, p 367).

In the light of these comments, it seemed clear that firstly, MALs have been widely accepted as tools in language research. Secondly, their usefulness in modelling first language specifically has come under some attack largely due to the use of adult participants. Thirdly, it is impossible to judge whether the artificial languages themselves are sufficiently similar to real language (due to the relative simplicity of their underlying structure) for the brain to be "fooled" into language input mode (if there is such a mode). However, it is acknowledged that the brain may not need to be "fooled" into anything and that the learner might be able to approach the learning task in a way they might approach learning any complex task. Fourthly, it would appear that a MAL would be a highly appropriate tool for shedding light on adult second language acquisition: MALs have been described as second language "writ small"; critics of MAL studies have focused on the problem of using adult learners and yet these are the prime targets of the work in the second language field.

In the field of second language acquisition, as stated in the review in the first part of this chapter, it has proved difficult to test hypotheses about acquisition without encountering problems of confounding and lack of control over the variables under manipulation. With the use of a suitable artificial methodology some of these problems could be overcome. It was therefore decided to adopt an artificial methodology and a suitable artificial language was sought.

1. 3. 3 The choice of the artificial methodology

Attempts were made to find a MAL which most closely resembled a natural language. One of the problems with some MALs is that, unlike natural languages, they both lack a referential field and tend to consist solely of linearly ordered strings (Schmidt, cited in Ellis 1994). One language which contained a reference field and which had constituent structure had previously been used in a series of studies carried out by Morgan and colleagues in the US (Morgan and Newport, 1981; Morgan *et al*, 1987; Morgan *et al*, 1989). They had used the language to model first language acquisition using adult participants. They had been interested in determining the extent to which cues to phrasal structure contained within the language facilitated syntax acquisition. The language could be described in terms of a set of rules which differed in complexity. Some of the rules were described as unconditional rules; these denoted the necessary components of the language. The remaining rules were more complex, conditional rules. These described the conditional aspects of the language i.e. the areas of the language which were conditional upon the presence or absence of other features of language. A full description of the language is provided in Chapter Two.

The language appeared to be ideal for testing hypotheses about second language acquisition. It not only resembled natural language in ways in which other MALs did not, but it also contained rules of differing complexity. This would enable more detailed analysis of performance according to rule type and individual rules. Different conditions of exposure could be manipulated and clearly defined outcome measures could be taken. The language could in principle be taught in one experimental session. There would be no confounding with respect to the first language of the participants or with respect to previous unknown exposure to the language because the language would be completely new to all participants.

However, there were potential drawbacks: despite the fact that the language had been described as resembling natural language more than other MAL systems (see above) there remained the question of the extent to which such a simplified system was truly analogous to real language. McLaughlin (1980) noted the argument that the formal properties of rule systems in natural language might be distorted in MALs by the processes of abstraction and simplification.

In the case of the MAL I propose to use, the language has been simplified to the extent that it contains no meaning in the usual sense: the reference field which is provided (to be fully described in Chapter Two) comprises geometric shapes which serve only to denote the class to which different words in the language belong. Whether the separation of syntax from semantics distorts the language to the extent that it is no longer recognisable by the brain as a language is unknown. It might be argued that the language faculty parses anything on the off chance it might be language! Whether or not this is the case, one could argue that by using a purely syntactic language one removes the potential confounding influences of semantics. This complex issue will be discussed further later in the thesis. Morgan and Newport (1987) concluded that artificial languages can at the very least be used to gain insight into how human learners "go about inducing complex rule -governed systems" and perhaps this is the most that can be claimed at this point.

A decision was made to adopt the language in the first study of the thesis in order to determine its potential suitability as a tool for modelling second language. It was decided that the first step would be to carry out a replication of Morgan, Meier and Newport's (1989) study. They used the miniature language to examine the effects on syntax acquisition of what they termed "cross-sentential" cues to phrase structure. Morgan *et al* reported that syntax learning was significantly improved where cues to phrase structure were provided in the input. Full details of the Morgan *et al* study will be provided later. The aim of carrying out the replication was to establish firstly, whether the language was appropriate for use in later studies to model second language learning scenarios and secondly, to see whether the cues Morgan *et al* referred to were important factors in facilitating syntax acquisition by adult learners.

In this first study, the conditions of input relate to scenarios "b" and "d" as defined in section 1.1.5. of this chapter, (further explanation will be provided in chapter two). The key question addressed in the first study was: does exposure to cues to phrasal structure (scenario "d"), in the absence of formal explanations of the rules, facilitate syntax acquisition compared to exposure without such cues (scenario "b")?

1. 4 Overview of the thesis

The thesis contains seven chapters. This, the first chapter, has described the literature underlying both the theme and methodology of the experimental work.

Chapters two to six are devoted to describing in detail each of the experimental studies and to reviewing the specific literature which underpins the rationale behind each study. Chapter seven is a discussion chapter which will draw together the main findings of the project and suggest possible directions for further research.

Chapter Two.
Study One.

2.1 Introduction

Study One is a replication of Morgan, Meier and Newport's (1989) study in which a miniature language was used to test out hypotheses concerning first language syntax acquisition. The aim of the replication was two-fold: firstly, it was to assess the language as a tool for testing out, under controlled conditions, hypotheses concerning adult second language acquisition; secondly, it was to explore the claim made by Morgan *et al* (1989) that cues to phrasal structure facilitate syntax acquisition and to address the key question: does exposure to cues to phrasal structure (described above as type "d" input), in the absence of formal explanations of the rules, facilitate syntax acquisition compared to exposure without such cues (type "b" input)? This hypothesis was of interest as the focus of the current research was to determine the best input conditions for syntax acquisition in adult learners. If cues to phrasal structure appear to facilitate syntax acquisition, then should such cues be focused upon in formal language teaching?

Morgan *et al* claimed that only learners who are exposed to some kind of cue which indicates the phrasal groupings of a language will learn the more complex aspects of language syntax, and the dependencies which exist between words within each phrasal grouping. They hypothesised that natural languages contain such cues and their mere existence in natural languages was evidence that cues of this nature were "psychologically necessary " (Morgan *et al,* 1987 p.502) for syntax acquisition. Whilst Morgan *et al,* (1987) had supported Chomsky's (1965) claim that children are endowed with an innate pre-programmed disposition to acquire language, they argued that cues to phrase structure served to augment such pre-programming.

The Morgan, Meier and Newport (1989) study had followed from a series of studies (Morgan and Newport, 1981; Morgan, 1986; Meier and Bower, 1986; Morgan, Meier and Newport, 1987) which had examined the proposal that syntax acquisition was facilitated by cues to phrasal structure. These studies had themselves developed from earlier work in the field which had examined the extent to which semantics mediated syntax acquisition.

Braine (1963) and Smith (1963, 1966) had reported that subjects who had been exposed to semantically empty linguistic systems failed to learn the dependencies between classes of words. An example of such a dependency in English can be seen in the noun phrase "the man" where the article "the" is dependent upon the noun "man" for its existence. "The" cannot exist without an accompanying noun class word. Such dependencies serve to unite the words to form a constituent or phrasal grouping. It is widely accepted that word order in language is best understood in terms of a hierarchy of constituents or phrasal groupings rather than in terms of a simple linearly organised sequence. Knowledge of dependencies holding between words is one important factor in determining constituent analysis.

Moeser and Bregman (1972) claimed that their subjects could only learn inter-word dependencies if the reference field was organised in a way which mirrored the syntactic organisation. They highlighted the dependencies between words of different classes by varying the borders around the geometric shape referents. The variations of the borders represented the dependent words (as in "the" above), the shapes themselves represented the word to which the dependent word was linked (as in "man" above). Because a border could not exist without an underlying shape it was argued that the inter-word dependencies were being cued by the field. Moeser and Bregman interpreted the information provided by the referent field as being semantic in nature and essential to the process of syntax acquisition.

Morgan and Newport (1981) however, disputed Moeser and Bregman's claim that *semantic* mediation was necessary for the learning of dependencies. In their study they positioned the geometric shapes into groupings (placing for example the geometric shapes corresponding to the two dependent words close together). This also served to highlight constituent structure but gave no explicit indication of formal dependency. They found that learners performed as well as those who had been given semantic cues to inter-word class dependencies (as described above). They concluded that

> "any cue encoding information about phrase structure might be equally effective in promoting learning of complex aspects of syntax."

Following from Morgan and Newport (1981), a series of studies was performed (Morgan, 1986; Meier and Bower, 1986; Morgan *et al,* 1987) in which a variety of possible cues to constituent structure were incorporated into the language input. The cues used included those of concord morphology, prosody, function words and pronominalisation all of which the researchers claimed can be found in natural languages. The cues indicate the phrasal grouping of sentence strings because they are in some way distinctive. For example, function words such as articles and prepositions are acoustically distinctive and generally occur at the beginning or end of phrases. Whilst it was conceded that not all the above devices are available in every language, Morgan *et al* proposed that all languages contain at least a subset which tend to be "good markers of syntactic constituents" (Morgan *et al*, 1987 p.502).

The miniature language methodology used in the majority of these studies consisted of nonsense words, each word belonging to one of five word classes which were described as being roughly equivalent to verbs, nouns, adjectives etc. Possible sentences in the language could be generated using both a finite state grammar and a phrase structure grammar (for examples see Method Section). In all the studies, participants were shown possible sentences in the language, accompanied by a reference field consisting of geometric shapes. Each word was individually paired with a specific shape which acted as the word's class referent. For example, all words of class A were paired with rectangles but each individual word in that class was paired with a rectangle of a different colour or pattern.

After being exposed to possible 'sentences' in the language, participants were given exercises to test their knowledge of the conditional and unconditional rules of the language and of their knowledge of the phrase structure. Morgan *et al* claimed that in every case where participants had been exposed to language input which had incorporated a cue to phrase or constituent structure, participants in those groups were able to learn the syntax. By contrast, participants whose input failed to incorporate any such cue were less successful in learning the syntax, particularly the more complex syntax which required knowledge of co-occurrence relations among word classes. Similar results have been found by other researchers (Braine, 1966; Green, 1979, Valian and Coulson, 1988, Valian and Levitt, 1996).

Morgan *et al* (1989) argued that the facilitation in the acquisition of syntax which arises when cues to phrase structure are present could be due to the way in which such cues "minimize the need for complex distributional analysis" (Morgan *et al*, 1989, p361). Such analysis requires learners to work out for themselves the patterns of "co-occurrence" in the input, (i.e. which features in the input occur together) and "equivalence" (i.e. which features have equivalent constituent structure). The cued input provides a possible short cut to acquisition. As stated above, Morgan *et al* (1987) suggested that whilst pre-programming of learners to consider only certain types of grammar as relevant might overcome part of the problem involved in syntax acquisition, input incorporating cues to phrase structure might reduce the load on such pre-programming.

The present study is a replication of Morgan, Meier and Newport's (1989) experiment which examined the effects of what they termed "cross-sentential cues" on syntax acquisition. They argued that such cues exist in natural language input. They provided examples of such cues in the discourse of care-givers and children having noted that work on child language (Snow, 1972; Newport, 1977) had revealed a high incidence of maternal self-repetitions (found to be positively related to language growth). For example, they cited an excerpt from a conversation between a child of 18 months and her mother (Brown, 1973; MacWhinney and Snow, 1985):

Child: Oh foot. (looking at foot sticking out of chair)

Mother: Your foot? Where is your foot?

Child: Foot [unintelligible] chair

Mother: **There it is. There's your foot.**

(Morgan *et al*, 1989, p 363.)

Morgan *et al* argued that the final two sentences (in bold above, my emphasis) provided an example of a repetition where the two utterances act as syntactic minimal pairs. They proposed that the existence of minimal pairs in close proximity to one another might supply phrase-structure information across the sentences or cross-sententially. In the example above, the proform "it" may be substituted for the noun phrase "your foot" so indicating that the grouping "your foot" constitutes a phrase."

To discover whether cues to phrase structure in the form of proforms would facilitate syntax acquisition, Morgan *et al*, using the miniature language methodology described earlier, presented participants with stimulus sets consisting of two sentences accompanied by one set of geometric referents. The second sentence contained two proforms which substituted for two different phrases in the first sentence. Morgan *et al* predicted that the proforms would cue the phrase structure of the paired sentence and that such information regarding phrase structure would facilitate the acquisition of the syntax.

Morgan *et al* also included a second experimental condition based upon further evidence from natural languages. They noted that in natural languages there exist rules allowing for *re-ordering* of words in sentences which commonly comprise the movement of complete phrases or the addition of extra morphology but where underlying meaning is retained. In the words of Morgan *et al*

> "the fact that a group of words shares a 'common fate' across semantically related, but differently ordered, sentences provides evidence that the group may constitute a phrase." (Morgan *et al* , 1989, p.363.)

To test the effects of such cues, Morgan *et al* included a condition in which two sentences were shown but the second was a permuted version of the first. The permuted sentence was generated by a rule allowing for the inversion of two of the phrases within the grammar. Morgan *et al* predicted that the re-ordering of the second sentence would cue the phrase structure of the first sentence and so provide information which would facilitate the acquisition of the syntax.

In the discussion of their findings, Morgan *et al* reported that cross-sentential cues did facilitate the acquisition of syntax. Participants whose input had not incorporated any cross-sentential cue to phrase structure failed to learn the more complex, conditional aspects of syntax whereas participants whose input had incorporated cross-sentential cues were reported as succeeding in learning both unconditional and conditional aspects.

The following study set out to replicate the Morgan *et al* (1989) experiment. The results of the replication and the Morgan *et al* study will be presented together in the results section.

The following study compares learners who are provided with "type d" input (see section 1.1.5, Chapter 1) i.e. those whose input contains no explanation of the rules of the language but does contain cues to phrasal structure, with those whose input contains no cues to phrase structure and again no explanation of the rules (type "b" input). According to the findings and theory of Morgan *et al*, those receiving scenario "d" type input should outperform those receiving scenario "b" type input. Furthermore, if the cues in "type d" input make the underlying rules more salient and if salience is the key to "noticing" and noticing is important for acquisition (Schmidt, 1990) then one would again predict that scenario "d" type learners would outperform scenario "b" type learners.

The key question addressed in this study was: does exposure to cues to phrasal structure in the absence of formal explanations of the rules, facilitate syntax acquisition compared to exposure without such cues ?

2.2 Method

2.2.1. Participants

Forty-two first year Psychology undergraduates studying at the University of Plymouth participated as part of a course requirement.

2.2.2. The Miniature Language.

The miniature language used in this study was constructed directly in accordance with the description provided in the Morgan *et al* (1989) and Morgan and Newport (1981) papers. The procedure for construction of the language is presented below.

The Lexicon

The language contained 15 nonsense words. The 15 words were grouped into five classes labelled A, C, D, E and F (see Figure 2.1 below). Morgan *et al* (1989) described these classes as being "analogous to categories like noun or verb".

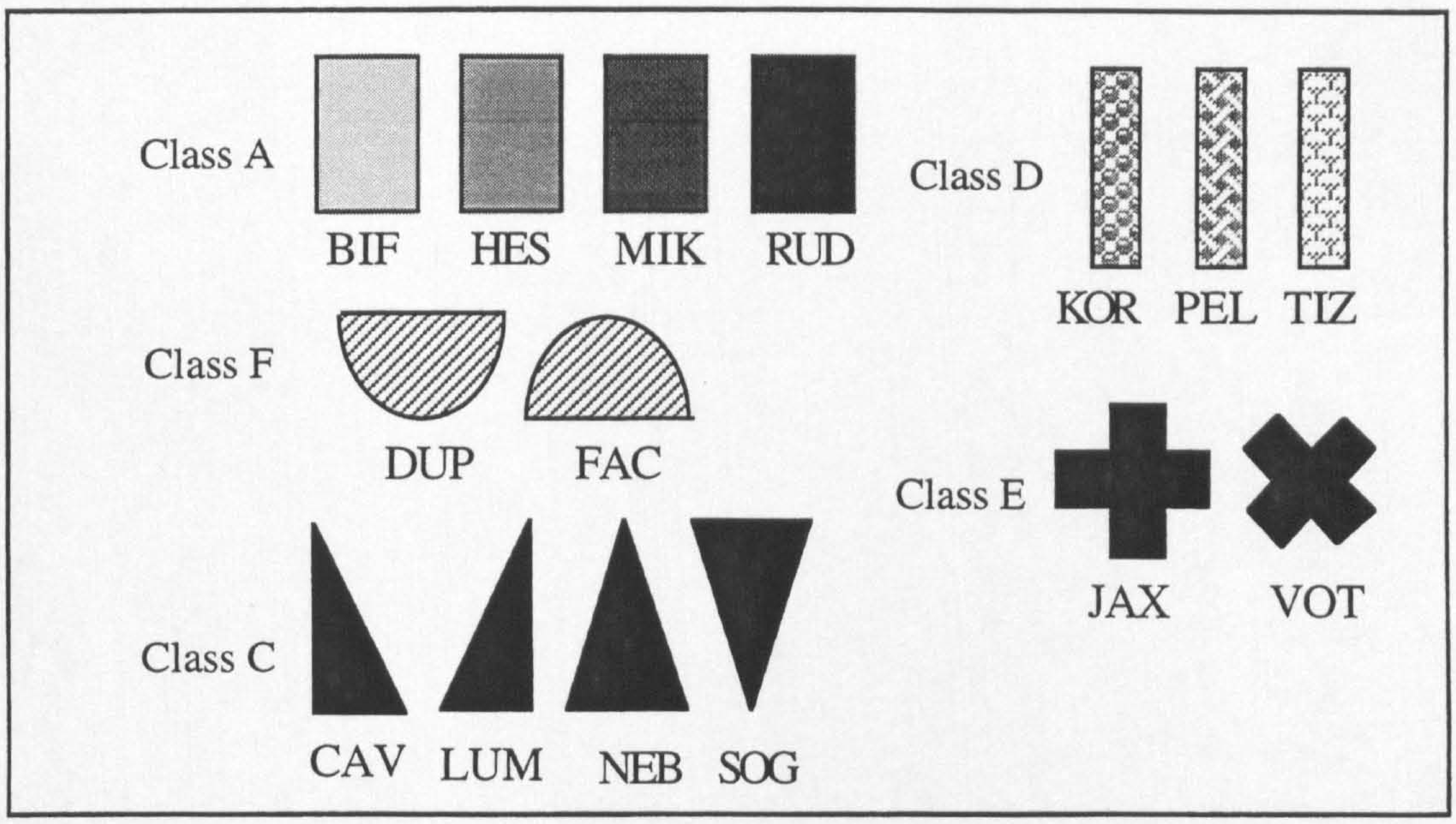


Figure 2.1 Words of the language and their geometric referents. Adapted from Morgan, Meier and Newport, 1989.

The Syntax

Sentences in the language could be generated using both a finite state grammar (see Figure 2.3) and phrase structure rules (see below):

S $\rightarrow$ AP + BP + (CP)

AP $\rightarrow$ A + (D)

BP $\rightarrow$ { E } or { CP + F}

CP $\rightarrow$ C + (D)

(Where "$\rightarrow$" = "is re-written as", S = Sentence, AP = A Phrase, BP = B Phrase, CP = C Phrase and letters A, C, D, E and F = lexical items. The 'curly' brackets ({ }) denote that the B phrase consists of either an E word or a combination C phrase and F word. The brackets serve to emphasise the fact that only one of these can be present in the input and that both comprise a B phrase.

The phrase structure rules supplied information regarding the hierarchical nature of the language: the language could be divided into three phrases A, B and C. This is exemplified in Figure 2.2 below.

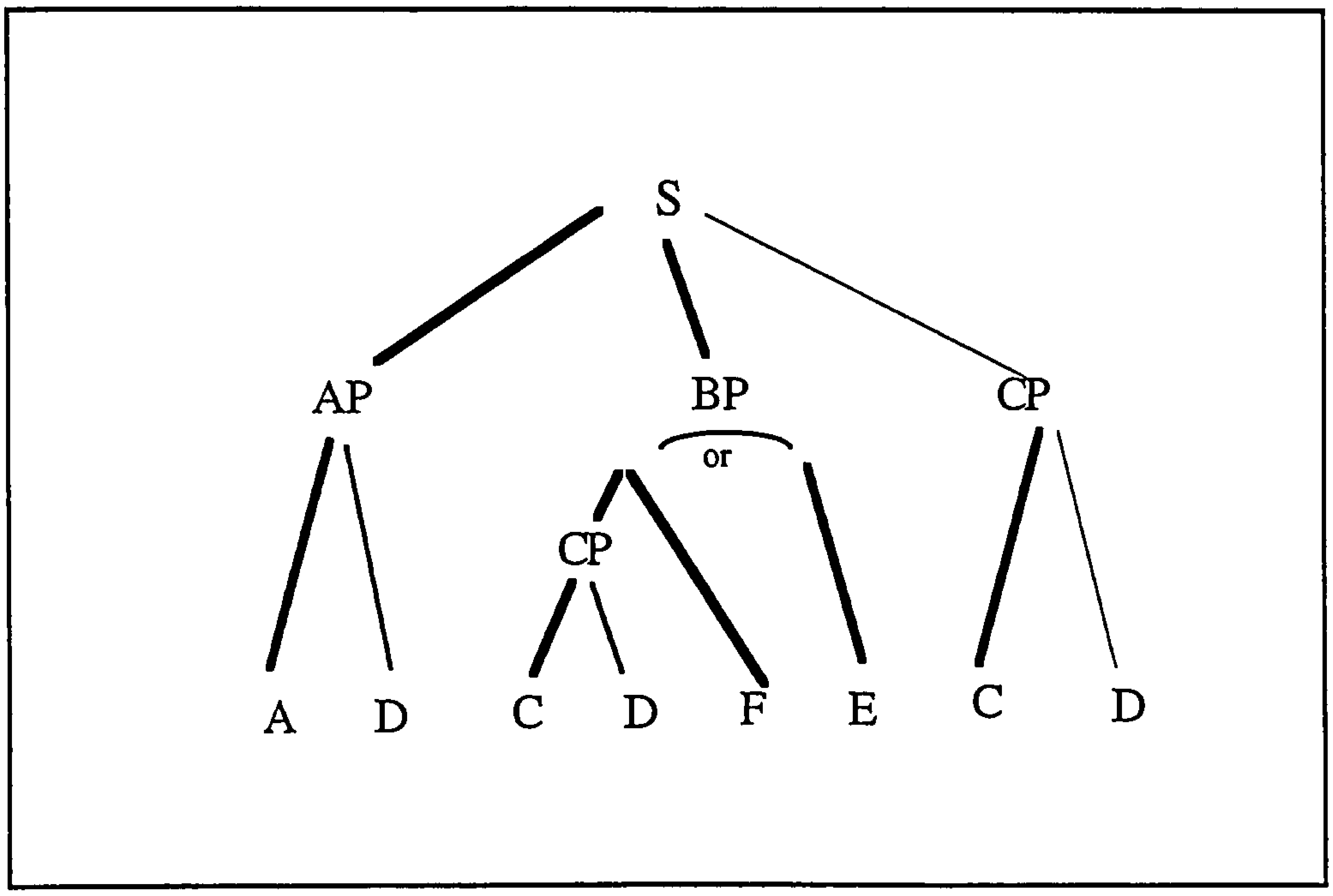


Figure 2.2 Phrase structure tree of sentences of the language.
Note: Thicker branches show obligatory elements; thinner branches denote optional elements. S = Sentence, AP = A Phrase, BP = B Phrase, CP = C Phrase and letters A, C, D, E and F = classes of lexical items.
(Adapted from Morgan, Meier and Newport, 1989.)

As can be seen from the Phrase Structure Tree diagram, sentences begin with an A phrase consisting of an A class word and an optional D class word. This is followed by a B phrase which is comprised of either: (i) a C phrase (C class word followed by optional D class word) and compulsory F class word or (ii) a single E class word. An optional C phrase completes possible sentences.

Morgan *et al* hypothesised that whilst the Phrase Structure Rules could enable participants provided with cues to phrase structure to learn the language by "chunking" into hierarchical phrases, such knowledge was not a necessary requirement to learn the language. The finite state grammar system presented in Figure 2.3 illustrates the linear ordering of the language.

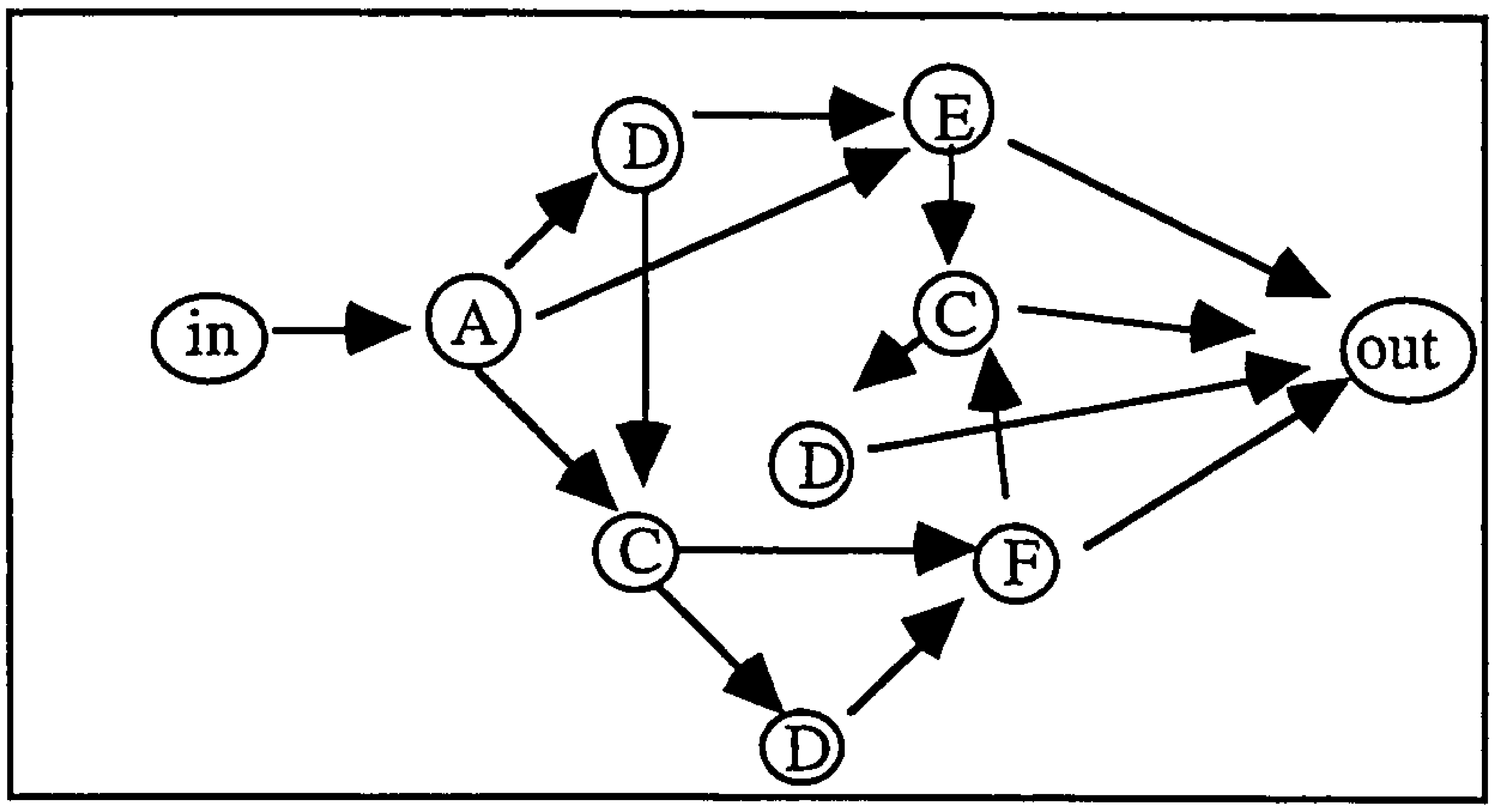


Figure 2.3 State diagram for a finite state grammar of language.
(Adapted from Morgan, Meier and Newport, 1989.)

The letters shown in the circles correspond to the five word classes. By following the direction of the arrows from "in" through to "out" passing through the circles corresponding to each word class, the following 16 linear sequences could be produced:

ADECD	AECD	ADCFC	ACFC
ADEC	AEC	ADCF	ACF
ADE	AE	ADCDFCD	ACDFCD
ADCDFC	ACDFC	ADCFCD	ACFCD

The Rules of the Language.

The language was also described by Morgan *et al* in terms of a set of unconditional and conditional rules. The unconditional rules described the necessary components of each sentence, for example: "Every sentence must contain one A word". The conditional rules captured dependencies between elements within the sentences. Thus the presence of one word might be conditional upon the presence or absence of another, for example: "If an E word is present, it cannot be preceded by a C word". Rules 1 - 4 were described as unconditional rules, rules 6 - 8 were conditional rules and rule 5 a hybrid of the two rule types. The eight rules of the language are presented in Table 2.1 below.

Table 2.1 Rules of the Language.

Rule 1.	Every sentence must have at least one **A** word.	
	RUD CAV KOR DUP *CAV KOR DUP	{ A - C - D - F } { C - D - F }
Rule 2.	No sentence may contain more than one **A** word.	
	RUD VOT SOG *RUD HES VOT SOG	{ A - E - C } { A - A - E - C }
Rule 3.	There may be at most one **C** Phrase at the end of a sentence.	
	BIF VOT LUM TIZ *BIF VOT LUM TIZ SOG	{ A - E - C - D } { A - E - C- D - C }
Rule 4.	Every sentence must contain at least one **E or F** word.	
	MIK PEL NEB DUP *MIK PEL NEB	{ A - D - C - F } { A - D - C }
Rule 5.	No sentence may contain more than one **E or F** word.	
	MIK SOG DUP NEB *MIK SOG DUP FAC NEB	{ A - C - F - C } { A - C - F - F - C }
Rule 6.	A **D** word cannot appear after an E or F word.	
	MIK KOR JAX *MIK KOR JAX PEL	{ A - D - E } { A - D - E - D }
Rule 7.	A **C** phrase cannot occur before an **E** word.	
	HES JAX SOG *HES NEB JAX SOG	{ A - E - C } { A - C - E - C }
Rule 8.	A **C** phrase must occur before an **F** word.	
	BIF NEB TIZ DUP LUM *BIF DUP LUM	{ A - C - D - F - C } { A - F - C }

Note: Sentences preceded by an asterisk are incorrect and break the rule described.
Adapted from Morgan, Meier and Newport, 1989.

Morgan *et al* hypothesised that participants who were given cues to phrase structure in their language input would learn the more complex conditional rules more readily as knowledge of phrase structure would simplify the task of learning the syntax.

Selection of the Base Language sentences.

Approximately 10,000 sentences could be generated in total when the 16 possible word orders were combined with the 15 nonsense words. Forty sentences were selected as the "base language" set using criteria set by Morgan and Newport (1981): two of each of the 14 possible types of sentences were included (sentence length was restricted to a maximum of five words). The remaining sentences were selected so that each of the 15 vocabulary items appeared ten times overall.

In the present experiment, an Acorn A5000 computer was programmed to generate random grammatical sentences. The sentences were accepted for inclusion in the base language in the order in which they were generated but were screened before inclusion to ensure they met the criteria described above. (After a sentence was selected, the criteria for the inclusion of subsequent sentences changed accordingly and the next sentence conforming to the new criteria was selected). An example of each sentence type is shown below (see Table 2.2), the full base language set can be found in Appendix A1.

Table 2.2 An example of each of the 14 sentence types.

Sentence type:	Sentence:
AE	HES VOT
AEC	RUD JAX CAV
ACF	BIF CAV FAC
ADE	MIK TIZ VOT
AECD	HES JAX NEB TIZ
ACFC	HES SOG DUP NEB
ADEC	RUD PEL VOT SOG
ACDF	RUD LUM PEL FAC
ADCF	HES KOR SOG FAC
ACFCD	RUD CAV DUP LUM KOR
ADECD	MIK PEL VOT LUM TIZ
ACDFC	MIK NEB TIZ DUP SOG
ADCFC	BIF KOR NEB DUP LUM
ADCDF	MIK KOR CAV TIZ DUP

2.2.3. Design and procedure

A between subjects design was adopted whereby the forty-two participants were assigned to one of three input conditions, one control and two experimental, equal numbers of participants being randomly assigned to each group. Each participant was given four trials or presentations of the language. Each trial was followed by a test period. The exact order of trials and tests, as presented to participants, is shown in Table 2.3.

Table 2.3 Order of Presentation of the Trials and Tests.

Trial 1
input identical for all participants
Tests 1
Vocabulary Test; Grammaticality Judgement Test
Trial 2
participants presented with input depending on input condition
Tests 2
Vocabulary Test; Grammaticality Judgement Test; Fragment Constituent Test
Trial 3
input identical to trial 2
Tests 3
Vocabulary Test; Grammaticality Judgement Test; Fragment Constituent Test
Trial 4
input identical to trial 2
Tests 4
Grammaticality Judgement Test; Fragment Constituent Test; Transformational Constituent Test

As can be seen from Table 2.3, the first trial or presentation was identical for all participants irrespective of condition. The second, third and fourth trials or presentations varied according to the three input conditions. The trials and tests will be described in detail below. First the general conditions of experimentation will be outlined.

Participants were seated individually in a quiet room. They faced a white screen onto which both the language presentation (the trial material) and test materials were projected using a slide and projector display. An Acorn A5000 computer, positioned to the left of the participant, was used to display all the experimental instructions and to record participants' responses to the test items. Morgan *et al* (1989 used an IBM PC computer for the entire presentation. However, in their previous studies using the miniature language (Morgan and Newport, 1981; Morgan *et al* , 1987) they too used a slide and projector display and this proved to be the most practical presentation to adopt in the current experiment.)

The entire presentation was in black and white. The word referents in the form of geometric shapes were also in black and white rather than in colour as used in the Morgan *et al* (1989) study. To distinguish individual word referents belonging to the same word class, different patterns were used within the shapes rather than different colours (see Figure 2.1 above).

Participants were given sets of instructions prior to each presentation of the language and each test. These are detailed below. The wording of the instructions was based as closely as possible upon information provided by Morgan *et al* . The only description they gave of instruction given *prior to language presentation* was as follows:

"At the outset participants were informed that they would see a number of sentences from a miniature artificial linguistic system that included a simple reference world. They were instructed to discover how the words and the figures in this world were paired and to search for patterns in the order and arrangement of words."

No other detail of instruction prior to the language presentation was supplied in their paper. The instructions given prior to testing in the present experiment are described below. Detail of the four trials and the tests are as follows. Refer to Table 2.3 for the order of presentation.

The Trials

Trial 1.

All participants, irrespective of condition, were shown the 40 "base language" sentences one sentence at a time for a period of 13 seconds per sentence in randomised order. The timing of the interval between each presentation depended on the time taken for the movement of the slide carousel to re-set for the next slide. (This never exceeded the inter-stimulus interval of 1.75 seconds used by Morgan *et al* .)

Above each sentence appeared the corresponding reference field that contained the referents (geometric shapes) of each word; these were ordered from left to right in the same sequence as the word order of the base language sentence. An example is shown below (Figure 2.4).

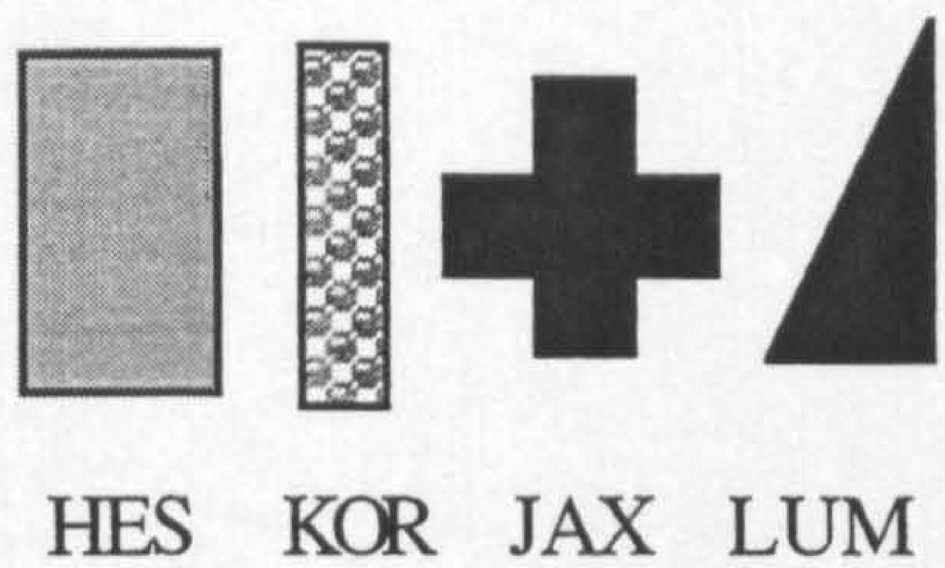


Figure. 2.4 Example of a possible base language sentence and accompanying reference field.

Instructions:

A set of introductory instructions were provided first (see below) followed by detail regarding the first trial.

Introductory instructions were as follows:

Thank you for agreeing to take part in this experiment which involves observing a number of sets of sentences in a new miniature language and trying to discover patterns in the order of the words in the sentences. After you have observed each set of words or sentences, you will be given a set of short exercises in which you will be asked to make judgements regarding which sentences or groups of words feel 'correct'. Don't worry if you are uncertain of the correct answer, simply make your best judgement based upon how you feel. A detailed set of instructions will be given at the beginning of each set of slides.

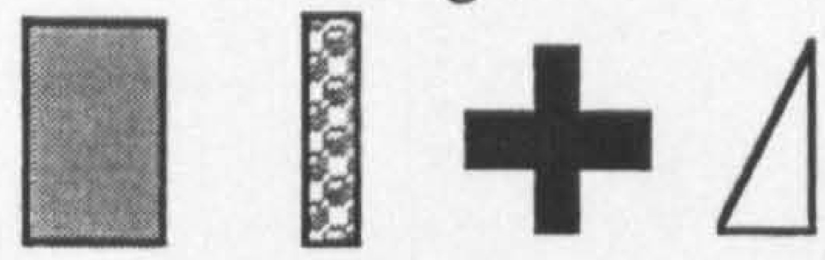
Instructions prior to the first presentation:

You will be presented with 40 slides projected to the white board in front of you.
Each slide will show a sentence taken from a new miniature language.
An example sentence is

HES KOR JAX LUM

Above each word is a geometrical shape:

e.g.



HES KOR JAX LUM

Each word is paired with the geometric shape above it.
for example: "HES" is paired with the patterned rectangle above it,
"LUM" is paired with the triangle etc.

You have two tasks:
firstly observe the sentences and try to discover which words are paired with which geometrical shape.
secondly try to find any systematic patterns in the order and the arrangements of the words in each sentence
You do **not** have to do anything, just observe with the above in mind

The sentences and their shapes will be presented one at a time for 13 seconds.
After this there will be a short pause before the next sentence is shown.
Do you have any questions? If so please ask the experimenter now.

Trials 2, 3 and 4.

During these three trials, participants were presented with *two* sentences, one above the other. Above both these sentences was the reference field that corresponded with the uppermost sentence. The uppermost sentences were the original 40 base language sentences. However, the accompanying lower sentences differed according to condition:

Control or Base Language Condition

Participants in the control or base language condition were presented with two sentences, one above the other. The upper sentence consisted of the 40 base language sentences and the lower sentence was identical to it. (See Figure 2.5.)

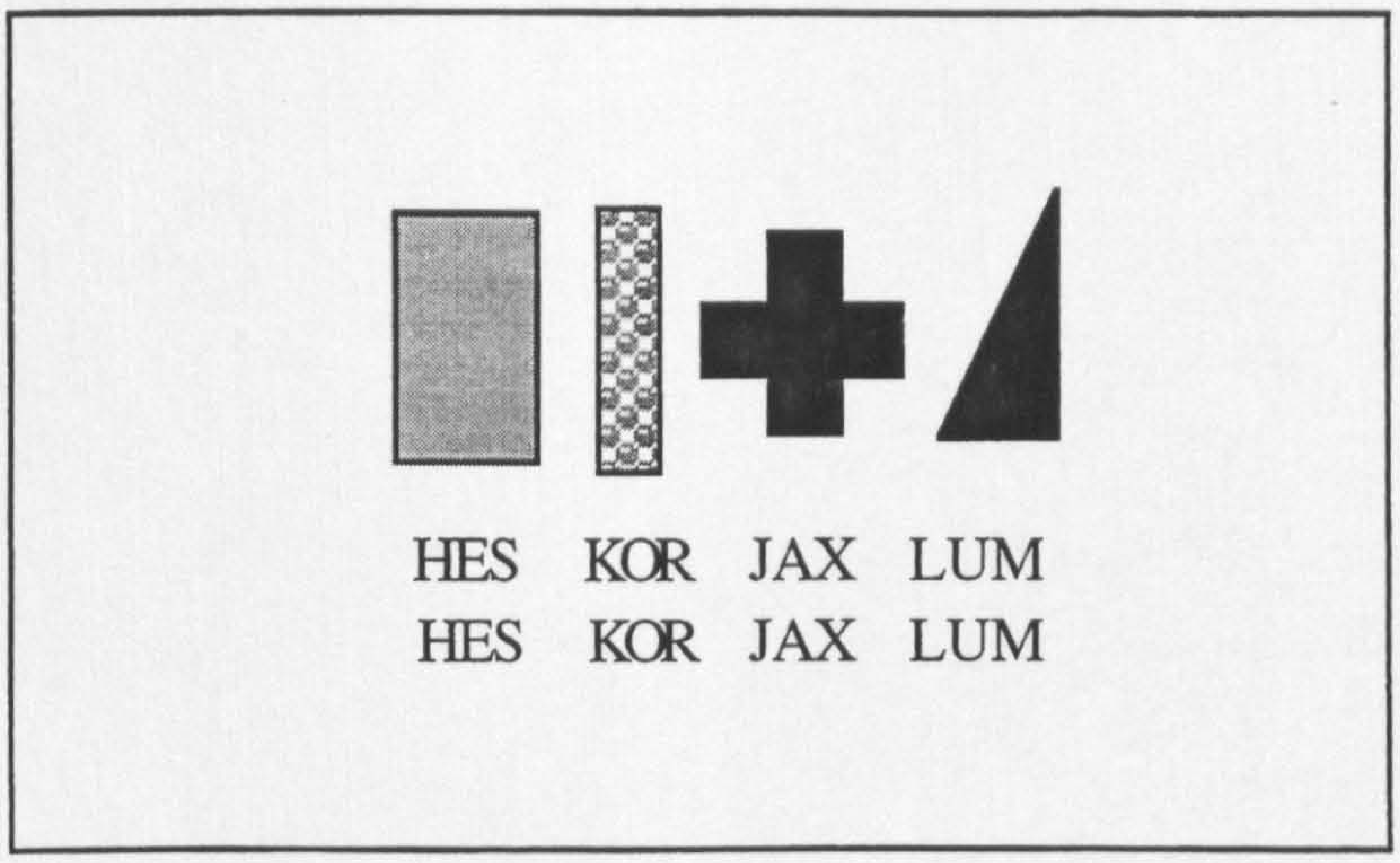


Figure 2.5 Example of a Base Language Condition presentation, trials 2 - 4.

Participants in the base language condition therefore had no cross-sentential cue to phrase structure because the second sentence did not contain any overt cue to the phrase structure of the first.

Instructions:

Participants were instructed as follows:

You will be presented with 40 slides. Each slide shows two identical sentences, one above the other. Above these sentences is the set of shapes which are paired with the words of the sentences. (Example as in Figure 2. 5. here) Firstly, try to discover the word and shape pairing. Secondly, try to find any systematic patterns in the order and the arrangements of the words.

Proform condition

Participants in the Proform condition were also presented with two sentences one above the other. The upper sentences were the 40 base language sentences. However, the lower sentence was a version of the uppermost sentence but contained the pronouns "ib" or "et" in place of the A phrase or the C phrase respectively.

An example is shown in Figure 2.6 below:

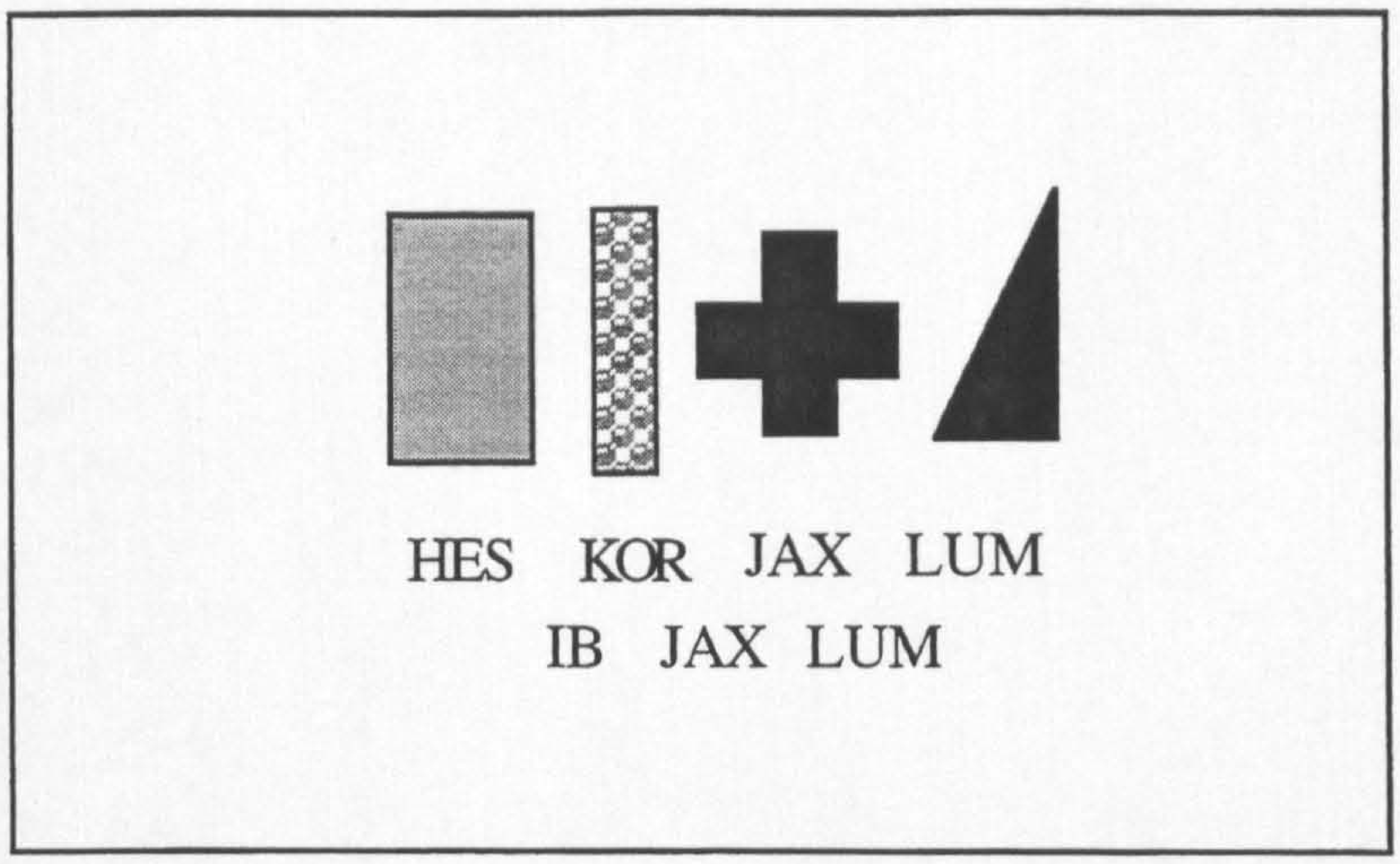


Figure 2.6 Example of a Proform condition presentation, trials 2 - 4.

In Figure 2.6 the lower sentence is a pronominalised version of the base language sentence "HES KOR JAX LUM". The A phrase, "HES KOR" has been replaced by the pronoun "IB". This pronoun might serve as a potential cross-sentential cue to the existence of the A phrase in the uppermost sentence. Only one pronoun was permitted in any one sentence. A complete list of the Proform condition sentences can be found in Appendix A1.

Instructions:

Participants were instructed as follows:

> You will be presented with 40 slides. Each slide shows two sentences one above the other. The sentences differ slightly from one another but both sentences are paired with the same set of geometrical shapes i.e. the set that is pictured above them.
>
> (Example as in Figure 2.6. here)
>
> Firstly, try to discover the word and shape pairing.
> Secondly, try to find any systematic patterns in the order and the arrangements of the words.
> You do **not** have to **do** anything, just **observe** with the above in mind.

Permutation Condition

Participants in the Permutation condition were also presented with two sentences one above the other. The upper sentence was one of the 40 base language sentences whereas the lower sentence was a permutation version of the same sentence whereby the A and B phrases were placed in reverse order. (see Figure 2.7 below.)

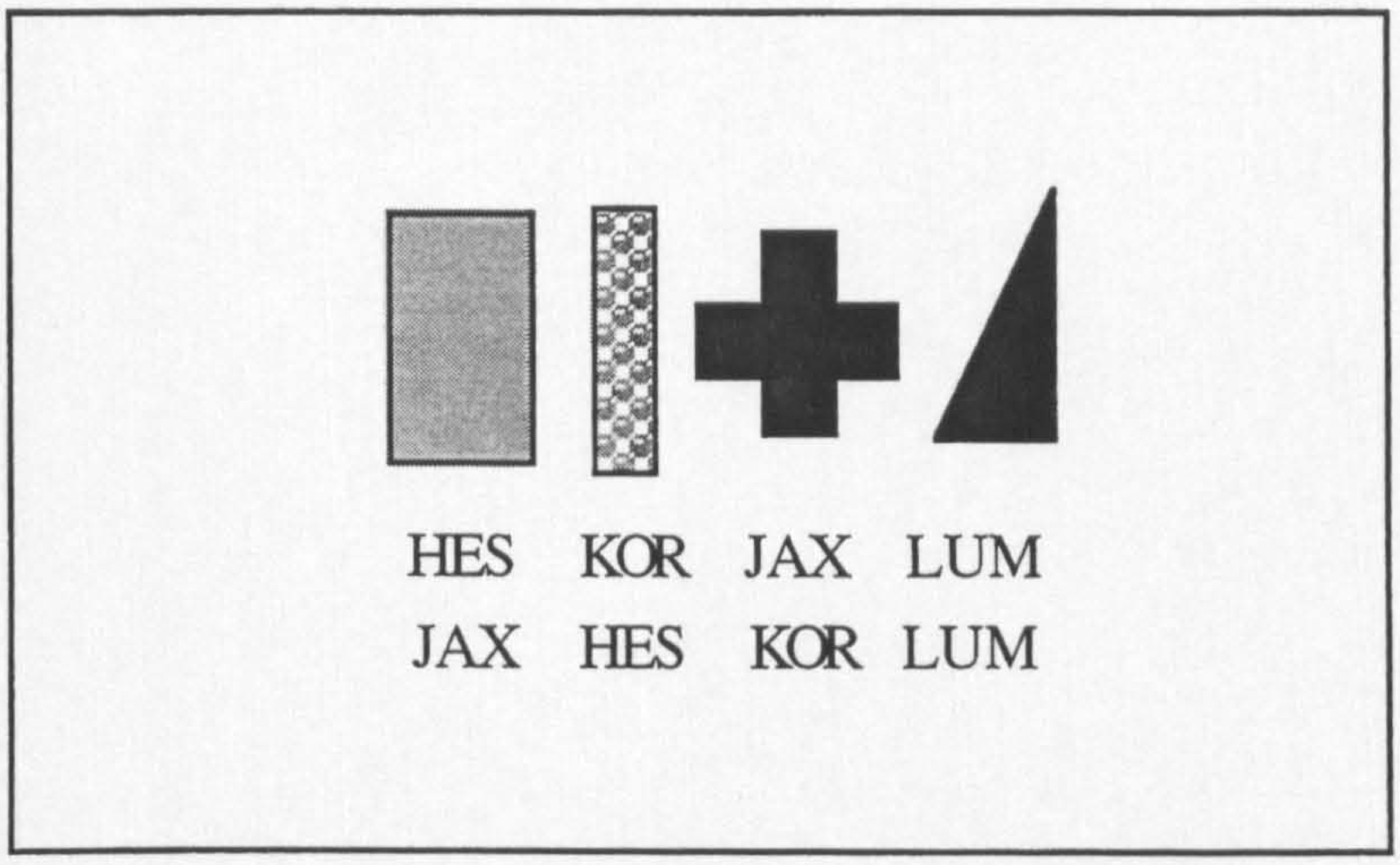


Figure. 2.7 Example of a Permutation Condition presentation trials 2- 4.

In Figure 2.7 the lower sentence is a permuted version of the base language sentence "HES KOR JAX LUM". The A phrase "HES KOR" has switched position with the B phrase "JAX". By holding the phrases intact and reversing their orders, the permutations serve as a cross-sentential cue to the existence of the A and B phrases.

The reference field corresponded with the uppermost base language sentence. A complete list of the Permutation condition sentences can be found in Appendix A1.

Instructions:

Participants were instructed exactly as described for participants in the proform condition.

The Tests

Four different types of test were set: vocabulary tests, grammaticality judgement tests and two tests of phrase structure. Testing took place after each trial (refer to Table 2.3 above). All test items were projected onto the white screen in front of the participants who recorded their responses on the A5000 computer positioned next to them.

Vocabulary Tests

Three vocabulary tests were given after trials 1, 2 and 3 only. Each of the possible 15 word referents or geometric shapes was projected individually onto the screen directly in front of the participant in random order. Below the referent four lexical items were displayed and were labelled 1 - 4. An example is given in Figure 2.8 below.

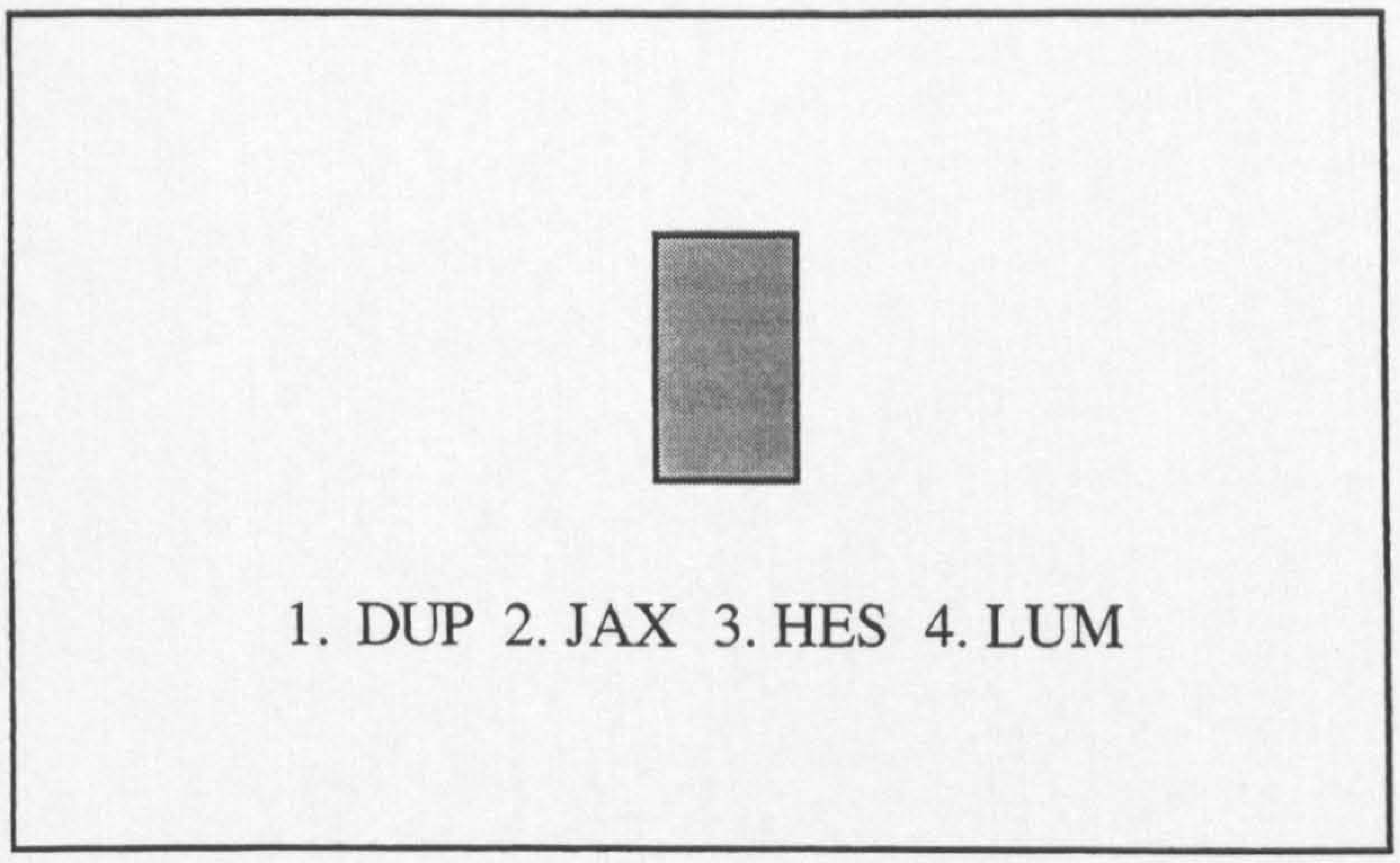


Figure 2.8 Example of a vocabulary test item.

Instructions:

Participants were required to choose which 'word' was paired with the referent. Participants recorded their answers by selecting the corresponding number displayed on the computer screen e.g. number 1 for answer 1 through to number 4 for answer 4.

None of the three incorrect alternatives was taken from the same word class group as the correct answer. For example, if the correct word was an 'A' word then none of the alternatives given was an 'A' word. The incorrect alternatives were taken from the fifteen lexical items and were equally distributed throughout each test. An example of a vocabulary test can be found in Appendix A1.

Grammaticality Judgement Tests

These tests were designed to examine participants' ability to judge the grammaticality of sentences according to the eight rules of the language. Four

Grammaticality Judgement tests were constructed in all, one being presented after each trial.

Each test consisted of thirty two test items, each item testing one of the eight rules of the language, four test items for each rule. Each item comprised the presentation of two sentences, one above the other and labelled 1 and 2 respectively. All the sentences were novel in that none of them had appeared in the base language set. The two sentences were identical to one another with the exception that one of the two sentences broke one of the eight rules of the grammar and the other did not. No referents were shown at this point. An example of a test item is given in Figure 2.9 below.

1. RUD CAV KOR DUP

2. CAV KOR DUP

Figure. 2.9 Example of a Grammaticality Judgement Test item.

Sentence 1 is correct, sentence 2 is incorrect. It is the same as sentence 1 with the exception that it breaks one rule of the language, in this case Rule 1: "Every sentence must have at least one A word." Sentence 2 contains no "A" word. The tests were constructed to ensure all vocabulary items were included an equal number of times. An example of a Grammaticality Judgement test can be found in Appendix A2.

Instructions:

Morgan *et al* stated that "participants were requested to indicate which of the two sentences was grammatical". How this request was actually presented to participants was not stated. In the present study participants were asked to decide which of the two sentences "feel correct according to the patterns in the language you have seen before." Participants recorded their choice on the computer terminal beside them. Items were presented for an unlimited period of time and the projector was programmed to move automatically to the next item once a choice had been made.

Fragment Constituent Tests

Two Fragment Constituent tests were presented to participants, one after trial 2 and one after trial 4. The tests were designed to assess participants' knowledge of the phrase structure of the language.

The tests comprised twenty four items, each item involving the presentation of two "fragments", one above the other, labelled 1 and 2. The fragments consisted of two or three words taken from permissible sentences in the language. One of the fragments consisted of an intact constituent or phrase (i.e. an A phrase, a B phrase or a C phrase) the other consisted of a fragment taken from the same permissible sentence but which cut across two phrases, so violating phrase structure. An example is given below (see Figure 2.10 below).

1. HES KOR
2. KOR VOT

Figure. 2.10 Example of a Fragment Constituent Test item.

Number 1 is correct as it shows an intact A phrase (an A and D word) whereas number 2 includes an A Phrase and a B phrase word thereby cutting across the boundaries between phrases. The fragments were taken from computer generated sentences none of which had appeared before. The tests were devised in order to ensure that testing of intact versus violated A, B and C phrases took place an equal number of times.

Instructions:

Instructions given by Morgan *et al* and in the present study were the same: participants were asked to judge which alternative in each pair formed a better "group or unit". An example of a fragment constituent test can be found in Appendix A1.

Transformational Constituent Test

A single Transformational Constituent test was given to participants after Trial 4. As with the Fragment Constituent Test, this test was devised to ascertain whether participants had learned the phrase structure of the language.

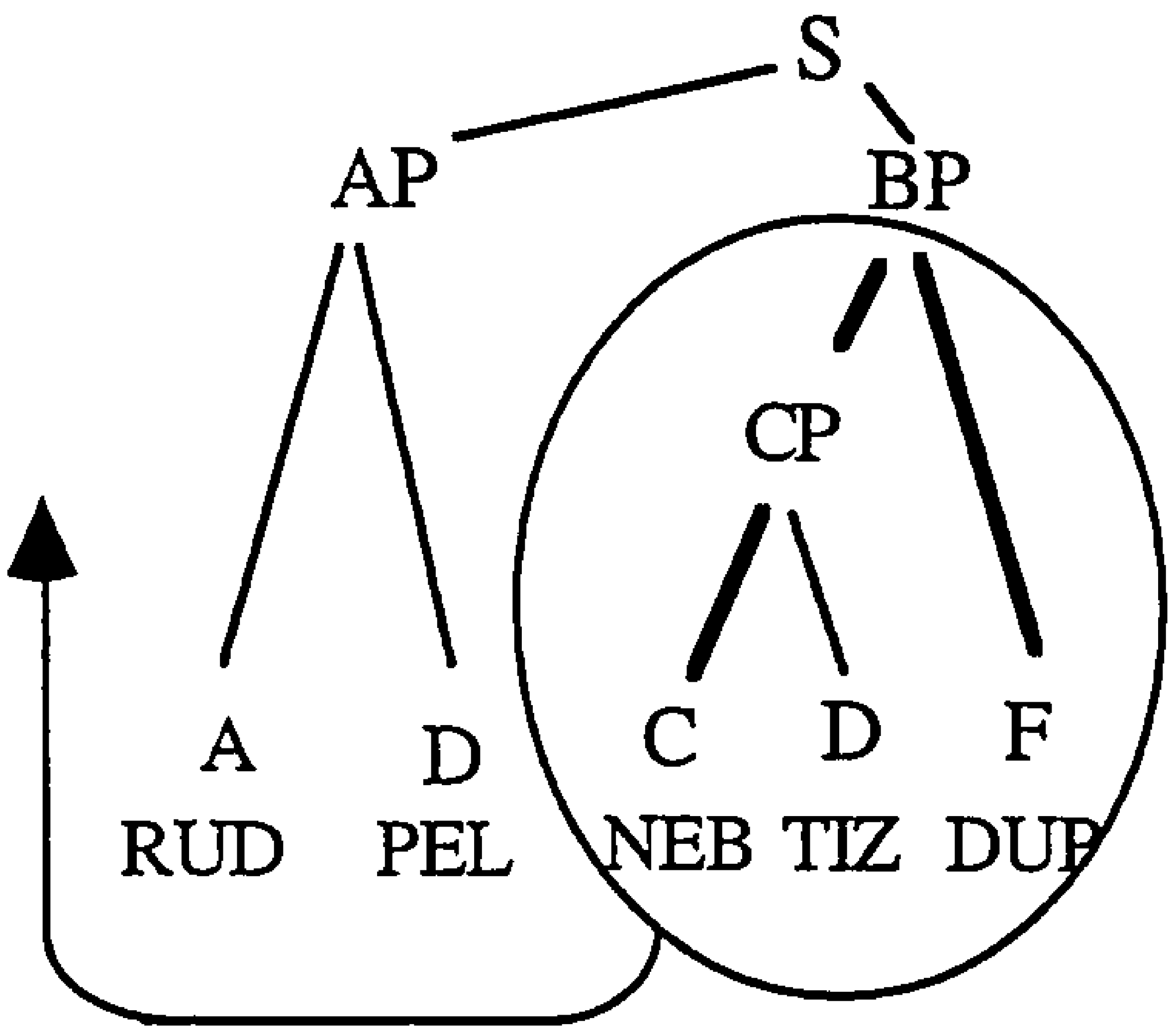
The test comprised twenty four items, each item involving the presentation of two sentences, one above the other and labelled 1 and 2. Each of the sentences was a transformed version of a novel grammatical sentence. One sentence had been transformed in such a way that phrase structure was preserved, the other so that phrase structure was violated. The transformation involved moving words in groups to a different position in the sentence. If this involved the movement of an intact phrase this was deemed a correct transformation and if the move involved the movement of a group of words which cut across phrase boundaries, this was deemed incorrect.

An example of such a test item is shown in Figure 2.11 in which the transformation in the first sentence preserves the phrase structure (in this case the movement of the B phrase) whereas the second violates phrase structure (by cutting across the B phrase). Further explanation is provided below.

1. **NEB TIZ DUP** RUD PEL
2. NEB RUD PEL TIZ DUP

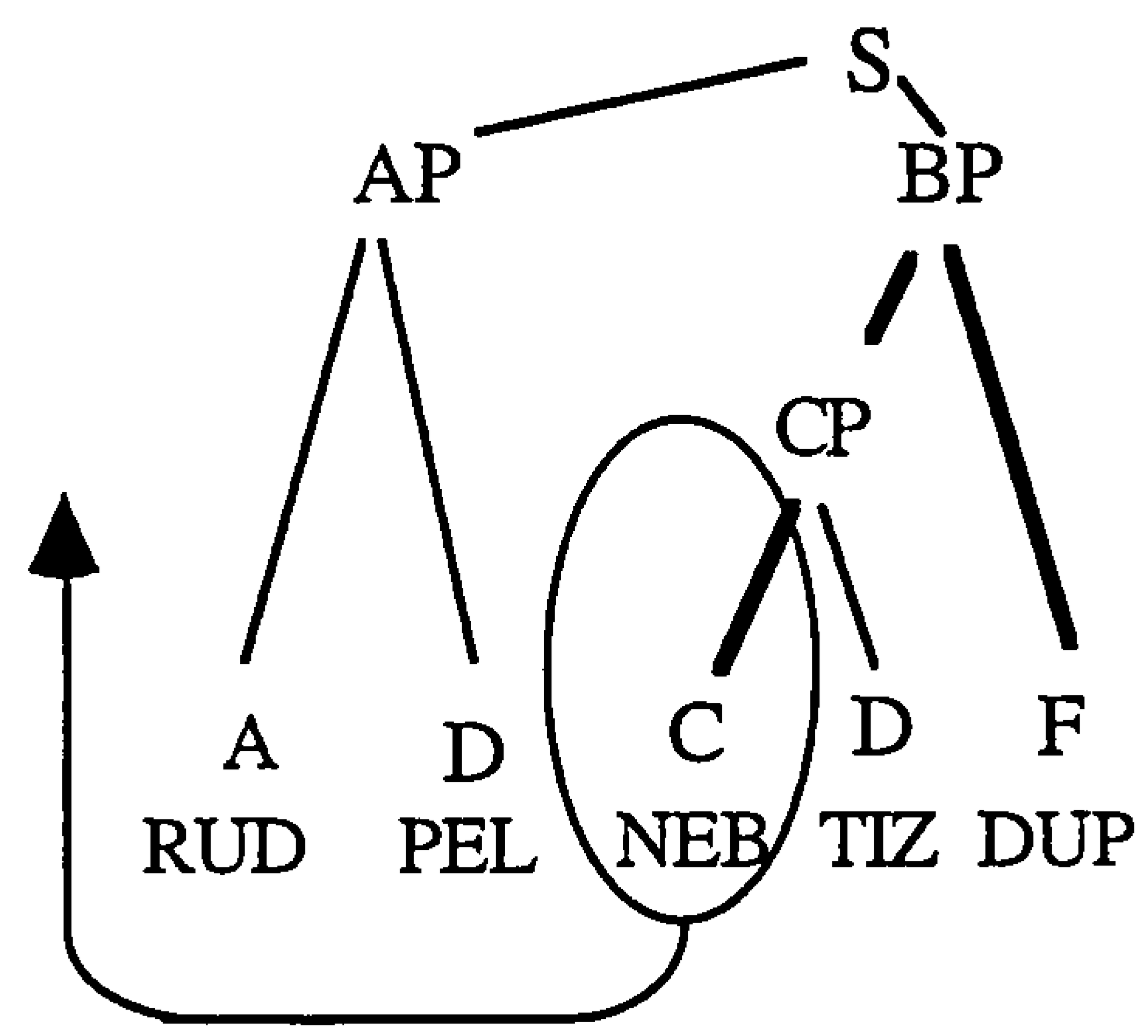
Figure. 2.11 Example of a Transformational Test item.

The two sentences above were generated from the sentence "RUD PEL NEB TIZ DUP". This sentence is shown below accompanied by two phrase structure tree diagrams the first of which shows the transformation of an intact B phrase (Figure 2.12) and the second a transformation which violates the phrase structure of the B phrase (and in this case the C phrase, see Figure 2.13).



"NEB TIZ DUP RUD PEL"

Figure. 2.12 Structure-preserving transformation



"NEB RUD PEL TIZ DUP"

Figure 2.13 Structure-violating transformation

The transformation in Figure 2.12 is correct as it moves an intact B phrase consisting of a CDF word class combination to a new position (which also does not cut across any other phrasal boundaries). The transformation in Figure 2.13 is incorrect because by separating "NEB" (a C word) from "TIZ DUP" (a D followed by F word) the transformation violates the B and C phrase structure boundaries. Eight of the twenty four test items involved the movement of either intact or violated A phrases, eight involved movement of an intact or violated B phrase and eight of a C phrase. The transformational constituent test can be found in Appendix A1.

Instructions:

Morgan *et al* did not give any outline of instructions given to participants for this test. In the absence of any guide the following instructions were used:

" ......in both sentences some words have been placed in a different position from the position you saw them in earlier........ judge which arrangement you feel is preferable"

Follow up questionnaire:

A follow up questionnaire was given to all participants after the current study (see Appendix A1). Participants were asked to: describe the kinds of strategies they had used to learn the language, the bases upon which they had made their decisions in the language testing phase, any patterns or regularities they had seen and any guesses they might have regarding the rationale behind the study. Participants were also asked to provide information regarding their previous foreign language learning experience.

2. 3 Results

2. 3. 1 Vocabulary Tests

In the Morgan *et al* study, all participants, with the exception of four, had reached ceiling on the last vocabulary test. Two of the exceptions were from the Permutation condition and one each from the other two conditions. Data from the four participants failing to reach criterion on the final vocabulary test were discarded leaving nine participants in each of the three conditions. Morgan *et al* stated that the vocabulary tests "were included primarily to ensure that participants were attending to the task." In the present study, the number of participants in each condition achieving a perfect score or making one or more than one error on the final vocabulary test were summed and the totals are presented in Table 2.4 according to input condition.

Table 2.4 Number of participants (i) achieving a perfect score (ii) making one error or (iii) making more than one error on the final vocabulary test.

	Base Language	Proform	Permutation
Perfect Score	11	7	5
1 error	3	1	4
More than 1 error	0	6	5

Note: There were 14 participants in each condition. A perfect score was 15.

Allowing for a single error, all participants in the control condition passed at this standard whereas only eight participants in the Proform and nine in the Permutation condition did so (although differences between groups on the third and final vocabulary test were not found to be significant). These results made further comparisons between the two studies problematic if the same criteria for inclusion were to be applied as those used by Morgan *et al*.

In response to this problem, analyses of the remaining test data were carried out firstly using all participants and secondly using data only from participants who scored at least 14 out of 15 on the Vocabulary Tests.

2. 3. 2 Grammaticality Judgement Tests:

Morgan et *al's* chief finding was that, by the final trial, participants in the experimental conditions (the Proform and Permutation conditions) outperformed those in the base language group, in particular on the more complex, conditional, rules of the language.

A series of analyses on the current study data were performed and the results of the analyses were later compared to those found by Morgan *et al.* Below is an overview outlining the order of the different analyses (see Table 2.5) :

Table 2. 5 Analyses carried out on Grammaticality Judgement Test data.

Analysis No.	Trials	Rules analysed	Participants
1	1-4	all 8 rules	all participants
2	1-4	rules 1-4 (unconditional) and rules 6-8 (conditional)	all participants
3	1-4	all analysis as in 1 and 2 above	only those reaching vocab test criterion
4	2-4 summed, 4 alone	all 8 rules	all participants
5	2-4 summed 4 alone	rules 1-4 (unconditional) and rules 6-8 (conditional)	all participants
6	2-4 summed, 4 alone	all analysis as in 4 and 5 above	only those reaching vocab test criterion

Note:

i)"trials" = performance on specified trials only;

ii)"rules analysed" where "all" = performance measured across all eight rules where "rules 1-4 (unconditional rules) rules 6-8 (conditional rules)"= performance is separated and measured on unconditional (rules 1-4) and conditional rules (rule 5-8)

iii)"participants" where "all" = all participants' data were included and "only those reaching vocab test criterion" = only participants' who reached criterion on the vocab tests were included in the Grammaticality Judgement tests' analyses.

1) Trials 1-4, all rules, all participants.

Data from all participants assessing performance on all eight rules of the language on all four trials were initially analysed using a two-factor analysis of variance (factors: input condition and trial). A main effect of input condition was found, $F(2,39) = 10.49$, $p < .001$ in which scores of participants in the base language condition were found to be significantly higher than those in the proform and permutation conditions (Scheffé's: $p < .001$, $p < .05$, respectively). Mean and standard deviations for each input condition are shown in Table 2.6.

(*Note, in the current study the Scheffé's post hoc test was used as this was the test used by Morgan *et al.* In the later studies in this thesis, other post hoc tests are used and justifications will be provided for their use later.)

Table 2. 6 Mean and Standard Deviation scores according to input condition across all four trials.

Input Condition	Mean score	St. Deviation
Base Language	20.89	3.90
Proform	17.28	2.90
Permutation	18.76	3.36

Note: maximum score = 32; 14 participants in each condition.

The direction of the effect was not as predicted from Morgan *et al* whose findings suggested that the experimental groups would outperform the base language condition. No effect of trial was found nor was there any significant interaction between input condition and trial. Mean scores for each input condition on each of the four trials are plotted below, (see Figure 2.14).

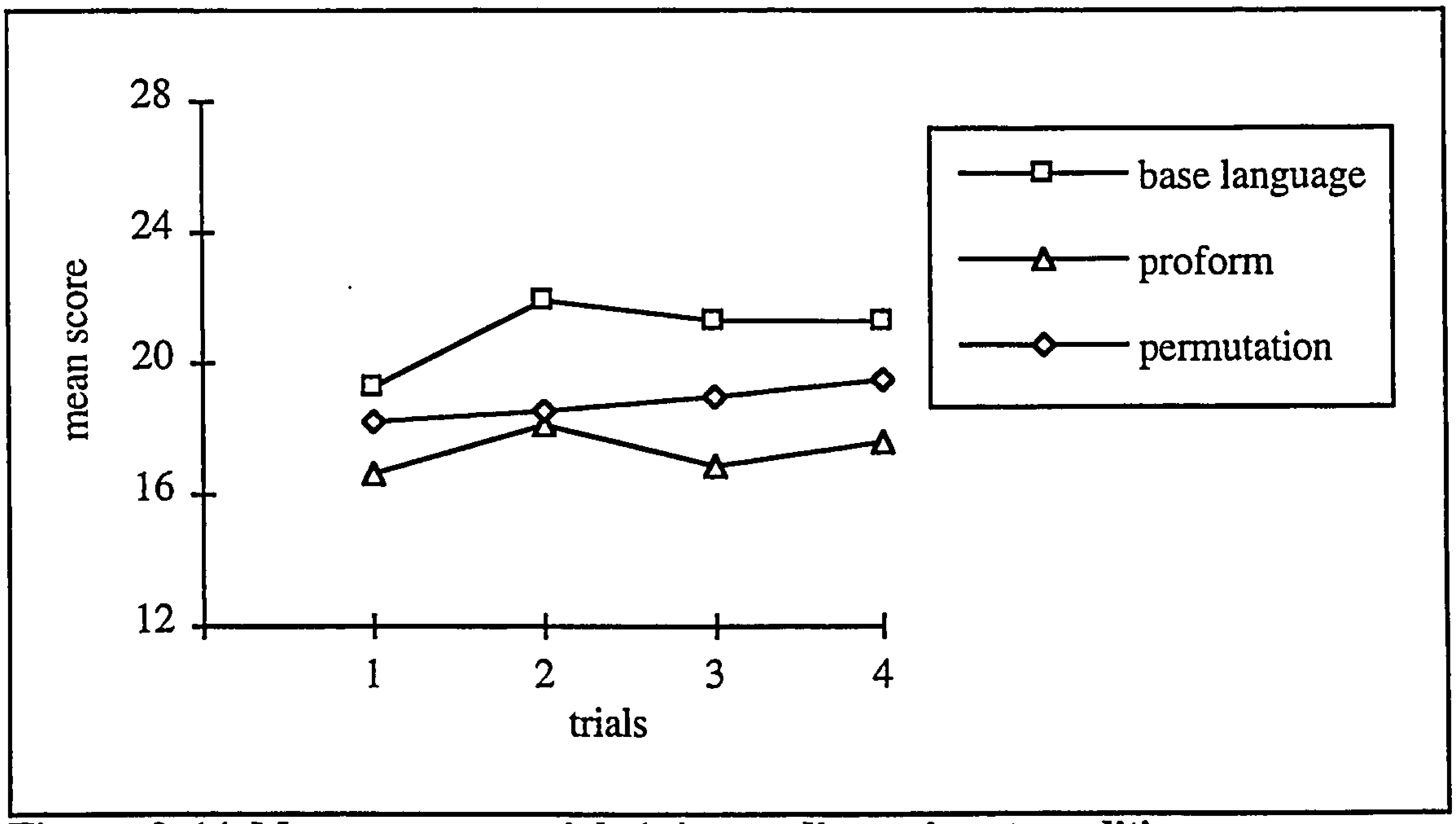


Figure. 2. 14. Mean scores on trials 1-4 according to input condition.
(Max. score 32.)

2) Trials 1-4, unconditional versus conditional rules, all participants.

Data were then analysed with the inclusion of a third factor: rule type, in which participants' performance on the unconditional rules (rules 1-4) and conditional rules (rules 6-8) were compared separately omitting scores on the hybrid rule (rule 5). A three-factor analysis of variance was conducted (factors: input condition, trial and rule type).

A main effect of input condition was again found (F(2,39) = 8.97; $p < .001$) with participants in the base language condition performing significantly higher (mean: 64.12, st dev: 16.78) than those in the proform condition (mean 53.96, st dev: 14.23; Scheffé's: p < .001) and better but not significantly better than those in the permutation condition (mean 58.02, st dev: 14.23; Scheffé's: p = .05). (Figures shown above are percentage correct.)

A significant interaction between input condition and rule type was found, (F(2,39) = 3.66; $p < .05$). Follow up analyses revealed that the superior performance exhibited by the participants in the base language condition over participants in the proform and permutation conditions was attributable to the base language condition participants' more accurate judgements of items testing the unconditional rules only (Scheffé's: p < .01, p< 0.05, respectively): see Figure 2.15. No differences were found between the three input conditions on the conditional rules of the language.

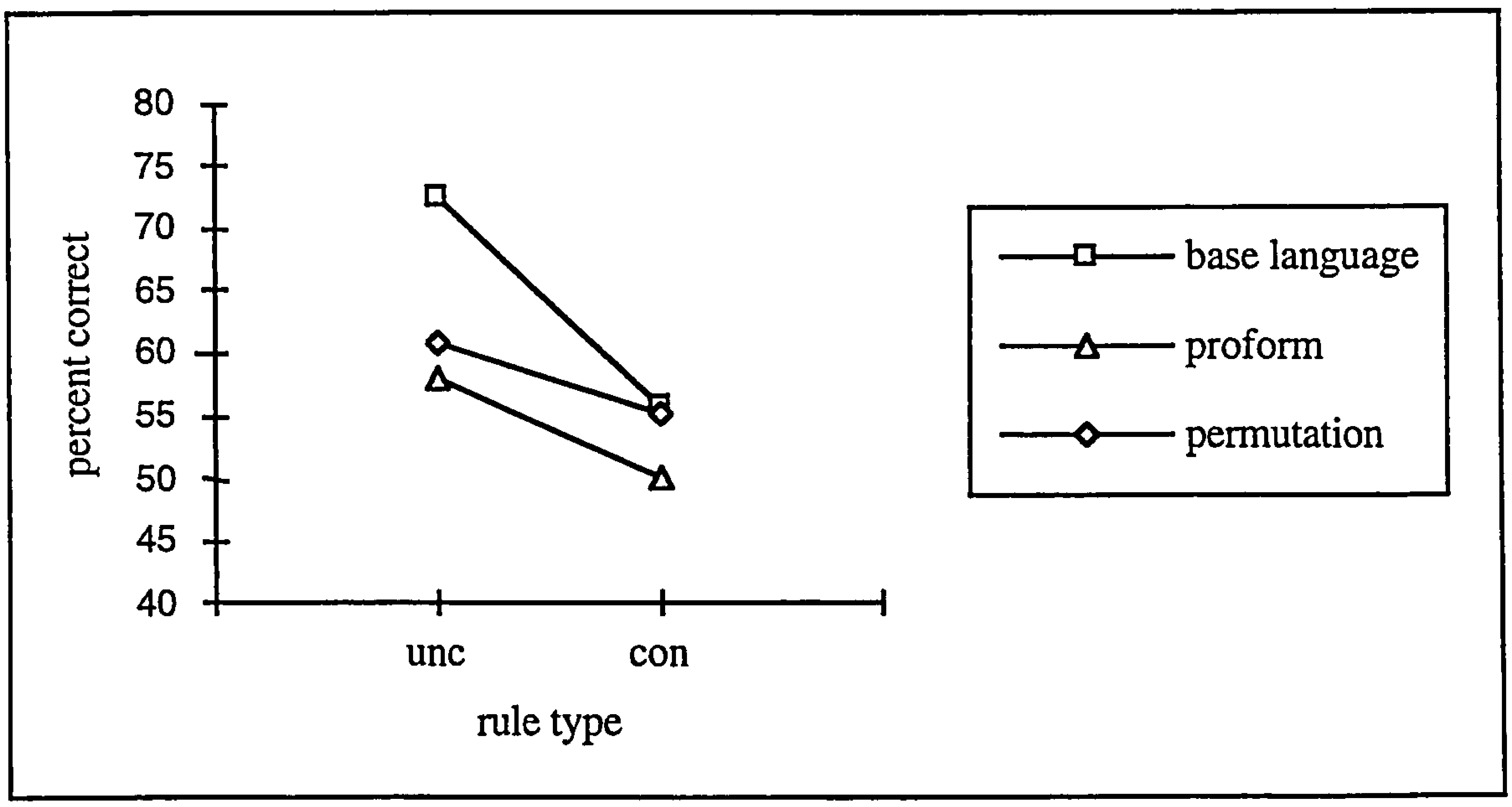


Figure. 2. 15 Mean percentage correct on unconditional compared to conditional rules according to input condition. (Note: "unc" = unconditional rules 1-4, "con" = conditional rules 5-8.)

A main effect of rule type (unconditional versus conditional rules) was found (F (2,39) = 32.89, $p < .001$) whereby performance on the unconditional rules (mean: 63.72, st dev: 15.26) was found to be higher overall than performance on the conditional rules (mean: 53.67, st dev: 14.41). Follow up analyses revealed that only participants in the base language condition performed significantly better on the unconditional compared to conditional rules (Scheffé's: $p < .001$).

3) Excluding participants not reaching criterion on final vocabulary test (all rules and unconditional and conditional rules).

The results remained the same even when data from participants not reaching criterion on the final vocabulary tests were discarded, with two exceptions: differences between the base language condition and the permutation condition were no longer found to be significant and no significant interaction between input and rule type was found.

A comparison with Morgan *et al*'s (1989) results.

The above analyses were carried out using data from all four trials. Morgan *et al* reasoned that on trial 1 participants from the different conditions were not expected to perform differently as they had received identical input up to this point. This was found to be the case in both the Morgan *et al* and the current study. Morgan *et al* therefore focused their attention on analyses of trials 2-4 and trial 4 on its own.

4) Trials 2-4 and 4 alone, all rules, all participants:

Morgan *et al* presented mean and standard deviation scores for each of the three input conditions from trials 2-4 and trial 4. Their results are shown below in Table 2.7 preceded by the equivalent scores obtained in the current study.

Table 2.7 Base language and experimental group mean scores on trials 2-4 and 4, comparing results across studies.

Input Condition	Trial	Current study		Morgan *et al*, 1989.	
		Mean	St. Dev	Mean	St. Dev
Base Language	2-4	**64.2** (64.2)	9.35	**63.56**	8.34
	4	21.2 (21.2)	3.88	21.56	3.21
Proform	2-4	**52.5** (53.1)	5.25	**77.44**	12.44
	4	17.5 (17.3)	2.84	26.89	4.68
Permutation	2-4	**56.8** (58.4)	7.23	**76**	7.28
	4	19.4 (20.1)	3.99	27.78	3.35

Note: Data from participants scoring to criteria in the vocabulary test are in brackets.

The base language condition mean and standard deviation scores summed across Trials 2-4 are strikingly similar across the two studies (see Table 2.7 above.) However, the scores from the two experimental conditions in the two studies appear to be almost mirror images of each other as is illustrated in Figure 2.16 below.

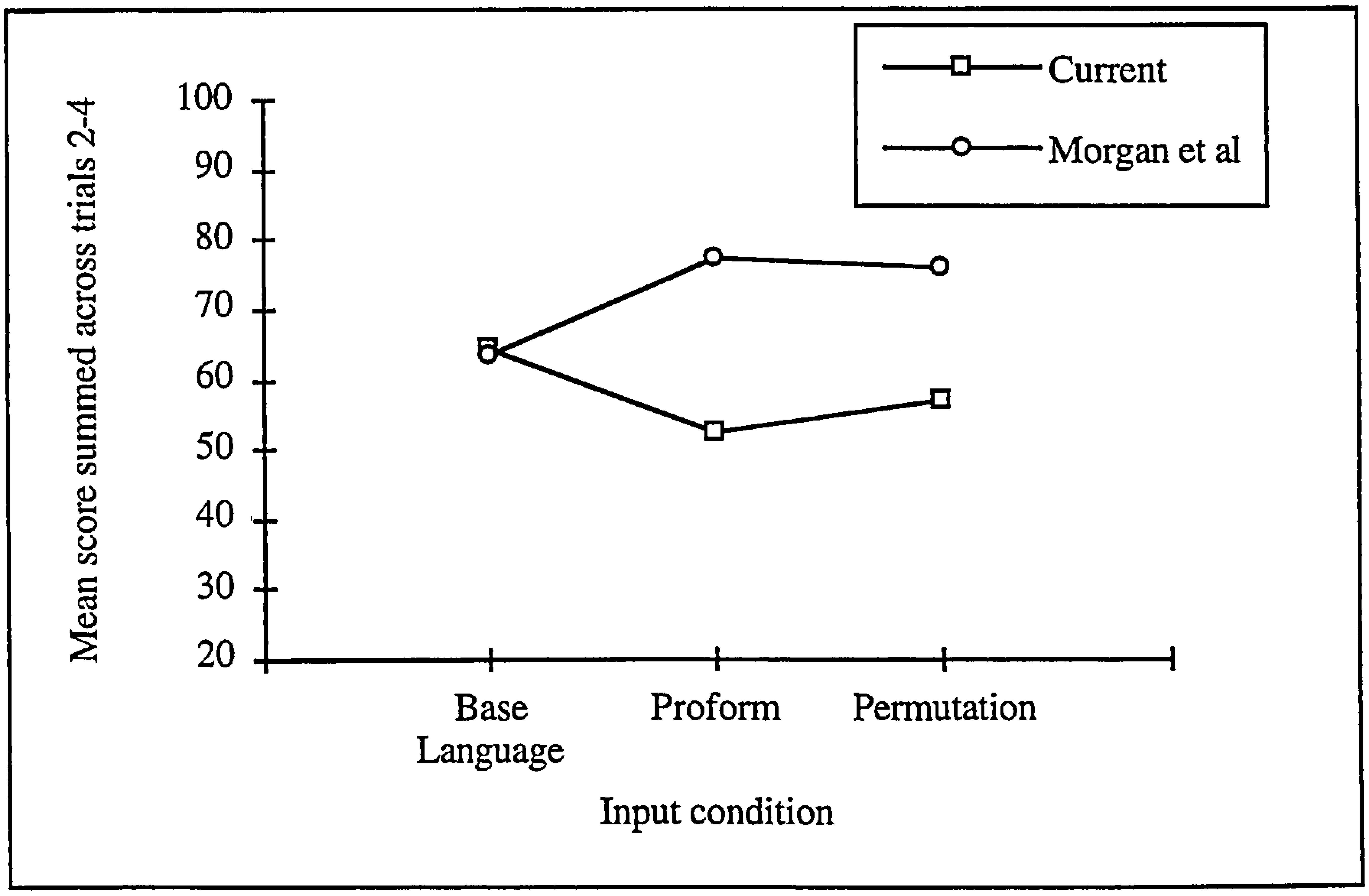


Figure. 2. 16. Mean score summed across Grammaticality Judgement Tests 2-4: a comparison across studies.

A one-factor analysis of variance (factor: input condition) was conducted and a main effect of input condition found, $F(2,39) = 8.91$; $p < .001$. Follow up analysis revealed that participants in the base language condition performed significantly *better* than those in the proform and permutation conditions in the current study on trials 2-4 using all participants' data (Scheffé's $p < .001$, $p < .05$, respectively). Those in the base language condition in the Morgan *et al* study scored significantly *lower* than the experimental groups on these trials.

Similar differences between the two studies were found when examining performance on trial 4 alone with the exception that in the current study, although the base language condition scores were higher than those of the permutation group, the difference was no longer found to be significant.

5) Trials 2-4 and 4 alone, unconditional versus conditional rules only, all participants.

A two factor analysis of variance (factors: input condition and rule type) was carried out in which a main effect of input condition, ($F(2,39) = 7.18$; $p < .01$) was found. Participants in the base language condition achieved significantly higher scores (mean: 65.3, st dev: 14.6) than those in the proform condition (mean: 54.1, st dev: 10.01, Scheffé's: $p < .001$) and higher but not significantly higher than those in the permutation condition (mean: 58.06, st dev: 9.74).

A significant interaction between input condition and rule type was also found, ($F(2,39) = 3.72$; $p < .05$) and follow up analyses revealed that those in the base language condition performed significantly better (mean: 74.25, st dev: 12.86) than those in the proform (mean: 58.33, st dev: 8.65) and permutation conditions (60.56, 8.72) on the unconditional rules alone (Scheffé's: $p < .01$, $p < .05$ respectively). No differences were found between input conditions on the conditional rules of the language.

A main effect of rule type (unconditional versus conditional rules) was found ($F(1,39) = 27.06$; $p < .001$) whereby performance on the unconditional rules (mean: 64.38, st dev: 12.96) was found to be overall higher than performance on the conditional rules (mean: 53.96, st dev: 9.45). Follow up analyses revealed that only participants in the base language condition performed significantly better on the unconditional compared to conditional rules (Scheffé's: $p < .001$).

On trial 4 no significant differences were found between input conditions but the general direction of the data was the same. A main effect of rule type was found ($p < .001$) with performance on the unconditional rules (mean: 65.17, st dev: 15.19) being overall higher than on the conditional rules (mean 53.37, st dev: 16.05). However, closer analysis revealed that none of the input conditions in isolation performed better on the unconditional compared to conditional rules on the final trial.

6) Excluding participants not reaching criterion on final vocabulary test.

In the current study, when discarding data from participants not reaching criterion on the final vocabulary tests, the results were very similar with the exception that those in the base language condition no longer performed significantly better than those in the other two conditions on the unconditional rules of the language although the trend in the data was in the same direction.

Summary of Grammaticality Judgement Test findings.

The chief finding here is that participants in the base language condition performed better than those in the experimental (proform and permutation conditions) on the unconditional rules and all participants had difficulty with the more complex conditional rules. The trend in the direction of data was the same when excluding participants failing to reach criterion in the final vocabulary tests.

These findings are unlike those reported in the Morgan *et al* paper where participants in the experimental conditions outperformed those in the base language condition on both unconditional and conditional rules. The mean and standard deviation scores of the base language conditions (control conditions) are very similar across both studies.

2. 3. 3 Fragment Constituent Tests.

These tests were designed to discover whether the phrase structure of the language had been acquired. A two factor analysis of variance was performed (factors: input condition and test type (test 1 or 2). No effects of input condition or test were found. Participants in the experimental groups did not outperform those in the base language condition. This suggests that participants in the experimental conditions did not have a superior knowledge of phrasal structure as measured by the fragment constituent tests.

The results obtained in the current study are similar to those reported by Morgan *et al* who reported no significant differences between conditions on test one. Morgan *et al* did report a significant difference between the permutation and base language condition performances but on test 2 only . No difference was reported between the performances of those in the proform and base language conditions on this test. A comparison of mean and standard deviation scores is presented in Table 2.8 below.

Table 2. 8 Base language and experimental group mean scores on Fragment Constituent tests 1 and 2 comparing results across studies.

		Fragment Test 1		Fragment Test 2	
Condition		Current study	Morgan *et al*	Current study	Morgan *et al*
Base Language	Mean	13.35	13.11	12.71	12.22
	StDev	3.17	2.37	3.71	3.46
Proform	Mean	14.21	13.33	12.5	14.89
	StDev	2.75	4.55	2.31	5.71
Permuted	Mean	12.28	13.89	13.35	17.00
	StDev	3.56	3.69	3.12	3.84

Note: maximum score = 24, chance =12.

Only participants in the proform condition performed above chance in the current study and only on the first test. In the Morgan *et al* study only participants in the permutation condition performed above chance and on trial two only.

2. 3. 4 Transformational Constituent Test.

This test was also designed to discover whether the phrase structure of the language had been acquired. A one-factor analysis of variance was performed (factor: input condition). No effect of input condition was found. These results are the same as those reported by Morgan *et al* who also found no effect of input condition. A comparison of mean and standard deviation scores from the two studies is shown below (see Table 2.9).:

Table 2. 9 Base language and experimental group mean scores on Transformational Constituent test comparing results across studies.

Condition		Transformational Test	
		Current study	Morgan *et al*
Base Language	Mean	13.07	12.78
	StDev	2.16	2.73
Proform	Mean	12.42	16.33
	StDev	2.44	4.9
Permutation	Mean	11.85	16.56
	StDev	2.34	5.22

Note: maximum score = 24, chance =12.

This suggests that participants in the experimental conditions did not have a superior knowledge of phrasal structure as measured by the transformational constituent test. None of the participants scored above chance levels in the current study. Only the experimental groups scored significantly above chance on the test in the Morgan *et al* study.

Summary of Constituent Test findings.

The chief finding from the current study is that participants in the experimental conditions did not outperform those in the base language condition on tests of constituent structure. These findings are similar to those of Morgan *et al* who reported that, out of the three tests of constituent structure, on only one did one experimental condition (the permutation condition) produce superior scores compared to the base language condition. In the other two tests no differences between performances were found.

It can be concluded that participants in the experimental conditions i.e. those who received input containing cues to constituent structure, did not have a better grasp of constituent structure than those participants whose input contained no such cues (as measured by these specific tests of phrasal structure).

2. 3. 5 Feedback from Follow up Questionnaire.

Foreign language experience:

Participants were asked to provide subjective assessments of the level of their mastery of languages other than their native language. Their responses ranged from almost fluent (good) to non-existent mastery (none) of one or more foreign languages. Table 2.10 shows the number of participants from each input condition who fell into each of the categories.

Table 2.10 Participants' self-assessed second language proficiency.

	Good	Average to weak	None
Base	4	6	4
Proform	4	6	4
Permutation	5	4	5

Note: the figures above relate to the number of participants in each input condition who assessed their knowledge of a second language under one of the three headings. Participants were placed in one category only. There were 14 participants in each condition.

No obvious differences between the groups appeared and no statistical analyses were carried out.

Ability to describe rules of language.

Participants' attempts to describe any "patterns or regularities in the language" after completion of the experiment, were categorised according to the number of regularities they were able to describe. No assessment of the accuracy of the description was made because of the variety of type of description. Some participants referred to the ordering or grouping of the geometric shapes and some referred to specific words. However, in order to get a rough assessment of what they had noticed about the language and to see if any clear difference between participants from different conditions was apparent, participants were scored according to the number of regularities in the language that they were able to describe. Those participants who failed to write anything in this section were later prompted by the experimenter who asked " Did you notice any word or shape occurring in any particular position?" these participants were then assessed according to their spoken feedback. The findings are recorded below (see Table 2.11).

Table 2.11. Number of "patterns or regularities in the language" noted by each participant, categorised according to input condition and on whether prompting by the experimenter was necessary.

	No prompting			After prompting	
No. of regularities noted	0 or 1	> 1	>3	0 or 1	> 1
Base	3	3	6	1	1
Proform	0	6	1	1	6
Permutation	1	2	4	1	6

Note: the figures above relate to the number of participants in each input condition who were able to describe the specified number of regularities. Participants can be placed in one category only. There were 14 participants in each condition.

No statistical analyses were attempted. Twelve participants in the base language condition provided some description of the regularities without prompting compared to seven in the proform condition and seven in the permutation condition. More participants in the latter two conditions appear to have relied on a prompt to elicit any regularities they had seen.

Bases upon which Grammaticality Judgements were made.

Participants were asked to describe "on what basis or bases did you make your decisions" on the grammaticality judgement test items. Four main categories of responses were recorded:

1. responses based on what participants described as mainly "feel"
2. responses based on what participants described as mainly "guesswork"
3. responses based on what participants described as mainly "memory"
4. responses in which participants attempted to describe underlying rules and showed some limited appreciation of the rules (relevant)
5. responses in which participants attempted to describe underlying rules and showed incorrect appreciation of the underlying rules (irrelevant)

Findings are presented below (see Table 2.12).

Table 2. 12 Feedback describing the bases upon which grammaticality judgements were made.

	Basis upon which grammaticality judgements were made				
	Feel	Guess	Memory	Relevant	Irrelevant
Base	4	0	1	8	1
Proform	5	2	2	4	1
Permutation	2	3	5	4	0

Note: the figures above relate to the number of participants in each input condition who reported the bases upon which they made their grammaticality judgements. Participants were placed in one category only. There were 14 participants in each condition.

Again no statistical analyses were carried out. There appear to be no obvious differences in the distribution across the categories according to input condition with the exception of participants in the base language condition who obtained relatively high scores in the "relevant" category.

Summary of Feedback from Questionnaire.

No obvious differences across input conditions were found with regard to participants' self assessed second language proficiency. Slightly more participants in the base language condition provided unprompted descriptions of regularities in the language than were provided by those in the two experimental conditions. Those in the latter conditions were more forthcoming after having been prompted.

No clear differences were found in descriptions of the bases upon which grammaticality judgements were made according to input condition. More participants in the base language condition provided more relevant descriptions than the number of participants in the experimental conditions although these differences were not subjected to statistical interpretation or analysis.

2.4. Discussion

As stated in the introduction to this study, the aim of this replication was two-fold: the first aim was to assess the miniature language as a tool for testing out hypotheses on adult second language acquisition; the second aim was to explore the claim made by Morgan *et al* (1989) that cues to phrasal structure facilitate syntax acquisition. The first of these issues will be discussed towards the latter half of this discussion section. The question of the extent to which cues to phrasal structure facilitate the acquisition of syntax will be addressed here. The two types of input which were compared in this study were referred to in Chapter One as scenario "d" type input (that input which contains cues) and scenario "b" type input (that which contains no cue nor explanation of any rule).

Morgan *et al* predicted that cross-sentential cues to phrasal structure would facilitate the acquisition of syntax and in particular of the more complex, conditional rules. To test this hypothesis, learners were exposed to input with or without cues to phrasal structure and then given two sets of tests. The first set were grammaticality judgement tests designed to assess the learners' knowledge of the unconditional and conditional rules of the language; the second set were designed to test directly the learners' knowledge of the underlying constituent structure. Morgan *et al* hypothesised that only learners who had been exposed to input containing the cues to phrasal structure would acquire the complex rules, as their superior knowledge of phrasal structure boundaries would reduce and simplify the analytical procedures necessary to determine the more complex ordering of the syntax. The findings from the current study will be described below and will be compared with the findings reported by Morgan *et al*..

In the current study, on the tests of grammaticality judgement, participants in the base language condition whose input contained no cue to phrasal structure (described as type "b" input), performed significantly better than those in the proform and permutation conditions who had received input which cued phrase structure (type "d" input). This difference was apparent on the more simple, unconditional rules only. When "non-criterion" participants' data were included, the differences were no longer significant, but the direction of the findings was the same. These results stand in direct contrast to those reported by Morgan *et al* who reported that the participants in the proform and permutation conditions performed significantly better on both unconditional and conditional rules than participants in the base language condition. Despite the differences between the experimental conditions' performances across the two studies, the performances of the two base language or control conditions were very similar.

On the tests of constituent structure, in the current study, no differences were found between performances of participants in the three input conditions. Participants in the proform and permutation conditions did not exhibit superior performances on tests of constituent structure compared to the performances of those in the non-cued base language condition, although learners in the proform condition performed above chance on the first test. These findings are similar to those reported by Morgan *et al* who found only one difference according to input condition, this difference was between the performance of participants in the base language condition and those in the permutation condition on one of the three constituent tests.

On the basis of the current study's findings, there is no evidence to support the contention that input incorporating cross-sentential cues to phrasal structure facilitates syntax acquisition as measured by performance on the grammaticality judgement tests. Similarly, there is no evidence that participants in the cued conditions had superior knowledge of the underlying constituent structure compared to that of the non-cued condition as measured by performance on the constituent structure tests. It would appear that the participants in the cued conditions might have even been hindered rather than facilitated by the input which incorporated the cues to phrasal structure because their performances on the tests of grammaticality judgement were poorer than those of the base language condition.

This outcome was unexpected. Previous literature in the field (Green, 1979; Morgan 1986; Meier and Bower, 1986; Morgan, Meier and Newport, 1987; Valian and Coulson, 1988; Valian and Levitt, 1996) had provided strong support for the facilitative effects of cued input on syntax acquisition. The findings reported by Morgan *et al* provided further evidence for this effect. In the light of this body of evidence, a facilitative effect of the cues was expected in the current study. Similarly, if salience of the features or rules in the input was important (as suggested by Sharwood Smith, 1994) one would also have expected learners in the cued input conditions (type "d" input) to outperform those in the non-cued condition (type "b" input).

Whilst one concern in the current study was with the miniature language itself and its potential as a tool for modelling second language acquisition, the difference in the findings obtained was intriguing and it was important to seek some explanation for those differences. Not only was it important to discover why there was a difference but also to form a judgement regarding whose results were likely to be the most valid and reliable. The next section of this discussion will attempt to address these key issues. The issue of the suitability of the language itself as a tool for modelling second language is related to these arguments.

Why was there a difference in findings? A detailed examination of the procedures followed in the two studies was necessary to ensure that the current study had faithfully replicated those described in the Morgan *et al* paper. However, before examining these procedures in detail, some important points must first be made regarding Morgan *et al*'s justifications of their own findings.

Whilst Morgan *et al* found that participants in the cued conditions performed significantly better on tests of syntax acquisition than those in the non-cued base language condition, those in the former group did not score significantly better on tests of actual phrase or constituent structure than those in the non-cued conditions. It would appear that the participants in the cued conditions had not actually fully acquired the phrasal structure, yet Morgan *et al* argued that it was just this knowledge of phrase structure which was responsible for the superior levels of syntax acquisition those participants had exhibited. Although Morgan *et al* argued that the Proform and Permutation groups performed above chance on one of these tests, I would suggest this provides insufficiently strong evidence that knowledge of constituent structure could account for the significant improvement in performance on the grammaticality judgement tests. This issue is central to the claims made by Morgan *et al* but is not discussed in the Morgan *et al* paper.

If knowledge of phrase structure is necessary for syntax acquisition and participants in the proform and permutation groups had not fully acquired the phrase structure then the results on the grammaticality judgement tests in the present study are perhaps not surprising. Indeed, as stated above, participants in the proform and permutation conditions might have been hindered rather than helped by their input: participants in these groups had three tasks to attend to: matching of word to referent shape, looking for patterns in the sentences and observing the second sentence to see how it related to the first. Participants in the base language condition had only two tasks, the first two outlined above. Participants in the experimental conditions might have been overloaded with tasks compared to those in the base language condition. Possible evidence of such overload is found in the results of the vocabulary tests which were included "primarily to ensure participants were attending to the task." (Morgan *et al* 1989, p367). Only participants in the proform and permutation conditions experienced difficulty on these "tests of attention" in the current study.

The input received by participants in the experimental conditions was also more complex than that received by those in the base language condition. Morgan *et al* acknowledged this themselves when referring to the type of input received by those in the cued conditions: those in the proform condition were exposed to a larger vocabulary than those in the base language and Morgan *et al* also noted that the finite state grammar underpinning the proform language would require more paths than would be required by the base language grammar. The Permutation language comprised at least twice the number of possible grammatical sentences as in the base language and required additional phrase structure rules to generate the alternate orderings of the A and B phrases.

Morgan *et al* argued that in spite of these differences, only those in the cued conditions acquired the complete set of base language rules. None of the participants in the current study acquired the complete set of rules and those exposed to more complex input struggled with even the comparatively simple, unconditional rules. This would seem hardly surprising given the number of tasks they had to perform and the extra-complexity in the language input.

As stated above, it could be argued that the differences found between the two studies could be due to differences in the way the study was run. However, the similarity of the performances of the base language conditions across the two studies possibly suggests that the procedure had been replicated faithfully. The base language condition was a control condition and the control groups were acting virtually identically to one another with regard to both mean and standard deviation scores.

The procedures for construction of the base language, proform and permutation sentences and the test items were followed exactly as described in the Morgan *et al* paper and these procedures were checked thoroughly before and after testing. Only two differences between the two studies were evident: firstly the studies differed in the use of black and white as opposed to colour slides, the former being used in the current study. This difference might have accounted for the lower numbers of participants reaching criterion level in the vocabulary tests in the current study, the black and white slides being potentially less salient, making the vocabulary memorisation more difficult. However, the base language condition did not experience a problem on this test and all participants in this condition reached the criterion set in the Morgan *et al* study. The issue remains as to why the participants in the experimental conditions did not reach the criterion level. A possible reason was the overload in the number of tasks to which these participants had to attend.

Did performance on the vocabulary tests by those in the cued conditions relate to performance on the other tests? This would not appear to be the case since analysis of the results taken from participants in the cued conditions who scored well on the vocabulary tests still indicates that these participants were trailing behind their base language counterparts.

The second difference in procedure between the studies was in the wording of the instructions supplied to participants. The degree of detail provided in the Morgan *et al* study was limited and in places it was necessary to create sections of instructions: firstly, in the introduction prior to the language presentation and secondly, prior to the tests.

Morgan *et al* provided only a limited description of the instructions they gave in the introduction. They stated that

> "At the outset participants were informed that they would see a number of sentences from a miniature artificial linguistic system that included a simple reference world. They were instructed to discover how the words and the figures in this world were paired and to search for patterns in the order and arrangement of words."

The exact wording that Morgan *et al* used in their instructions was not provided. The following instructions were therefore created:

> "Thank you for agreeing to take part in this experiment which involves observing a number of sentences in a new miniature language and trying to discover patterns in the order of the words in the sentences. After you have observed each set of words or sentences, you will be given a set of short exercises in which you will be asked to make judgements regarding which sentences or groups of words feel 'correct'. Don't worry if you are uncertain of the correct answer, simply make your best judgement based on how you feel."

In the wording of the instructions given prior to the grammaticality judgement tests Morgan *et al* stated that:

> "participants were requested to indicate which of the two sentences was grammatical."
>
> The instructions given in the current study were as follows:
>
> "Judge which of the two sentences feel correct according to patterns in the language you have seen before"

In the current study, participants were advised to make judgements based on their "feel" regarding correctness. The introduction of the word "feel" into the instructions had been intentional. I was concerned that participants might suffer undue stress if they were uncertain of the correct response. I also wished to prevent the situation arising whereby participants might feel they could not continue because they did not "know the right answer.".

However, it is possible that in encouraging participants to base their judgements on "feel", participants in the current study were acting differently from those in the Morgan *et al* study who had potentially adopted a different approach to the task. In a study by Reber, Kassin, Lewis and Cantor (1980) it was found that the type of instructions given to participants in an artificial grammar learning task interacted with the salience of the stimulus display to which they had been exposed. They noted that instructions encouraging an implicit approach to learning were more effective where the stimulus display (in this case letter strings generated by a finite state system) was less salient and that those encouraging an explicit approach were more effective when the display was more salient.

It was possible that the instructions used in the current study were a combination of explicitly oriented (encouraging participants to consciously and actively search for rules) and implicitly oriented (encouraging participants to base their judgements on intuitive, non-conscious "feel"). The instructions in the Morgan *et al* study might have been predominantly explicit. (No reference was made to participants being encouraged to make intuitively based judgements, participants being asked only to look for patterns and to decide on grammaticality of the test items.)

As noted in chapter 1, (section 1.1.5) it could be argued that in both the Morgan *et al* and the current study, the language which incorporated a cue to constituent structure increased the salience of the underlying grammatical system. If this were the case, and following from Reber (1980), it might be predicted that acquisition of that system would be facilitated by more explicitly oriented rather than implicitly oriented instructions.

If participants in the Morgan *et al* study had received more explicit instructions and had adopted a more explicit approach to the task, one *would* predict a better performance by those in the cued conditions because under these conditions the underlying system is hypothetically more salient. A poorer perfomance might be predicted for those in the base language condition, because in the absence of the cues to constituent structure the underlying system might be considered less salient and efforts to find the rules more difficult.

In the current study, participants were given a mixture of explicit and implicit instruction. It could be argued that participants in the cued conditions had not profited from the increased salience of their input because the instructions they had received were less explicit. This might account for the relatively poor performances by the participants in the cued conditions in the current study. It could also be argued that those in the base language condition might not have been affected because their input was less salient and therefore less likely to be affected by less explicit instruction. This argument does not account for the poor performance by those in the cued groups on tests of constituent structure but it is possible that these tests were not necessarily good measures of such knowledge.

In order to determine if more explicit instructions were the key to the differences between the findings of the two studies, a second study was designed in which participants from all three input conditions were given a set of entirely explicit instructions avoiding all reference to "feel" based judgements. Their performances were compared with a second group, again separated according to input condition, who were exposed to the same set of instructions as were provided in the current study.

In Chapter One of this thesis, a set of hypothetical scenarios were presented (see Chapter One, section 1.1.5, table 1.1). It was stated that in order to see how type of input affects acquisition, the type of input must be tightly controlled. However, despite the fact that the input in the Morgan *et al* study and Study One were controlled, the outcomes were different. It is possible that the source of the different findings was due not to differences in the input received but was due to what learners did with the information they had received. This was referred to in the scenarios described in the second row of Table 1.1 in Chapter One. It was stated that learners might or might not use the cues or learn the rules in their input. The learners in the two studies might have done different things with the cues because firstly, the type of instruction they had been given encouraged them to do so and secondly, because they had followed those instructions. The outcome might have been that the Morgan *et al* learners noticed the cues and those in Study One did not. Schmidt (1990) argued that conscious awareness at the level of "noticing" is required for learning to take place. If learners in Study One had not noticed the cues in the input it is possible that they did not use them and consequently did not learn.

In summary, when attempting to determine the effect of differing types of input on syntax acquisition, one needs to control not only the type of input received but also the type of instruction provided to learners stating what to do with that input. If learners were encouraged to look for the cues in the input through carefully worded instruction, it might increase the likelihood of their looking for the cues and possibly finding them. Study Two attempts to investigate the effect of manipulating the type of instruction given to learners who are provided with the same type of input.

The use of the miniature language as a tool for testing out hypotheses on adult second language acquisition.

If subtle differences in instructions used in this MAL learning task can potentially affect learning to such a degree, it casts some doubt on the utility of using this methodology as a model of first language acquisition. Such effects of changes in instruction might be more relevant to the circumstances under which adult second language acquisition takes place, where adult learners are commonly exposed to different types of input and different types of instruction.

One crucial aim of this replication was to ascertain the usefulness of adopting this miniature language to model second language learning processes. I would conclude that the language would appear to be ideal for such purposes. It is sufficiently complex that none of the adult participants taking part in the replication achieved ceiling levels on the complex, conditional rules, it can be learned to an adequate level within a relatively short training session lasting approximately two hours and clear comparisons can be made between performances on simple and complex rules.

The current research aims to investigate the effects of manipulating differing types of input on syntax acquisition. In particular, it aims to examine the importance of instruction, defined as "having the rules explained" on the acquisition of syntax. The MAL system will allow not only for the controlled manipulation of type of input to which learners are exposed but also of the instruction which accompanies that input. As has been seen in the first study, the type of instruction which is given to learners to accompany differing types of input might in itself impact on acquisition. All these manipulations are not easily controlled for in natural learning environments and would be unlikely to reflect properties important in the study of child first language acquisition. It was decided therefore to use the MAL system in the remaining studies in this thesis. The next study examines the potential influence of the manipulation of instructional set on the cueing of phrase structure in syntax acquisition. The study again compares scenario "d" and "b" type input but with a further manipulation of the instructions which accompany that input.

Chapter Three.
Study Two.

3.1 Introduction.

In Study One it was found that cross-sentential cues to phrasal structure did not facilitate the acquisition of syntax - not only were the cues ineffective but the performance of learners in the non-cued condition was significantly better than that of learners in the cued-condition. These results stand in direct contrast to those provided by Morgan *et al* (1989) who reported finding a strong facilitative effect of the cues. It was argued in Study One that non-cued learners might be *expected* to outperform those given cues, firstly, because the input presented to non-cued learners was less complex than that presented to cued learners and secondly, because non-cued learners had fewer tasks to perform. Furthermore, it was noted that in both Study One and the Morgan *et al* study, the results on the tests of constituent structure indicated that learners in the cued conditions had not learned the phrasal groupings - one would therefore not expect a superior performance by cued learners if performance depended on knowledge of this structure. However, as stated in Chapter Two, it was possible that the tests of constituent structure were not necessarily good measures of constituent knowledge. In summary, it is not clear whether knowledge of phrasal structure was superior in the cued learners in the Morgan *et al* study. Two questions remain: why did learners in the Morgan *et al* study benefit from the cued input when those in Study One did not, and how did they benefit?

Firstly, it is possible that learners in Study One might simply not have noticed the cues in the input whereas those in the Morgan *et al* study did. Evidence supporting the possibility that some learners in Study One did not notice the cues is presented below but there is no equivalent information available from the Morgan *et al* study to check that learners in their study had noticed the cues. Secondly, it was noted in the discussion section of Study One that learners in the two studies might have received slightly different sets of instructions. Previous studies have indicated that differences in instructional set can interact with the type of input presented to learners and can affect performance in the learning of complex systems. In view of these findings, examination was made of the instructions given in the two studies. In Study One, participants were given instructions which encouraged them to search for rules in the input stage but at the testing stage encouraged them to base their grammaticality judgements on "feel". In the Morgan *et al* study, whilst no detailed description of the exact instructions given to learners was provided, it was evident that learners had also been encouraged to rule search at the input stage but there was no indication that they had been encouraged to base their grammaticality judgements on "feel". It was argued in Chapter Two that learners in the two studies might have adopted different approaches to the learning task and to the judgement task based on the instruction they had received. Such differences in approaches might have led to differences in performances across the two studies.

Whilst, as argued in Chapter One, it is not possible to determine the approach to learning adopted based upon the type of input provided, there was some evidence in Study One that learners, particularly those in the cued conditions, had adopted a more implicit, intuitive approach at the judgement stage: feedback obtained from the post-experimental questionnaire indicated that almost twice as many participants in the cued conditions reported that they had based their grammaticality judgements on "feel" or "guesswork" than those in the base language condition. (Note: It is acknowledged that, even given this feedback, one cannot state conclusively that learners actually adopted an implicit approach to the task. The main point is that learners might have adopted different approaches given the hypothesised difference in instructional sets.)

In addition to this, a small number of learners in all three conditions in Study One reported on handing back their questionnaire, that they had not examined the second sentence. Some mentioned that they had stopped looking at the second sentence (which for some contained the cue) because they did not know why it was there. These participants might have adopted a policy of ignoring the second sentence as a strategy to simplify the learning process. Such a strategy would result in a failure to notice the cues and profit from them. Sharwood Smith (1994) noted "learners are very good at ignoring what appears to the outside observer to be very obvious." (Sharwood Smith, 1994, p181.) (In the preparation for Study One, it was fully expected that learners would notice what seemed to me to be the obvious cues contained in the second sentence, in particular the proform cues.)

If learners in Study One had adopted a more implicit approach to the judgement task, and those in the Morgan *et al* study had adopted a more explicit, rule search approach overall, how might these differences in approach explain the different patterns of performance found across the two studies? Previous studies (Reber, 1976; Brooks, 1978; Abrams, 1987; Rathus, Reber and Kushner, 1990) using artificial grammars similar in structure to that underlying the MAL used in Study One, have reported differential effects of manipulating instruction type on acquisition. The studies were designed primarily to investigate the concept of implicit learning, a process by which learners are hypothesised to acquire knowledge (in this case, the underlying structure of a complex system) independently of conscious attempts to learn the system and without the ability to verbalise knowledge of the system. Whilst implicit learning was not the focus of either Study One or the Morgan *et al* study, parallels can be drawn between these and the implicit learning studies as will be explained below. First, a brief account will be given of the basic experimental paradigm used in the implicit learning studies.

The standard procedure is to expose learners to sets of letters generated by a finite state system (similar to that used to generate the strings of nonsense syllables in Study One) and request that learners memorise those sets; under this procedure the learners are not told that the strings of letters have an underlying system. Learners have been consistently found to be able to discriminate novel grammatical strings from novel ungrammatical strings at above chance levels (Reber 1967) but without the ability to verbalise how they were able to discriminate. It has been hypothesised that this ability to distinguish strings is accomplished without conscious awareness of the underlying rules of the system, the conclusion being that learners implicitly learn the underlying grammar. One question that has arisen is the extent to which one can be sure that the undergraduate learners commonly used in such studies are not looking for a system and have not actively attempted to "crack the code".

To examine the effects of such conscious efforts to search for rules, Reber (1976) manipulated the instructions given to learners: in one condition learners were told explicitly that an underlying system existed prior to the memorisation task; learners in the other condition were not given any such information prior to the memorisation task. Reber reported that those who had been given the explicit instruction performed more poorly than those who had not been given this information. These findings, although replicated by Brooks (1978), were not replicated by Millward (1981), Abrams (1987) or Rathus, Reber and Kushner (1990) who found no differences according to type of instruction.

Reber, Kassin, Lewis and Cantor (1980) suggested that one reason explicit instruction to search for rules did not *improve* performance was that it might not be possible to find rules if, according to Reber *et al,* they are too difficult to find. They hypothesised that if the underlying grammatical structure of the letter strings were made more obvious, instructions encouraging rule search might be more beneficial. Reber *et al* presented learners with groups of letter sets arranged on a board. The sets were presented either in a sequence which made the underlying structure more salient or in a random sequence which made the underlying system less salient. They reported a positive effect of instruction to search for rules under the more salient conditions. Reber concluded that: "Looking for rules will work if you can find them" (Reber, 1994, p 49).

It has been suggested above that learners in the Morgan *et al* study might have been given more explicit, rule search instruction than those in Study One. Studies on implicit learning have found that explicit instruction interacts positively with a more salient display (Reber *et al*, 1980). In 1994, Reber cited two studies which had used MAL systems whose underlying grammatical structure, he claimed, had been made more salient because they contained a semantic component. One of these (Morgan and Newport, 1983) had used a MAL almost identical to that used in Study One and the Morgan *et al* study (1989). In this MAL the semantic component comprised a reference field.

If the reference field of the MAL used in Study One and Morgan *et al* did make the underlying system more salient, it could be argued that learners would benefit from a more explicit, rule search approach (as might have possibly been adopted by the Morgan *et al* learners). In Study One it was further proposed that the cues to phrasal structure present in the input could have added *extra* salience to the stimulus display. If Morgan *et al*'s participants had adopted an overall more explicit, rule search approach than those in Study

One, one would expect this explicit approach to be more effective for those in the cued conditions than for those in the non-cued condition. In Study One, the poor performance of learners in the cued condition might be attributed to their having adopted a less explicit approach to the learning and judgement tasks. This might have resulted in their failing even to notice the cues and consequently failing to profit from the more salient display provided by them.

In order to determine whether the differences between the findings of Study One and the Morgan *et al* study could be explained by differences in the instructions given to learners, a second replication (Study Two) was conducted. One group of learners was provided with a set of instructions which encouraged them to search for rules in the input, use the second sentence to help them work out the rules and use the rules they had worked out to make their decisions regarding grammaticality. No mention was made of the term "feel" and no encouragement was given to learners to base judgements on "feel". Learners in this condition were described as "explicitly oriented" learners. A second group of learners was provided with identical instructions to those given to participants in Study One. Learners in this condition were described as "originally instructed" learners. Learners in both conditions were provided with either cued or non-cued input exactly as described in Study One.

It was hypothesised firstly that learners in the cued condition who were explicitly oriented would perform better than explicitly oriented non-cued learners because the increased salience provided by the cued input would make rule search (if rule search is adopted) more successful. Learners in the cued condition would therefore outperform those in the non-cued conditions as reported by Morgan *et al* (1989).

Secondly it was hypothesised that the explicitly oriented learners would perform better overall than those given the original instructions because the presence of the reference field, making the underlying structure more salient, would interact positively with a more explicit rule search approach (Reber *et al*, 1980). If no differences in pattern of performance were found between the performance of learners in the "explicitly oriented" condition and those in the "original instruction" condition then the differences found between Study One and Morgan *et al's* (1989) study could not be explained in terms of differences in level of explicitness of the instructional set.

It is emphasised here that the instructions given to learners can only *encourage* learners to adopt a particular approach to learning. One cannot know exactly which approach those learners will subsequently adopt. Any differences found between learners in the different instructional conditions can only be attributed to the input itself - any speculation as to how that input affected the process of or approach to acquisition is purely conjecture.

3. 2 Method

3. 2. 1 Participants

Forty-eight first year Psychology undergraduates studying at the University of Plymouth participated as part of a course requirement. None of the participants had taken part in Study One.

3. 2. 2 The Miniature Language.

The miniature language was constructed exactly as described in Study One, Chapter Two.

3. 2. 3. Design and Procedure

The procedure followed in this study was identical to that of Study One. A between subjects design was adopted in which participants were assigned to one of three input conditions: base language, proform or permutation conditions. However, half the participants in each input condition were given identical instructions to those described in Study One whereas the other half were given 'explicitly oriented' instructions. As a consequence six conditions were created to which the forty eight participants were randomly allocated, equal numbers being allocated to each. The conditions were as follows:

Condition	Input condition	Instructional set
1	Base language	Original
2	Proform	Original
3	Permutation	Original
4	Base language	Explicitly oriented
5	Proform	Explicitly oriented
6	Permutation	Explicitly oriented

The "explicitly oriented" instructions were based closely on the original instructions in Study One and in parts were identical to them. However, changes were made which were designed to:

i) focus participants' attention on the existence of underlying grammatical rules
ii) encourage participants to work out the rules by examining the word order
iii) focus attention on the second sentence which contained possible cues to phrase structure
iv) encourage participants to use the rules they had acquired to judge the grammaticality of sentences and constituent structure
The use of the term "feel" was avoided.

Changes were made to the introductory instructions and to instructions prior to each trial and test, these are detailed below. Refer also to the original instructions (see Chapter 2) and the overview of procedure (Table 2.3, Chapter 2.))

1) Changes in instructions in the introduction to the study

The first section of the introductory instructions was the same for participants in both instruction conditions. Participants were informed that

"the experiment involves observing a number of sets of sentences in a new miniature language .... try to discover patterns in the order of the words in the sentences."

The instructions then differed. Those in the explicitly oriented condition were told that a set of underlying grammatical rules existed and that later tests would require participants to utilise their knowledge of the rules to make grammaticality judgements on novel sentences. Participants in the original instruction condition were not explicitly told that the rules existed. They were told that in later tests they would be asked to make judgements about the grammaticality of sentences based upon what they *felt* to be correct.

The exact instructions are presented below, words in italics highlight those sections which have changed. Figure 3.1 shows the instructions presented to participants in the explicitly oriented group, Figure 3.2 shows those presented to participants in the original instruction group.

> *A complex set of rules determines the ordering of the words in each sentence. The rules will only allow certain sequences.*
>
> After you have observed each set of words or sentences you will be given a set of short exercises in which you will be asked to make judgements regarding which sentence *is 'correct' according to the rules of the language.*
>
> *It will be to your advantage, therefore, to try to work out what the rules are by paying close attention to the sentences.*

Figure. 3.1. Instructions given to participants in the explicitly oriented instruction condition during introduction to Study Two.

The instructions above were an altered version of the original set shown below (Figure 3.2).

> After you have observed each set of words or sentences you will be given a set of short exercises in which you will be asked to make judgements regarding which sentences *or group of sentences feel 'correct'.*
>
> *Don't worry if you are uncertain of the correct answer, simply make your best judgement based upon how you feel.*

Figure. 3.2 Instructions given to participants in original instruction condition during introduction to Study 2.

All other instructions in the introduction were the same.

2) Changes in instructions prior to the first trial

After the introduction, participants were presented with information on the first trial or set of presentation slides (see Study One procedure). The instructions were identical up to the point where the participants' observation tasks were explained. Participants in both conditions were told to:

"observe the sentences and try to discover which words are paired with which geometric shape."

Participants in the explicit instruction condition were then given advice on a possible strategy for working out the word order rules:

"try to work out the rules that govern the word order. The order of the shapes will help you. Try to work out which words tend to come at the beginning, middle and end of the sentence, which words tend to precede or follow each other and which words 'go together' to form groups."

Participants in the original instruction condition were not given any such advice, they were told only to:

"try to find any systematic patterns in the order and arrangements of the words in each sentence."

3) Changes in instructions prior to trials 2, 3 and 4

In trials 2-4, participants were presented with slides showing i) the base language sentences ii) a second sentence (which varied according to input condition) and iii) the geometrical shapes to which the sentences corresponded (see Study One procedure). Participants in both instructional conditions were asked to:

"try to discover the word and shape pairings."

Participants in the instructional condition were then given explicit advice on how to work out the word order rules and their attention was drawn towards using the second sentence as a cue to working out the word groupings. They were asked to:

"try to work out the rules concerning the order of the words, for example, which words tend to come at the beginning, middle and end of the sentences, which words tend to precede or follow each other and which words 'go together' to form groups. You can use the second sentence to help you work out the word groupings."

Participants in the original instruction condition were asked only to:

"try to find any systematic patterns in the order and arrangements of the words."

4) Changes in instructions prior to the Vocabulary Tests:

No changes were made. Participants in both instructional conditions received identical instruction (see Study One).

5) Changes in instructions prior to the Grammaticality Judgement Tests:

Participants from both instruction conditions were presented with an example of two test sentences (see Study One for example) and were told they would be asked to make judgements regarding their grammaticality. Participants in the explicit instruction condition were explicitly informed of the existence of rules of the language and were instructed to base their grammaticality judgements on the rules they had worked out. They were told:

"one of the sentences follows the same rules as the correct sentences presented earlier. The other breaks the rules. Choose which you think is correct according to the rules you have worked out."

Participants in the original instruction condition were not supplied with any reference to "rules" but were asked to:

"decide which of the sentences you *feel* is correct according to the patterns you have seen before."

6) Changes in instructions prior to the Fragment Constituent Test.

Participants in both instructional conditions were presented with fragments taken from possible sentences in the language as described in Study One. Those in the explicit instruction condition were asked to:

" judge which set of words you think forms a better group or unit according to the rules which determine which words 'go together'."

Participants in the original instruction condition were asked to make the same judgement based upon:

"the patterns of the language you have seen."

The instructions given to participants in the explicit condition were therefore designed to focus attention specifically on the existence of a set of rules governing phrasal groupings whereas those given to participants in the original instruction condition were directed towards 'patterns' in the language.

7) Changes in instructions prior to the Transformational Constituent Test.

Participants from both instruction conditions were presented with two sentences, both of which were transformed versions of a grammatical sentence. They were informed that:

> "in both sentences, some words have been placed in a different position from the position you saw them in earlier."

Participants were then shown an example (see Study One). Participants in the explicit condition were asked to judge which transformation preserved phrase structure groupings using the following instruction:

> "in one of the sentences words have been moved in a manner which is consistent with the rules for grouping words together. In the other sentence, the word groupings are not consistent with the rules because the movement has cut across the permissible groupings."

Participants in the original instruction condition were asked only to:

"judge which arrangement is preferable."

3.3 Results

3.3.1 Vocabulary Tests

The number of participants in each condition achieving a perfect score, making one error or more than one error on the final vocabulary test is shown in Table 3.1 below.

Table 3.1. Number of participants from each input condition (i) achieving a perfect score (ii) making one error or (iii) making more than one error on the final vocabulary test.

	Original instructions			Explicitly oriented instructions		
	Base	Proform	Permuted	Base	Proform	Permuted
Perfect score	5	4	5	6	6	4
1 error	1	1	0	1	0	3
More than 1 error	2	3	3	1	2	1

Note: There were eight participants in each condition. A perfect score was 15. Participants from both instructional conditions received identical instructions for the vocabulary tests.

Allowing for a single error, 13 participants in the base language condition (regardless of instruction type) passed at this standard, 11 in the proform condition and 12 in the permutation condition. (No effects of input condition or instruction type were found on the final vocabulary test. It should be noted that instruction preceding the vocabulary test was the same for all conditions.)

A perfect score was the original criterion set by Morgan *et al* (1989) for inclusion in further analyses. In Study One, this criterion was lowered to include participants scoring 14 out of 15 and the same criterion was adopted here. Analyses of the remaining tests' data were carried out firstly using all participants, and secondly using data only from participants making no more than one error on the final Vocabulary Test.

3.3.2 Grammaticality Judgement Tests

In Study One, participants in the base language condition outperformed those in the two experimental conditions (the proform and permutation conditions) on the unconditional rules of the language. No difference between conditions was found on the conditional rules. This finding was a reversal of that reported by Morgan *et al* (1989) whose participants in the experimental conditions outperformed those in the base language group on both unconditional and conditional rules.

In the current study, a further replication of the Morgan *et al* study, a comparison was made between performance under the Study One instructions and performance using a more explicit set of instructions. A series of analyses on the current study data were performed. Below is an overview outlining the order of the different analyses (see Table 3. 2). In Study One an analysis was performed on data from all four trials. It was noted that Morgan *et al* had reasoned that on trial 1 participants were not expected to perform differently because they had received identical input on this trial. Morgan et al therefore focused their attention on analyses of trial 2-4 and trial 4 on its own. As no differences were found on trial 1 in Study 2, no analyses further analyses were performed including data from this trial.

Table 3.2. Analyses carried out on Grammaticality Judgement Test data.

Analysis No.	Trials	Rules analysed	Participants
1	2-4, 4 alone	all rules	all
2	2-4, 4 alone	all rules	only those reaching final vocab test criterion
3	2-4, 4 alone	rules 1-4 (unconditional) and rules 6-8 (conditional)	all
4	2-4, 4 alone	rules 1-4 (unconditional) and rules 6-8 (conditional)	only those reaching final vocab test criterion

Note: "trials" = performance on specified trials only; "rules analysed" = performance measured across all eight rules ("all") or performance on rules 1-4 (unconditional rules) separated from rules 6-8 (conditional rules); "participants" where "all" = all participants' data were included and "only those reaching vocab test criterion" = only those participants' data were included in the Grammaticality Judgement Tests' analyses.

1) Trials 2-4 and 4 alone, all rules, all participants.

All participants' data assessing performance on all eight rules of the language on trials 2-4 combined were analysed using a two-factor analysis of variance (factors: instructional set, input condition). No effect of instruction was found.

The effect of input condition approached significance (F (2,42) = 3.06; p = .057). Participants in the base language condition achieved the highest mean score (mean: 65.87, st dev: 10.8) compared to the proform group and permutation conditions (means: 60.37, 57.12; st devs: 10.68, 8.92 respectively).

On trial 4 the findings were similar with the exception that the effect of input condition did not approach significance. The base language condition achieved the highest score (mean: 22.06, st dev: 5.02) compared to the proform and permutation condition scores (means: 20.37, 19.25; st devs: 4.64, 4.4, respectively).

2) Trials 2-4 and 4 alone, all rules (excluding participants not reaching criterion on final vocabulary test).

A two-factor analysis of variance was conducted (factors: instructional set and input condition). No effect of instructional set was found although learners in the explicitly oriented condition produced higher mean scores on all three input conditions that those in the originally instructed condition (see Table 3.3 below).

Table 3. 3. Mean and Standard Deviation scores according to input condition and instructional set across trials 2-4.

	Original instructions			Explicitly oriented instructions		
	Base	Proform	Permuted	Base	Proform	Permuted
Mean	61.62	58.37	56.25	70.12	62.37	58
St. Dev	10.99	12.33	8.74	9.38	9.11	9.60

Note: eight participants in each condition.

A main effect of input condition was found (F (2, 30) = 3.94; p < .05.). Participants in the base language condition performed significantly better (mean: 68.38, st dev: 9.77) than those in the permutation condition (mean: 57, st dev: 9.63; Scheffé's: p < .05) and better but not significantly better than participants in the proform condition (mean: 64.36, st dev: 9.58).

On trial 4 findings were similar with the exception that there was no effect of input condition and the trend in the effect of instruction was no longer evident.

7) Trials 2-4 and 4 alone, unconditional versus conditional rules, all participants.

A three-factor analysis of variance (factors: instructional set, input condition and rule type) was conducted. No effect of instructional set was found although on both unconditional and conditional rules the explicit instruction mean was higher than the original instruction condition mean.

The effect of input condition approached significance ($F(2,42) = 3.11$; $p = .054$. Participants in the base language condition achieved the highest mean score (mean: 67.38, st dev: 12.78) compared to the proform group and permutation conditions (means: 62.41, 59.22; st devs: 11.66, 10.97 respectively).

A main effect of rule type was found ($F(1, 42) = 33.44$; $p < 0.0001$) whereby performance on the unconditional rules (mean: 67.77, st dev: 12.26) was found to be overall higher than performance on the conditional rules (mean: 58.22 st dev: 10.13). Further analysis revealed that only participants from the base language condition performed significantly better on the unconditional compared to conditional rules (Scheffé's $p < .05$).

On trial 4 the findings were similar with the exception that the effect of input condition did not approach significance although the base language mean score was still the highest. A main effect of rule type was found ($F(1,42) = 21.89$; $p < .0001$) but follow up analyses revealed that none of the input conditions in isolation performed better on the unconditional compared to conditional rules on this trial. No effect of instruction was found but participants in the explicit instruction condition produced a higher mean score on the unconditional rules only compared to those in the original instruction condition.

4) Trials 2-4 and 4 alone, unconditional versus conditional (excluding participants not reaching criterion on final vocabulary test).

A three-factor analysis of variance was conducted (factors: instructional set, input condition and rule type). No effect of instructional set was found.

A main effect of input condition was found ($F(2, 30) = 3.45$; $p < .05$.). Participants in the base language condition performed significantly better (mean: 69.52 st dev: 12.7) than those in the permutation condition (mean: 58.9, st dev: 11.52; Scheffé's: $p < .05$) and better but not significantly better than participants in the proform condition (mean: 65.02, st dev: 12.35).

An effect of rule type was found ($F(1,30) = 54.57$; $p < .00001$) whereby performance on the unconditional rules (mean: 70.54, st dev: 12.15) was found to be overall higher than performance on the conditional rules (mean: 58.71 st dev: 10.75). Further analysis revealed that participants from all three input conditions performed better on the unconditional compared to conditional rules, (Scheffé's: Base: $p < .01$; Proform and Permutation: $p < .05$.

A three way interaction between instruction, input and rule type was found ($F(2, 30) = 3.84$; $p < .05$), see Figure 3.3 below. Follow up analyses revealed that none of the input conditions performed significantly differently according to type of instruction given on either of the two rule types.

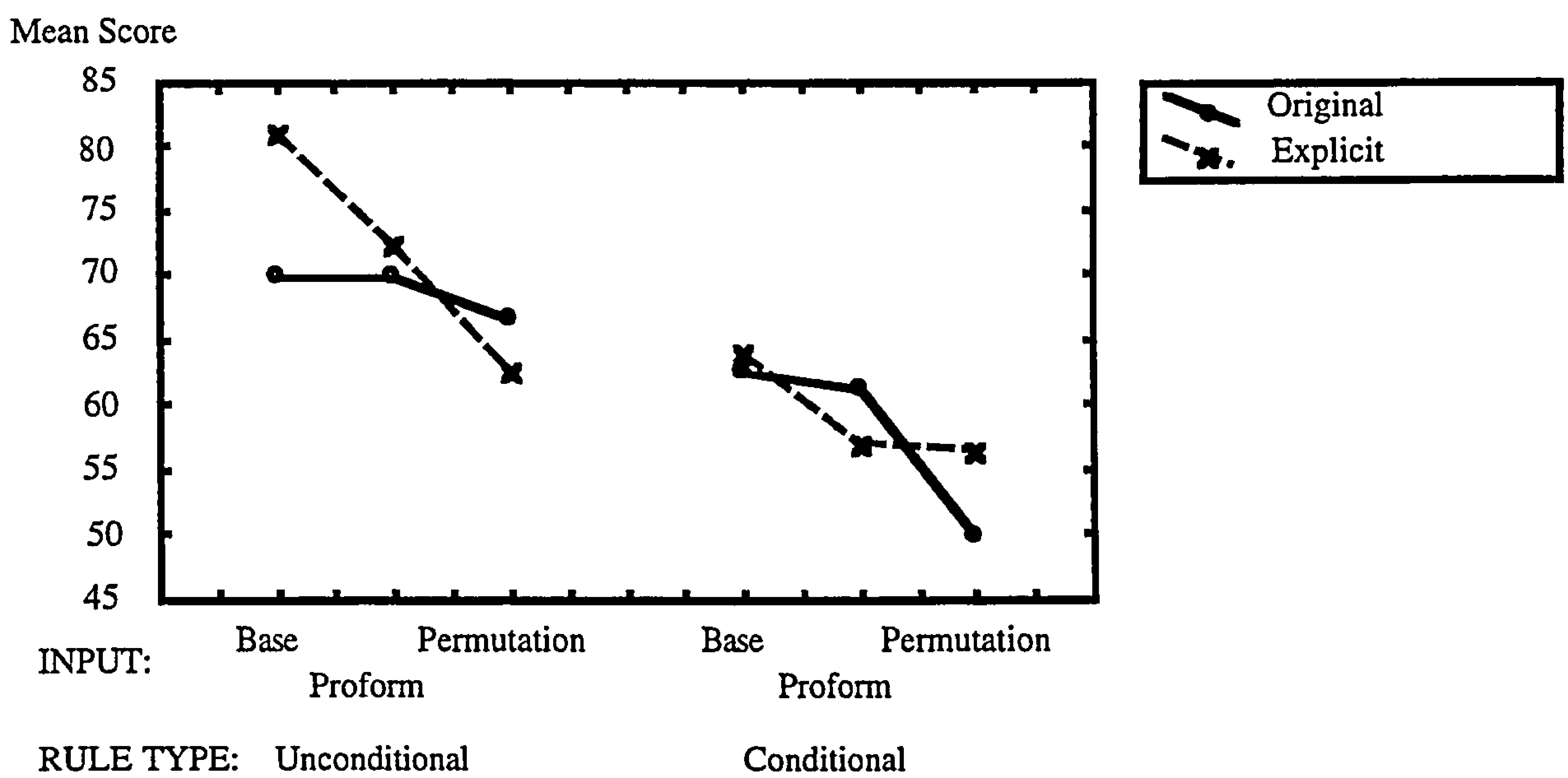


Figure. 3.3 Mean score for each input condition according to rule type and instructional set.

On trial 4 findings were similar with the exception that no effect of input condition was found and only the base language and proform conditions performed better on the unconditional compared to conditional rules (Scheffé's: $p <.05$; $p < .05$; respectively).

A three way interaction between instruction, input and rule type was found ($F(2, 30) = 3.82$; $p < .05$). Follow up analyses revealed that none of the input conditions performed significantly differently according to instruction on each of the two rule types.

However, on examination of the mean unconditional rule scores, the base language and proform conditions performance tended to be slightly higher under the explicitly oriented instruction set compared to scores obtained by participants in the same input conditions under the original instruction condition. The opposite effect was found when examining the performance on the conditional rules when base language and proform scores tended to be lower given the more explicitly oriented instruction. This is exemplified in Figure 3.4 below.

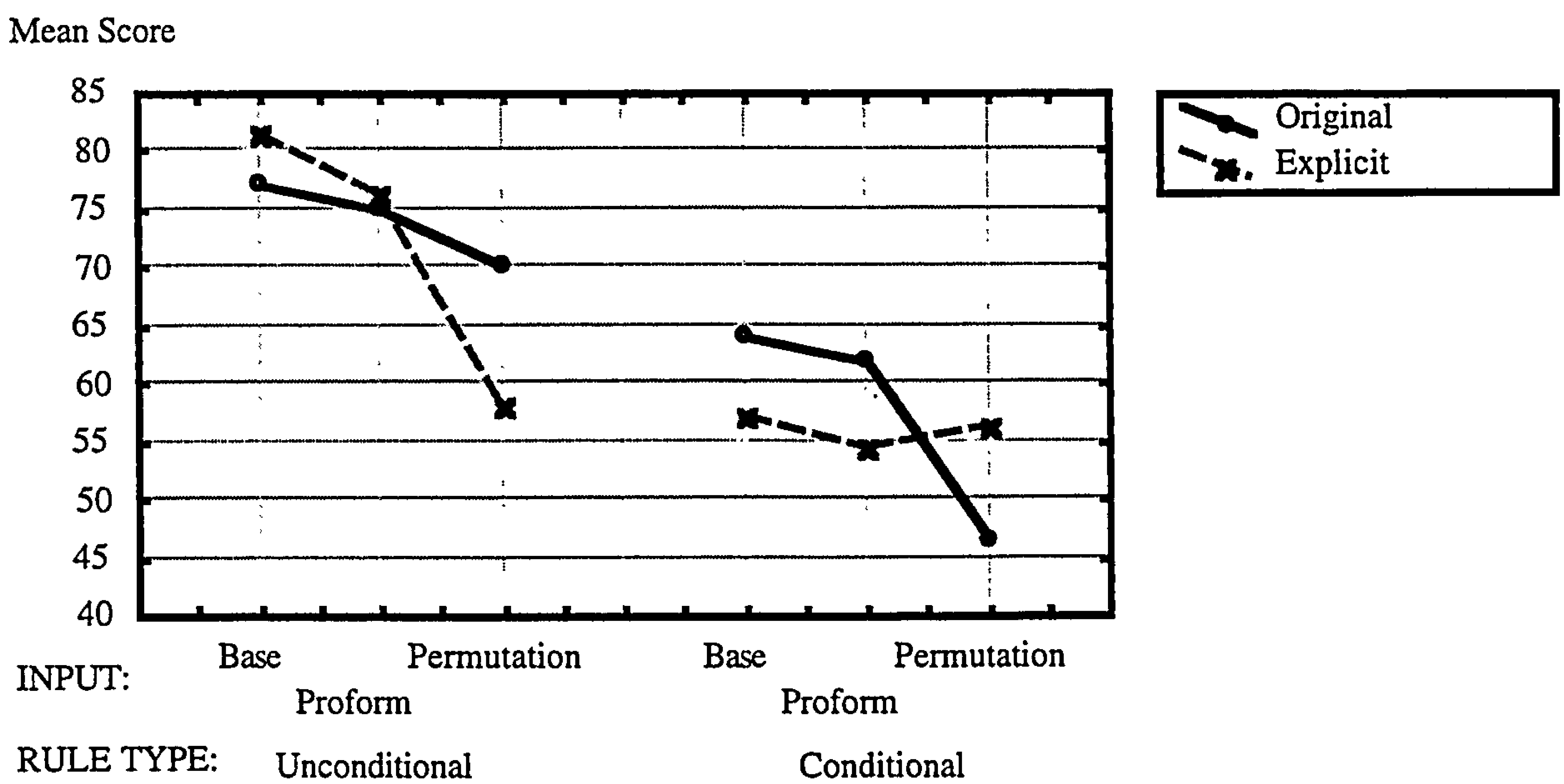


Figure. 3.4 Mean score for each input condition according to rule type and instructional set.

The permutation condition mean scores showed a reversal in the pattern of results obtained for the base language and proform conditions.

Summary of Grammaticality Judgement Test findings.

1) Effect of Instructional Set.

No effect of instructional set was found. However, a consistent trend in the data could be observed on virtually all the analyses carried out. Participants in the explicitly oriented instruction group produced higher, though not significantly higher means on trials trials 2-4 and 4 alone when all participant data were used. The same trend was seen when excluding non-criterion participants with the exception of the final trial where the mean scores of the explicitly oriented and original instruction conditions were virtually identical.

Analyses comparing performance on unconditional and conditional rules revealed a similar trend on the unconditional rules only where explicitly oriented condition mean scores were consistently higher. However, scores on the conditional rules tended to be very similar across instruction conditions.

On trials 2-4 and trial 4, using data from participants scoring to criterion on the vocabulary test only, a three-way interaction between instructional set, input condition and rule type was found in which participants' performance appeared to be influenced by a combination of all these three factors. As none of the participants in any of the input conditions performed significantly differently according to instruction on the two rule types, the picture of exactly how the three factors interact is unclear. By the final trial, participants in the base language and proform conditions appeared to profit slightly more from explicitly oriented instruction on the unconditional rules and yet benefited more from the original instruction on the conditional rules. The trend in performance of those in the permutation condition was in the opposite direction.

2) Effect of Input Condition

On trials 2-4, using criterion participants only, those in the base language performed significantly better than those in the permutation condition and produced overall higher scores (though not significantly higher) than participants in the proform condition. When all participant data were included no significant differences were found but again the base language condition scores were highest. On trial 4, no significant differences between input conditions were found.

3) Effect of Rule Type

A main effect of rule type was found. Participants from all three input conditions performed better on the unconditional rules of the language compared to the conditional rules with the exception of trials 2-4 using all participants' data when only the base language condition performed better on the unconditional rules. On trial 4, in the analysis of data from all participants, none of the three input conditions performed better on the unconditional rules and using criterion participants only, the base language and proform condition performed better on the unconditional rules. No interaction was found between rule type (unconditional versus conditional rules) and input condition.

Participants in the base language condition performed overall better than participants in the experimental conditions irrespective of rule type (unconditional compared to conditional). All participants tended to find more difficulty with the more complex conditional rules.

4) Effect of Trial

No effect of trial was found.

5) Comparison of results across studies: Current Study, Study One and Morgan *et al* (1989).

A comparison between mean scores in this study and those in Study One and the Morgan *et al* study is presented below, (see Figure 3.5).

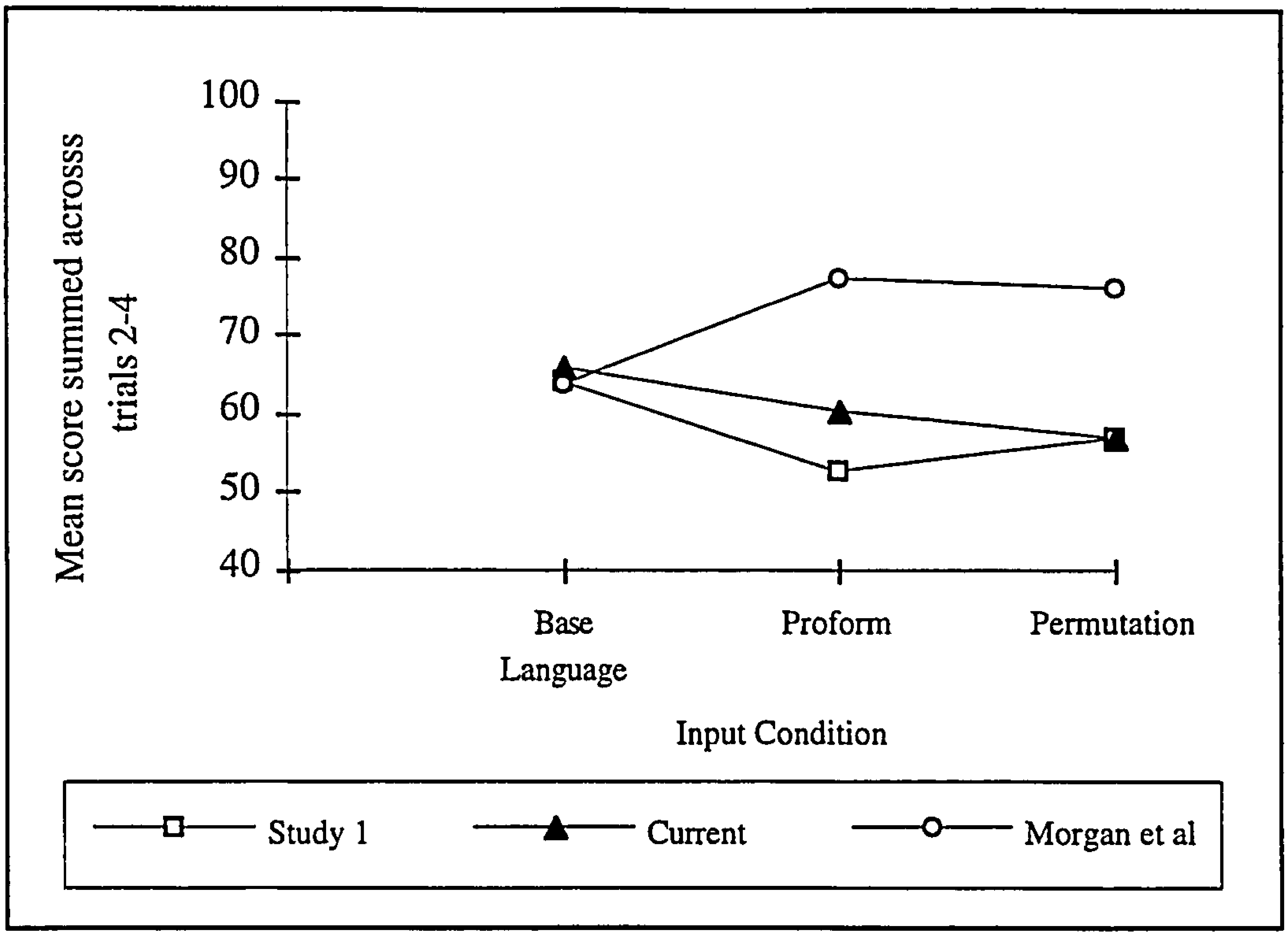


Figure. 3.5 Mean score summed across trials 2-4: a comparison across studies.

The base language condition mean scores were virtually identical across all three studies; mean scores in the experimental conditions were similar in Study One and the current study but differed from those reported in the Morgan *et al* study.

3.3.3 Fragment Constituent Tests.

A three-factor analysis of variance was conducted on the data taken from the two fragment constituent tests (factors: instructional set, input condition, trial). No effect of instructional set was found.

A main effect of input condition was found ($F(2,42) = 3.41$; $p < .05$) but follow up analyses revealed no significant differences between the individual input conditions. The proform condition achieved the highest mean score (mean: 15.37, st dev: 3.25) compared to the base language condition (mean: 13.28, st dev: 3.06) and the permutation condition (mean: 12.93, st dev: 3.67).

Similar results were found when using data from participants scoring to criterion in the final vocabulary test, with the exception that the proform condition performed significantly better (mean: 16.45. st dev: 3.15) than the permutation condition only (mean: 13.29, st dev 3.59; Scheffé's: $p < .05$).

A main effect of trial was found ($F(1, 30) = 7.24$; $p < .05$; in which participants scored higher overall in trial 2 (mean: 15.08, st dev: 3.79:) than in trial 1 (mean: 13.63, st dev: 3.09).

Only participants in the proform condition scored above chance on the first test and those in both proform and base language condition scored above chance on the second test.

3.3.4 Transformational Constituent Test.

A two-factor analysis of variance was conducted on the results obtained from the single transformational constituent test (factors: instructional set and input condition). No effect of input condition was found.

A main effect of instruction was found ($F(1,42) = 4.49$; $p < .05$) in which participants in the explicit instruction condition performed overall better than those in the original instruction condition (explicit instruction mean: 13.75, st dev: 2.99; original instruction mean: 11.83, st dev: 3.37). Follow up analyses revealed that no individual input condition differed in performance depending on instructional set.

Similar results were found when using data from participants scoring to criterion in the final vocabulary test with the exception that the effect of input condition approached significance ($F(2, 30) = 2.85$; $p = .07$). The base language condition achieved the highest score (mean: 13.92, st dev: 2.69), the proform condition achieved a very similar score (mean: 13.45, st dev: 3.14), the permutation condition achieved the lowest score (mean: 11.41, st dev: 4.37). Only participants in the base language condition scored above chance on this test.

Summary of Fragment Constituent and Transformational Constituent Tests.

In both tests participants in the permutation condition experienced the most difficulty: never scoring above chance levels. Those in the proform condition performed best in the fragment constituent test but failed to score above chance in the transformational constituent test. Participants in the base language condition scored above chance in both tests.

Before discussing the findings a brief summary of the results on the Grammaticality Judgement Tasks is presented to enable easier referencing.

Summary of results on the Grammaticality Judgement Tasks.

1) Effect of Instructional Set.

No effect of instructional set was found but participants in the explicitly oriented instruction group produced higher but not significantly higher means on trials 2-4 and 4 when all participants' data were used and performed consistently higher on unconditional rules only. Using data from participants scoring to criterion, a three-way interaction between instructional set, input condition and rule type was found but the picture of exactly how the three factors interacted was unclear.

2) Effect of Input Condition

On trials 2-4, using criterion participants only, base language participants performed significantly better than those in the permutation condition and produced higher scores than those in the proform condition. When all participant data were included no significant differences were found but again the base language condition scores were highest. On trial 4, no significant differences between input conditions were found.

3) Effect of Rule Type

A main effect of rule type was found. All participants tended to find more difficulty with the more complex conditional rules than the simpler rules although this difference was not always significant.

3. 4 Discussion

In Study One it was found that learners receiving input containing cross-sentential cues to phrase structure performed more poorly on tests of syntax acquisition than those whose input contained no such cues. Study One was a replication of Morgan, Meier and Newport's (1989) study in which a facilitative effect of such cues had been found.

It was hypothesised that the differences in findings between the two studies could have been due to the type of instructions given to learners. It was argued that learners in the Morgan *et al* study might have received more explicit instructions than those received by learners in Study One. It was further hypothesised that input incorporating a cue to phrasal structure might make the underlying system of that input more salient. Previous research, (Reber *et al 1980*) had reported that explicit instructions were more effective where the underlying structure of a system was made more salient. It was therefore argued that learners in the cued input studies would be expected to perform better than those in the base language condition (as was the case in Morgan *et al*'s study) where more explicit instruction might have been provided.

In the current study, Morgan *et al*'s study was replicated for a second time, but with a manipulation of instructional set such that one condition received more explicitly oriented instructions than those given in Study One and a second condition received the same instructions as provided in Study One.

The chief finding was that learners in the cued conditions did not profit from the more explicitly oriented instructions as predicted. Learners in the non-cued base language condition performed better but not significantly better than those in the cued conditions under the explicitly oriented instructions. The same pattern of results was found for those in the original instruction condition - the results replicating those reported in Study One. There was no overall effect of instructional set. However, there was a consistent but non-significant trend in the data whereby participants in the explicitly oriented group produced generally higher scores on the grammaticality judgement tests (with the exception of the final trial using non-criterion participants).

When separating performance according to the unconditional and conditional rules, the mean scores of the explicitly oriented condition tended to be overall higher (though not significantly higher) on the unconditional rules but not on the conditional rules. A three way interaction between instructional set, input condition and rule type was found but follow up analyses revealed that none of the input conditions performed significantly differently according to type of instruction on either the unconditional or conditional rules. However, the highest mean score was achieved by those in the base language condition under the explicit instructional set on the unconditional rules. Learners in the base language condition who had received the explicit instructions achieved a mean score of 82% correct on the unconditional rules; this compared with a mean score of only 69% correct achieved by those who had received the original instructions. This increase, whilst not significant, is nonetheless interesting. No similar increase in performance was found for those in the cued input conditions.

An overall main effect of input condition was found whereby participants in the base language condition performed significantly better than those in the permutation condition and better but not significantly better than those in the proform condition on trials 2-4, using criterion participants only.

On the fragment constituent tests, no effect of instruction was found Participants in both the base language condition and the proform condition performed above chance on these tests but they did not perform significantly differently from those in the permutation condition. On the transformational constituent test, an effect of instruction was found which indicated that instruction improved overall performance but no individual input condition improved significantly in performance depending on instructional set. Only participants in the base language condition scored above chance on this test. In summary, participants in the permutation condition failed to learn the phrase structure as measured by the constituent structure and transformational constituent tests. Those in the proform condition fared better but their performance on these tests was no better than that of the participants in the base language condition who had actually received no cue to phrasal structure.

In conclusion, results from the current study indicate that input which incorporates a cross-sentential cue to phrase structure seems to make the task of acquiring the syntax more rather than less difficult. These results lend support to those found in Study One and fail to replicate those reported by Morgan *et al.* Learners in the non-cued base language condition outperformed those in the cued conditions. Learners in the cued conditions did not appear to profit from more explicit instructions focusing attention on the cues. Learners who received input without cues to phrase structure did improve slightly under more explicit instruction on the simpler, unconditional rules of the language.

It had been predicted that more explicit instructions would be advantageous to learners in the cued conditions, because of the increased salience of the underlying structure afforded by the cues to phrase structure. However, it might be the case that the cues did not increase the salience of the system. The cues might hypothetically add salience but only under conditions where learners have capacity to attend to and notice the cues: learners might have been unable to give sufficient attention to the cueing sentence because their attention was divided between three tasks. A number of researchers (Doughty, 1991; Hulstijn, 1988; Van Patten, 1990) have reported that learners have difficulty attending to both form and meaning simultaneously and have concluded that learners attend to one or the other in the input. This appears to be the case in the current study where learners might have failed to notice the cues because they were attending either to the form in the non-cueing sentences or the 'meaning' (the shapes). Schmidt (1990) emphasised the need to consciously notice the features in the input in order to acquire those features. It is possible that the cues were simply not noticed even with the extra focus made on them by the more explicit instruction. Any prospective advantage of the cues could have been lost due to attentional limitations.

The base language input might have profited from the more explicit instruction because their input had a simpler underlying grammatical system which might have been more salient and therefore easier to "crack" than that of the more complex system underlying the cued input. The unconditional rules of the language, in particular, rules 1 and 2, did not require knowledge of phrasal structure. These rules (see Chapter Two, section 2.2.2) require only knowledge that every sentence contains one and no more than one "A" class word. Learners in the base language condition performed slightly better on the unconditional rules under the more explicit instructional set probably because these simple rules were easy to spot and, according to Reber, if a learner is searching for something which is easy to find, it will be found. Learners in the cued conditions might have experienced difficulty finding even the most simple rules because their input complicated the picture. The extra burden of one more task and the extra complexity of the grammatical system might have resulted in their failing to find even the simpler rules.

One question which was posed in Chapter One (section 1.1.5) was that of the extent to which the salience of the syntactic rules in the input facilitates the acquisition of syntax. It was predicted that learners of type "d" input would outperform those exposed to type "b" input - one reason for this was that in the former, the rules in the input were hypothetically more salient. However, the extra demands of the tasks the learners were required to perform on the input might have eliminated the potential benefits of the hypothesised extra salience. One factor then to consider in determining the "best" type of input to provide for learners is to assess exactly what learners have to do with the input to learn from it. If there are too many tasks to attend to, i.e. there are too many concurrent tasks to be performed, then learning under explicit instruction is not facilitated even when the underlying structure is judged to be more salient.

3. 4. 1 Conclusion.

In view of the findings of both Studies One and Two, there seems to be little in the way of evidence to support the contention that cross-sentential cues to phrase structure can facilitate syntax acquisition. It was felt that it was time to leave cross-sentential cues behind and to focus on the primary question of the role of formal instruction in syntax acquisition.

In the current study, when the instructional set was manipulated, there appeared to be a trend in the data. Those in the base language condition seemed to have been differentially affected in their performance on the unconditional compared to conditional rules depending on instructional set. With the more explicitly oriented set of instructions which encouraged learners to look for the underlying system, only the simple and not the more complex rules could be found (possibly because the latter were too difficult to find). This leaves the question of how to improve performance on the more complex conditional rules. Morgan *et al* argued that knowledge of phrasal structure is necessary for the acquisition of complex rules. They suggested that *cues* to such structure would aid acquisition but this effect was not replicated in Study One or Study Two. If cueing phrasal structure does not work, would explicit teaching of the rules themselves be beneficial? Would explicit teaching of the rules facilitate the acquisition of the more complex aspects of syntax?

Sharwood Smith (1980) referred to "consciousness raising" as being important in acquisition and suggested that extra salience in the input might be sufficient for acquisition to take place. He downplayed the usefulness of the teaching of rules and argued that a more subtle approach of making features more salient would suffice. Schmidt (1990) in contrast, emphasised the importance of "conscious noticing" of the feature in the input: it could be argued that explicit teaching of rules and phrasal structure in which explicit focus is placed upon the rules would ensure such noticing took place. Teaching of rules directly certainly increases the salience of those rules but is this almost "too" salient? Would such teaching fail to facilitate acquisition because it does not reach the "subconscious inaccessible system some linguists call 'competence'" (Sharwood Smith, 1994, p.178) Or would such teaching enable the learner to consciously notice the rules and therefore facilitate acquisition? By making the complex conditional rules clear, can they then be learned? Or are learners best left to try to work out the rules for themselves?

In Studies One and Two, learners in the base language condition had been exposed to exemplars taken from the language and had achieved high levels of success on the simple, unconditional rules of the language but had struggled on the more complex, conditional rules. Assuming these learners had followed the instruction to search for rules, then these learners had in effect taught themselves the language. Such learners could be equated with learners of second languages who have received no formal instruction but who have attempted to work out language rules for themselves. Such "naturalistic" learners are commonly assumed in the literature to learn their second language "implicitly" without conscious effort. They are frequently compared to "instructed" learners who, it is assumed, do make conscious efforts to learn what they are taught. I would argue that learners in naturalistic second language learning situations might also make some conscious efforts to learn the rules. If this were the case, how would learners under the two conditions compare in their subsequent performance. What would happen if learners instructed to search for rules were compared with learners who had been systematically taught all the rules and the underlying phrasal structure? This second group would be analogous to learners studying formally in a classroom environment. Study Three investigated these questions.

Study Three attempted to address the central key questions: what impact does formal instruction (type "a" input) have on the acquisition of syntax by adult learners? Is formal instruction only effective for simple rules or can complex rules also be formally taught? Is there a difference in learning outcome when learners have attempted to deduce the rules for themselves (type "b" input) compared to the learning outcome of those who have been formally taught rules?

Chapter Four.

Study Three.

4.1 Introduction.

In Study Two it was found that cross-sentential cueing of phrasal structure was not facilitative in the acquisition of the syntax of the artificial language. It was hypothesised in Chapter Three that a direct approach might be more effective in which the rules of the language and the phrasal structure were explicitly taught. In the second language field, the explicit teaching of grammatical rules is commonplace yet does such an instructional approach work? A large body of research has been devoted to this question yet few studies have maintained careful control over variables or provided precise definitions of the measures used.

Many studies have compared classroom-based "instructed" learners with "naturalistic" learners who have not received any formal instruction. In Chapter One of this thesis, a number of these studies were reviewed and it was noted that not only do many of them fail to control adequately for factors such as motivation to learn the language, language learning ability, working memory capacity, amount of exposure to the target language and conditions of input but they also make unsubstantiated links between the type of input received and the approach to learning adopted. It is commonly maintained that instructed learners adopt a conscious approach to learning and naturalistic learners adopt an unconscious, implicit approach. Whilst it might appear reasonable to assume that learners who are taught rules make conscious efforts to learn those rules, this might not actually be the case, instructed learners might not focus at all on what is being taught (a situation all too familiar to teachers). Neither can it be presumed that naturalistic learners make no conscious efforts to learn rules, indeed learners might make a great deal of effort to work out the rule system.

In Study Three a comparison was made between learners who were systematically taught the rules of the MAL system with those who were instructed to search for rules in example sentences taken from the same system. The author would argue that such a comparison is roughly analogous to a comparison between instructed second language learners and naturalistic second language learners who have made efforts to learn the rules for themselves. (A comparison with naturalistic learners who have not been instructed to search for rules is made later in Study Five). It is acknowledged that there are limitations in the extent to which the findings from an artificial language study can be generalised to real second language learning: these concerns were discussed in Chapter One. However, the adoption of an artificial approach allows for the careful control of factors such as those described above and if the findings from Study Three fall in line with those of experimentally controlled studies which use real language then the adoption of an artificial approach to model second language would be, to an extent, justified.

Study Three addresses the following key questions: Is there a difference in learning outcome when learners have been encouraged to deduce the rules for themselves (type "b" input) compared to the learning outcome of those who have been formally taught rules (type "a" input? Is formal instruction (type "a" input) only effective for simple rules or can complex rules also be formally taught?

Before detailing further the rationale behind Study Three, a review of the literature relevant to each of the key questions will be provided. The first and second key questions relate to the large body of literature which was reviewed in Chapter One and is summarised below, and to more recent studies, which will be presented later. The majority of the early studies compared "instructed learners" with "naturalistic learners". Reviews by Long (1983), R. Ellis (1985, 1990) and Harley (1988) indicated a positive effect of instruction on the rate and success of acquisition (Briere, 1978; Carroll, 1967; Chihara and Oller, 1978; Ellis and Rathbone, 1987; Krashen and Seliger, 1976; Krashen *et al*, 1974; Krashen *et al*, 1978, Weslander and Stephany, 1983) but not on the process of acquisition (R. Ellis, 1982; Ewbank, 1987; Felix, 1981; Felix and Simmet, 1981; Pica, 1983; Pienemann, 1984, 1985, 1986; Pienemann and Johnston, 1987; Weinert, 1987). In the current study the aim was to focus only on the success of acquisition of the syntax, not on the rate or process of acquisition. It is acknowledged that instruction might be ineffective in altering the order of acquisition. The principal interest here was to examine the effect of instruction on success under controlled conditions to see if the positive effect could be replicated.

Other researchers have reported positive effects of instruction but under specific conditions. Some of these conditions have been investigated in the current study. Firstly, positive effects have been found but only in carefully planned production (Lightbown *et al,* 1980; Schumann, 1978; Ellis, 1984b, Kadia, 1988). In view of this an untimed free production test was introduced into Study Three in addition to the grammaticality judgement tests, to see whether effects of instruction varied according to type of test used.

Secondly, positive effects of instruction were found but disappeared over time (Lightbown, 1983): in the current study learners were tested immediately after input and then eight weeks later. Finally positive effects of instruction were reported but for simple rules only (Pica, 1985). This last finding relates to key question three: "Is formal instruction only effective for simple rules or can complex rules also be formally taught?" Pica's conclusion was that complex rules "might be excluded from direct instruction ....so that increased attention can be given to items more responsive to classroom presentation and practice." (Pica, 1985, p 214.). She found that her instructed group supplied more instances of simple rules (plural -s inflection) than her mixed (rule learners and exposure) or naturalistic learning group (exposure only) but that instruction retarded the attainment of more linguistically complex forms (progressive -ing). For highly complex features (for example articles e.g. "a" and "the") instruction had little effect, a similar developmental order emerging for learners in all three conditions. Other studies have also examined the issue of complexity and will be reviewed later.

Other more recent studies have examined the usefulness of focusing on form or highlighting form in the input. Whilst these precise conditions were not replicated in Study Three, the findings support the notion that a focus on form at some level is potentially useful. Spada (1986) reported that learners who received higher levels of contact with the language performed better than low contact learners when the contact was accompanied by more form-focused instruction rather than less form-focused instruction. Lightbown and Spada (1990) suggested that there might be links between the teachers' emphasis on particular grammatical features and accuracy levels, and finally White, Spada, Lightbown and Rada (1991) found that input enhancement in the form of form-focused instruction and corrective feedback improved performance on written, form-focused and oral tests.

Other recent studies (Doughty, 1991; Hulstijn, 1988; Van Patten, 1990) compared learners who were given instructions which encouraged them to attend to meaning or both meaning and form. Doughty (1991), using a computer controlled design, presented learners with meaningful sentences containing defining and non-defining relative clauses. One group was given an explanation of the rules underlying the use of the clauses and the clauses were highlighted in the input; a second group was provided with information designed to aid the learners' comprehension of the sentences and a third group, a control condition, was simply exposed to the sentences with no additional explanation. Learners in both experimental conditions improved significantly more than those in the control condition when performance was compared on pre- and post tests of the acquisition of the features. However, whilst learners in both the form- and meaning-focused groups learned the form, only those in the meaning-focused condition performed well on tests of comprehension: those in the form-focused condition had only minimal comprehension of the sentences in which the feature was embedded yet they had acquired the grammatical form.

In a similar study conducted by Van Patten (1990), learners were encouraged to focus on meaning alone or on meaning and one of three other features (a lexical item, a grammatical feature or a verb form). Learners in the conditions requiring focus on both meaning and form experienced difficulty attending to both, having generally lower recall scores on the passages in which the features had been presented. Van Patten concluded that conscious attention to the form competes with conscious attention to meaning - he hypothesised that only when learners have understood the message can they attend to the form. Finally, Hulstijn (1988) compared learners whose attention was oriented towards the form, meaning or both form and meaning of twelve target sentences. It was reported that form-focused learners outperformed meaning-focused learners on recall of structure yet meaning-focused learners outperformed form-focused learners on recall of contents. Learners in the meaning- *and* form-focused group performed similarly to those in the form- focused group, being more successful in recall of form rather than content. It is possible that learners in this group sacrificed their focus on content and attended mostly to form. Paying attention to form in the input appears to be an important factor in learning that form. However, attention is limited and attention to both form and meaning simultaneously appears to be difficult. In response to this, in the current study, learners were taught the "meaning" of each lexical item before receiving either a description of the rules of the language or exposure to grammatical sentences in the language.

In more recent experimentally based studies (De Keyser, 1995; N. Ellis, 1993; Robinson, 1996; Shaffer, 1989) comparisons have been made between learners under differing types of conditions of input. These studies relate most directly to the current study as some of these conditions are similar to those to be manipulated here and relate directly to all three key questions.

De Keyser (1994; 1995) using a miniature linguistic system called "implexan" (which he claimed constituted a natural language) compared what he termed "explicit-deductive" learners with "implicit-inductive" learners. The former were presented with the rules of the morphology of the language, examples of sentences from the languages and an accompanying picture which represented the meaning of the sentence. The latter (the "implicit-inductive" learners) were presented with the same sentences and pictures but received no indication of the rules. De Keyser did not give any indication of what learners were asked to do as they saw the picture/sentence combinations but he stressed that they received no explanation of grammar nor were they told that the sentences had a grammatical rules. De Keyser reported that the "explicit-deductive" learners performed overall better than those in the "implicit-inductive" group. He reported that "no evidence for implicit learning of abstract rules was found" (De Keyser, 1995).

Whilst the type of input in De Keyser's research was made reasonably clear and the outcomes on tests of acquisition were clear, the terms used to describe the learners were less clear. De Keyser referred to the learners who had received an explanation of the rules as "explicit and deductive". In the early part of his paper, he defines the concepts "explicit" and "deductive" only in terms of a description of a particular *type of learning* a learner might engage in. It would appear that De Keyser is inferring that learners who are presented with a particular type of input automatically adopt a particular type of learning. This is not necessarily the case. De Keyser defined the terms "explicit" "implicit, "deductive" and "inductive" as follows: "explicit learning" was defined as learning which occurs with concurrent awareness of that which is being learned; "implicit" learning as learning which occurs without concurrent awareness of what is being learned; "deductive" learning was defined as the situation whereby rules are seen before examples are encountered and finally "inductive" learning was defined as the situation whereby examples are encountered before rules are inferred.

De Keyser paired the terms "implicit-induction" and "explicit-deduction" whilst at the same time acknowledging that "*explicit induction* can happen" (De Keyser, 1995, p. 380; my emphasis). This is somewhat confusing. In the first pairing ("implicit-induction") it is assumed that learners who are given no description of the rules, learn the rules *without* concurrent awareness. However, in the acknowledgement that "explicit-induction" can happen, it is assumed that learners given no explanation of the rule might learn the rules *with* concurrent awareness. (I would imagine this would be where the learners attempt to crack the code for themselves and learn the rules they have worked out, with concurrent awareness of that rule.) Two questions remain: why did De Keyser categorise learners in the way he did? how does he defend the assumption that a particular type of input gives rise to a particular type of learning?

I would argue that it is not possible to discern, from the type of input learners are exposed to, the type of learning which follows. All that can be said with any certainty is that those who were given the rules of the morphology performed better on tests of acquisition than those that were not. One cannot say that this superior performance was due to an explicit approach to learning as it is perfectly possible that learners acquired the rules without concurrent awareness. De Keyser again acknowledges this in his discussion of the findings stating that "almost half the E-D (explicit-deductive) subjects said they did not think about grammar during the picture/presentation and a few subjects skipped through the grammar presentation itself at a suspiciously fast pace" (De Keyser, p. 398). He also described the difficulties of ensuring that learners "stick to the implicit and explicit strategies" (De Keyser, p. 398).

Yet despite these acknowledgements, De Keyser continued to refer to "implicit" learning in his concluding section, stating that no evidence for implicit learning could be found. He proposed that the results of a speeded grammaticality judgement test which revealed no difference between learners under the two conditions supported this contention. He argued that learners in the explicit-deduction condition needed time to access their consciously learned knowledge: their poorer performance on the speeded tests relative to their performance on the untimed test indicated that this conscious knowledge could not be accessed under timed conditions. However, this interpretation assumes firstly that explicit knowledge is slower to access; this might or might not be the case. It also presumes that in the tests where time to respond *was* allowed, learners would only draw upon their explicit knowledge. It is possible that learners in the "explicit-deductive" input condition actually acquired the knowledge of the rules implicitly. There is insufficient evidence to support De Keyser's assumptions. My main point here is that the definitions given to learners should relate only to the type of input they have been given and not to hypotheses regarding the kind of learning which supposedly takes place. De Keyser might more fairly conclude that the existence of overt rule description in the input appears to facilitate acquisition but only under conditions where sufficient time is available on tests of acquisition.

N. Ellis (1993) using a computer designed study, examined the acquisition of "soft"-mutations of Welsh. Learners were presented with written phrases in Welsh and were asked to attempt to translate them into English. Each of the phrases contained a soft mutation which caused changes in word initial consonants in specific grammatical contexts. The rules governing the change of the consonant were highly complex.

Learners were assigned to one of three conditions: firstly, "random" learners were exposed to random instances where mutations did or did not occur depending on grammatical context - no other information was provided. They were required to translate the Welsh phrases into English. Ellis stated that "this group constitutes our broad operational definition of implicit or "naturalistic" learning in that learners are trying to comprehend meaningful utterances." (Ellis, 1993, p292.) Ellis acknowledged that direct comparisons between learners in this condition and real life "naturalistic" L2 learners might not be appropriate.

In the second condition, participants were described as "rule" learners. Whilst Ellis stated that these learners were "explicitly taught" the rules, he emphasised that learners were not given explicit statements about the rules but instead were shown "protowords" (words which consisted of a consonant and a number of equal signs for example "t ===" where "t===" is equivalent to any word beginning with a "t"). The protowords were placed alone or within a phrase. Some of the phrases required a mutation; others did not. Learners were required to translate phrases into English but include the protoword in its correct form. Learners were given feedback on their responses and the phase continued until the learner had completed all trials correctly on their first presentation. It would appear that learners did not receive explicit rule instruction in the form of an explicit description of the rules. Rather, they appear to be forming hypotheses about the underlying rules based upon the feedback given.

The third condition was described as a "rule and instances" group. Learners were presented with phrases which contained both protowords and Welsh words, some mutating and some non-mutating. Learners were required to translate the phrases into English in a similar way as described for the rules learners above. Ellis argued that learners in this condition were taught both the rules and their application. He called this programme of exposure a "structured" programme.

Learners in all three conditions were then presented with a number of other phases or trials. The first of these exposed learners to random sequences of phrases, some requiring a mutation and some not. The learners' task was to write a translation. This phase was followed by a series of test phases including rules tests which Ellis defined as testing "explicit" knowledge, a well formedness test and a timed well formedness test which he claimed assessed "implicit" awareness of grammatical correctness.

The rules test was identical to the "rule learning" phase undergone by the rules learners with the exception that learners were not given feedback. Ellis maintained that this tested *explicit* knowledge of the rules. He found that the learners in the random condition performed significantly more poorly on the test than those in the other two conditions on the soft-mutating rule. On the untimed well formedness test, learners in the rules and instances condition performed overall better than those in the rule learning and random conditions when making judgements about incorrect sentences - learners in the latter two groups accepting incorrect phrases more than those in the rules and instances condition. On the timed well formedness test the results were similar except that performance overall for all the groups was lower than under the non-timed conditions. However, the timed test had included items not presented before and Ellis concluded that some of the accuracy on the previous test might have been due to learners correctly recognising phrases they had seen before. The rules group was slower in making judgements than the random group when judging phrases containing a mutation. The rules and instances group performed overall better than learners in the other two conditions and their responses were relatively fast.

Ellis concluded that the random learners had acquired very little explicit or implicit knowledge of the rules. He suggested that they might have adopted a functional approach concentrating attention on the meaning. This finding is similar to the findings reported by Van Patten (1990) and Hulstijn (1988) in which it appears that learners are able to focus attention on meaning or form but find it difficult to attend to both.

Ellis proposed that learners in the "rule learning" condition had "learned" the rules (in Krashen's sense) and had gained explicit knowledge of the rules. This, he claimed, was evidenced in tests which required transfer of a rule to new structure and on one of the rules tests where learners in the rule learning group outperformed those in the random group. Having discussed this issue, Ellis suggested that "There does, therefore, appear to be some useful transfer from explicit to implicit knowledge in these aspects of L2 learning" (Ellis, 1993, p313.) It appears that Ellis is arguing that the ability to transfer knowledge of a rule to a new construction involves *implicit* knowledge. I will return to this point below.

Finally, Ellis stated that learners in the "rules and instances" condition had "both explicit and implicit appreciations of its [the language] structure." (Ellis, 1993, p 313): "The structured instruction allows for generalisation at both explicit and implicit levels" (Ellis 1993, p 314.) He argued that only these learners were able to judge when novel phrases were ungrammatical and abstract a functional schema for the soft mutations.

There are potential problems with the conclusions Ellis draws regarding the roles of explicit and implicit knowledge. Ellis did not provide any clear justification or rationale behind his contention that explicit knowledge can turn into implicit knowledge. Nor does he operationalise the terms formally or present any evidence supporting his claims that the tests he used tapped into either knowledge base.

Ellis did not present any formal hypothesis regarding the predicted outcome of these three manipulations on the acquisition of the rule structure. Nor did he formally relate the two rule learning conditions to natural second language learning environments. It would appear likely, given the content of the introductory literature review, that the two rule learning groups might be considered analogous to formally instructed learners. However, this was never overtly stated. On close inspection of the conditions of input, it appears that Ellis was in fact manipulating the degree to which the rules were made salient or highlighted in the input. In the random condition there was no overt highlighting of the grammatical features in the input to be learned. However, in the "rule learning" and "rule learning with instances" conditions, the grammatical feature was highlighted by presenting the head initial consonant in isolation. By presenting the feature in the input in this way, the learner's attention is hypothetically drawn towards the feature. Such "attention drawing" was described by Sharwood Smith originally as "consciousness raising" (Sharwood Smith, 1980) and later as "input enhancement" (Sharwood Smith, 1993). It is perhaps this input enhancement that has produced the facilitatory effects on acquisition. What cannot be said is how the input becomes intake.

As stated above, Sharwood Smith originally referred to "attention drawing" as "consciousness raising". However, he acknowledged that the use of the latter term implied that once conscious awareness occurred input automatically became intake. This further implied that the process of learning (going from input to intake) is conscious. In view of this, he changed the term "consciousness raising" to "input enhancement" (Sharwood Smith, 1993) arguing that this term implied only that the input alone could be manipulated but no further assumptions regarding the consequences of that input on the learner could be made.

In conclusion, I would argue that the results of N. Ellis' (1993) study provided support for the contention that enhancing input by highlighting features in the input and accompanying this with exposure to instances facilitates acquisition of those features. This is measured both in terms of performance on untimed and timed grammaticality judgement tasks and in tests of translation. However, I am in agreement with Sharwood Smith (1993) that input enhancement or focus of attention onto particular features in the input does not automatically imply that conscious learning of those features occurred; neither can it be claimed that a particular type of test taps into a particular type of knowledge without further justification for such a claim.

In summary, in both De Keyser's and N. Ellis' studies reviewed above, input only was manipulated, yet in both studies claims were made regarding both the type of learning involved and type of knowledge acquired. The central comparison made was with regard to the implicit/explicit distinction. Parallels were drawn between learners who are explicitly taught rules of the language (frequently referred to as "instructed learners) who supposedly learn the rules "explicitly" and "naturalistic" learners who supposedly learn the rules "implicitly." De Keyser overtly connected the former with his explicit-deductive group and the latter with his implicit-inductive group. N. Ellis equated his random learners to "naturalistic" learners (with qualification) but made no direct reference to possible analogies between his "rule learning" or "rule and instance" learners and learners in a second language context. He did suggest that the "rule learners" were "explicitly taught the rules" (Ellis, 1993, p.293) which could be taken to mean that these learners equated with the "instructed" group. The "rule and instances" learners are possibly equated with a combination of "naturalistic" and "instructed" learners.

The essential point here is that in comparing learners under different conditions of input, researchers relate the conditions of input to either an explicit or implicit approach to the learning task. However, it is impossible to gauge whether or not such an approach to learning has been adopted. One study which focused more on the conditions of input and less on the type of learning engaged in was that of Shaffer (1989). She compared learners who were presented simultaneously with a rule and sentences in which the rule had been applied with learners who were presented only with the sentences. Learners in the first of these conditions were referred to as "deductive" learners: this approach was defined as one in which learners are given an explanation of the rule before seeing the rule in operation. Learners in the second condition were described as "inductive" learners: this approach was defined as that in which the learners' attention is focused on examples where the feature is present but learners themselves are required to formulate and verbalise the underlying pattern or rule. Shaffer found no differences in performance on a cloze test between learners in the two conditions and she concluded that an inductive approach was as successful as a deductive one.

In Shaffer's study learners were either provided with the rule or they were asked to search for the rule themselves. A similar comparison was made by Robinson (1996) in a study which comprised a comparison of four conditions, two of which were similar to those manipulated by Shaffer. The four conditions were: an "instructed" condition (analogous to Shaffer's deductive group), a "rule search" condition (analogous to Shaffer's inductive group), an "implicit" and an "incidental" condition (to be explained below). The four conditions were chosen to model conditions of learning experienced by learners of second languages and learners of artificial grammars. Robinson had noted that similar claims had been made by researchers in the two fields, as a result he wanted to see if it were possible to generalise the findings of studies in one field (artificial grammar learning) to the context of the other (second language acquisition).

Reber, (1989, 1994) working with artificial grammars, claimed that learners who had been asked to memorise strings of letters generated by a finite state grammar system could make accurate grammaticality judgements of novel strings but could not articulate the underlying rules of the system. He claimed that this was evidence of "implicit" learning. Reber further reported that learners who were encouraged to consciously search for rules in the input, performed more poorly than those in the "implicit" memorisation condition when the materials were complex and when the array in which the strings were presented made the underlying rule system less salient. (Details of the above studies were presented in Chapter Two of this thesis.)

Robinson drew a parallel between Reber's findings and Krashen's (1981, 1982, 1985, 1994) claims regarding second language learning (detailed in Chapter One). Krashen argued that complex rules could only be unconsciously or implicitly acquired and not consciously learned: the role of conscious learning being restricted to the learning of simple rules. In both fields, it was argued, complex materials could best be learned under unconscious, implicit conditions. For Reber, such conditions could be created by asking learners to memorise strings of letters and for Krashen by encouraging learners to attend to meaning (learners attend to "comprehensible input").

Reber compared learners in his "implicit" memorisation condition with those in an "explicit" rule search condition and Krashen compared "implicit" meaning focused learners with those receiving "explicit" formal instruction in the classroom. Robinson reasoned that if Reber's artificial grammar studies could be generalised to second language contexts as described by Krashen, then the two "implicit" conditions should pattern together and the two "explicit" conditions should pattern together.

In Robinson's (1996) study, learners were assigned to one of four conditions, each relating to one of the four conditions described above. Learners in Robinson's "implicit" condition were asked to memorise sentences containing examples of simple and complex rules (these learners were comparable to Reber's "implicit" memorisation learners); learners in Robinson's "incidental" condition were tested on their comprehension of the sentences containing the same rules, (these learners were comparable to Krashen's '"implicit" meaning focused learners); those in the "instructed" condition were given written descriptions of the rules (comparable to Krashen's "explicit" formally instructed learners) and those in the "rule search" condition were asked to try to identify the rules (comparable to those in Reber's "explicit" rule search condition).

Robinson presented four hypotheses: firstly that the implicit and incidental learners' performances would pattern together and the instructed and rules search learners' performances would pattern together, secondly, that those in the former "implicit" conditions would outperform those in the latter "explicit" conditions on the complex rules of the language; thirdly, all learners would score higher on the simple compared to complex rules and fourthly, learners would be more aware of the simple than complex rules.

Hypothesis one was only partially supported: Robinson found that only learners in the "implicit" learning conditions (implicit and incidental) patterned together on grammaticality judgement tasks. However, those in the "explicit" learning conditions differed from each other: learners in the instructed condition outperforming those in the rule search condition on both difficult and easy rules.

Hypothesis two was not supported: learners in the implicit and incidental learning conditions did not outperform those in the instructed and rule search conditions on the complex rules of the language. Learners in the instructed condition actually performed better than those in the implicit condition and better but not significantly better than those in the incidental learning condition.

Hypothesis three was partially supported - learners in all conditions except the implicit condition performed better on the simple rather than the complex rules. Finally, hypothesis four was not supported as few learners were able to verbalise the rules and there was no difference in ability to verbalise the easy compared to the hard rules.

Robinson concluded firstly, that findings from Reber's research were generalisable to the context of second language but only for the "implicit" learning conditions. The pattern of findings for the memorisation condition and the incidental conditions was similar but the pattern of findings for the rule search and instructed groups was different. Robinson suggested that whilst both these latter groups might be similar with respect to consciousness the important difference in performance lay with the distinction between the inductive and deductive approaches adopted.

Robinson's second conclusion was that complex rules were *not* better acquired under "unconscious" conditions, these "unconscious" conditions being modelled on the conditions set up by Reber (the memorisation condition) and implied by Krashen (the incidental "meaning focused" condition).

In both the above conclusions, Robinson referred to different states of consciousness. In the first, he argued that the inductive or deductive learning process "facilitated" by the input conditions was of more importance than any similarity in "consciousness". Robinson seems to be emphasising that even if the level of conscious processing is the same, learners will differ in performance and this performance is dependent upon the approach to learning adopted. Here, Robinson is making three claims: firstly that the input conditions themselves result in a particular approach to learning, secondly that the level of consciousness during this process is the same in the rule search versus instructed conditions and in the incidental versus implicit conditions and thirdly, that the approach to learning (inductive or deductive) is more important than the level of consciousness in determining performance.

Whilst it might be the case that the conditions of input induced a particular approach to learning, one cannot be certain of this. All that can be said is that the learners provided with rules performed better than those asked to look for rules. In the second conclusion, Robinson referred to "unconsciousness", implying that learners in the implicit and incidental learning conditions learned "unconsciously". Again, the conclusion that these conditions actually led to "unconscious" learning cannot be substantiated. All that can be said is that the type of input provided to learners and the instructions accompanying that input did not result in enhanced performance on complex rules.

Despite these references to levels of consciousness in the early part of his discussion, Robinson later focused his discussion on the relationship between the effect of transfer of input training on performance by the instructed and implicit learners. Robinson explained the performance of learners in the two conditions in terms of the type of input they had received. For example, he explained the better performance of the instructed learners in judging easy ungrammatical sentences compared to hard ungrammatical sentences by proposing that learners used their knowledge of the rules to systematically search for disconfirmations of the rules. This process was effective for the easy rules because only a limited number of checks were required for a correct judgement to be made. However, for the more complex, ungrammatical items learners might end the search for disconfirming evidence prematurely after confirming the grammaticality of other rules in the target sentence.

Robinson further hypothesised that learners in the "implicit" condition noticed co-occurrences of words in the input during memorisation and that noticing which co-occurrences were permissible facilitated their performance in judging grammaticality. Robinson argued that the pattern of results obtained for learners in this condition could be explained in terms of knowledge of allowable bigrams.

Robinson finally concluded that task demands led to differences in learning and not to differences in access to conscious or unconscious systems. He claimed that learning in both the implicit and instructed conditions was similar because it involved the use of conscious processing strategies (described above) adopted in response to the task demands. Robinson appears to be emphasising the importance of relating the type of input to the type of information which can be abstracted by the learner from that input rather than relating input to type of learning and level of consciousness. (However, even with this view, one cannot be certain that this *is* the kind of knowledge that has been abstracted.)

In summary, Robinson found that instructed learners performed better than rule search learners on both simple and complex rules. Reber and Krashen's claim that implicitly oriented and meaning focused learners would outperform those in the instructed and rule search conditions on the complex rules of the language was not supported. Robinson concluded that parallels could be drawn between Krashen and Reber's implicit conditions but not their explicit conditions. Robinson further explained the pattern of his own results in terms of the transfer of the type of training that learners received. He finally argued that focus should placed on comparing inductive and deductive approaches to learning rather than on different levels of hypothesised consciousness.

Conclusions:

In this review of second language studies it appears that learners who receive either a detailed explanation of rules and an example sentence, on the one hand, or input which highlights the rules and an example sentence, on the other, outperform those who receive instruction to look for rules, memorise sentences or focus on meaning. These results do not support the claims made by Krashen and Reber that meaning focused or memorisation learners learn the complex rules or complex systems best.

Researchers lack consensus in their views of how type of input relates to type of learning and to the type of knowledge which hypothetically results. Researchers also either fail to operationalise the terms they use or use the terms differently: in some studies "instruction" equates with the teaching of rules, in some to the highlighting of rules in the input and in others to rule search. Before describing Study Three in the current research - a summary of the different studies and claims made will be presented (see Table 4.1).

In Table 4.1 below, four of the second language studies outlined above are presented along with Reber *et al*'s (1980) study and conditions of input relating to Krashen's (1984)

Table 4. 1 A review of studies examining the effects of differing input type on syntax acquisition.

Scenario	**a**	**b**	**c**	**-**	**-**	**-**	**-**		
Type of input and type of instruction:	**Rule(s) taught and example given. (Instructed to learn rules.)**	**No rules taught. Example given (Instructed to look for rules.)**	**No rules taught. Example given (Instructed to memorise sentences.)**	**No rules taught. Example given**	**No rules taught. Example given (Instructed to look for meaning.)**	**Rules highlighted No example given. (Instructed to learn rules.)**	**Rules highlighted Example given. (Instructed to learn rules.)**	**Findings**	**Conclusions**
Shaffer, 1989 (natural language)	deductive	inductive						No differences found between conditions.	Inductive approach as good as deductive approach.
N. Ellis, 1993 (natural language)					random (implicit)	rules (explicit)	rule and instances	Rules and instances learners best.	Evidence of implicit and explicit learning.
De Keyser, 1995 (miniature linguistic system)	explicit/ deductive			implicit/ inductive=				Explicit /deductive learners best	Explicit /deductive learning best.
Robinson, 1996. (natural language)	instructed (explicit)*	rule search (explicit)*	implicit (implicit)*		incidental (implicit)*			Instructed learners best; *implied by author	No evidence for "implicit learning."
Reber et al 1980. (artificial grammar)		explicit	implicit					Implicit learners learn more complex materials better than explicit learners except if underlying system made salient.	Evidence for implicit learning. Better for complex materials. Explicit learning works if rules are easy to find.
Krashen 1984. (natural language)	instructed explicit				naturalistic implicit			Naturalistic learners learn complex rules. Instructed learners only learn simple rules.	Unconscious learning superior to conscious learning for complex rules.
Fowler. (miniature language)	instructed	exposure	(memorise)						

views on second language acquisition. The conditions of input, terms used to describe learners in the different input conditions, main findings and claims made by the researchers regarding the roles of implicit and explicit learning are presented. The final section of the table shows the input conditions relating to Study Three in the current research (referred to under "Fowler"). (The top row of the table refers to "scenarios" - where a scenario is given, this indicates that the conditions of input were similar to those described in Chapter One of the current research.)

As can be seen in Table 4.1, two of the studies have made comparisons between learners who have been given input similar to that described in scenarios a and b (see Chapter One). Shaffer (1989) found no difference in overall performance when comparing her "deductive", (type "a") learners with her "inductive", (type "b") learners. Robinson (1996) came to a different conclusion when his instructed learners outperformed his rule search learners. N. Ellis also found a positive effect for his "rules and instances" learners but in his study rules were not explained: examples of the rules were highlighted in the input. This manipulation falls outside the input conditions relating to the scenarios presented in Chapter One. It is possible that highlighting of rules in the input has a similar effect to providing written explanations of those rules. Further research is needed to determine whether this is the case.

Whilst De Keyser (1995), produced similar findings to Robinson and N. Ellis reporting that his "explicit/deductive" learners outperformed those in the "implicit/inductive" condition, it is unclear precisely what his implicit/inductive learners were instructed to do whilst observing the sentences and the pictures. The explicit/deductive condition received input similar to type "a" input but his implicit/inductive learners received exposure only to meaningful sentences. No information was provided regarding the instructions these learners received. It is possible that they were asked to search for the rules but equally they might have been told only to examine meaning or memorise sentence picture combinations. The conditions of learning might be type "c" input in which learners are also instructed to memorise the input but it might also similar to the conditions of Ellis' random learners who were instructed to search for meaning. In view of these uncertainties one cannot make valid comparisons between De Keyser's study and the others.

Whilst at least two of the above studies made comparisons between input relating to type "a" and "b" input, two studies included a condition relating to type "c" input where no rules were taught and hypothetically learners did not know rules existed. Reber *et al* (1980) compared learners given type "c" input accompanied by instructions to memorise letter strings with learners given type "b" input who were further asked to search for rules in the input. They referred to the former as implicit learners and the latter as explicit learners. They reported that learners in the implicit, memorisation condition outperformed those in the explicit rule search condition when exposed to complex materials and where the underlying system was not made salient. However, when the underlying rules were made more salient the explicit learners outperformed implicitly oriented learners.

Robinson (1996) made the same comparison as Reber but found that the memorisation learners did not outperform the rule search learners on the more complex rules. Robinson's memorisation learners patterned together with his incidental, meaning-focused learners, (input based upon Krashen's description of input available to naturalistic, learners). No differences were found between learners in these two conditions, they performed generally more poorly than those in the instructed and rule search conditions. Robinson's findings were not in line with the predictions made by Krashen that meaning-focused learners (akin to naturalistic learners) would outperform instructed learners on more complex rules.

In virtually every case described above, instructed learners, i.e. those learners who were given descriptions of rules, outperformed learners who did not receive a description of rules. Whilst there appears to be some disagreement concerning the usefulness of instruction in the teaching of complex rules, there does appear to some agreement, even from those who tend to oppose the use of instruction that simple rules can be taught. As noted above, Pica (1985) found a positive effect of instruction but only for simple rules; Reber *et al* (1980) reported that rules could be found if they were easy to find (as is likely to be the case with more simple rules) and even Krashen (1981, 1982, 1985) conceded that simple rules of thumb could be taught .

In Study Three, a comparison was made between learners who were given descriptions of rules and learners who were instructed to search for rules. In the light of the findings above, the key questions, presented earlier in the introduction to this chapter (and repeated below) were posed. In previous studies, learners who have been provided with rules have been described as deductive, explicit and/or instructed learners and those in the rule search oriented conditions as inductive or explicit learners. In Study Three learners in the former condition were described as "instructed" and those in the latter condition as "exposure". These terms were adopted as they describe only the type of input provided to the participants and do not imply any particular approach to learning. Participants in the exposure condition were given the same instructions to rule search as were received by learners in the more explicit instructional set in Study Two. After receiving input, learners were given three grammaticality judgements tests (referred to now as "rules tests") immediately after input and then one shortened test eight weeks later. The later test was introduced to examine Lightbown's (1983) claim that the effects of instruction disappear over time. In the light of findings (reported above) that positive effects of instruction have been found but only in carefully planned production, the grammaticality judgement tests were interspersed with free production tests which were introduced to see if performance would vary according to the type of test used.

The MAL system used was identical to that adopted in Study One and Two in the current research but it was now used to model second language. In order to encourage participants to approach the task as if they were learning a real second language, they were presented with a fictional description of a country called "Nosmo" inhabited by "Nosmoians" who write (but do not speak) Nosmoish (the MAL system). Nosmoish was described as being a written language which had no meaning in the traditional sense but contained shapes which were paired with each word to give the word its meaning. Learners in the instructed condition were told they would receive computer written instructions describing the rules of the language, those in the exposure condition were told that there were no Nosmoish teachers but they could attempt to work out the rules of the language for themselves by examining sentences taken from the language.

Under these conditions the key questions were presented: what impact does formal instruction (as defined in Chapter One scenario "a") have on the acquisition of syntax of the artificial language by adult learners? Is there a difference in learning outcome when learners have been encouraged to deduce the rules for themselves (type "b" input) compared to the learning outcome of those who have been formally taught rules? Is formal instruction only effective for simple rules or can complex rules also be formally taught?

4. 2 Method

4. 2. 1 Participants

Forty first year Psychology undergraduates studying at the University of Plymouth participated as part of a course requirement. No restrictions were applied regarding previous language learning experience. None of the participants had taken part in either of the previous studies.

4. 2. 2 The Miniature Language

The language used in this study was constructed in exactly the same way as described in Study 1, Chapter 1 with the following additions and omissions:

1. Eight new, longer sentences were added to the forty "base language" sentences (see Appendix A2). Two sentences were generated from each of the following word class orders:

'ADCDFCD' 'ACDFCD' 'ADCDFC' 'ADCFCD'

These word orders had not been used in the original base language sentences as the corresponding sentence lengths of six and seven words exceeded the five word limit imposed by Morgan *et al* in their 1989 study. The items were generated to ensure that, as far as possible, each lexical item was used an equivalent number of times.

The extension of the base language set was due to changes made to the type of input to be given to participants in the current study. These changes are described in detail below (see Design and Procedure). Half the participants were to be taught the rules of the language in full and during this process they would become aware of the existence of sentences of all possible lengths. It was decided therefore, that the remaining participants who were to be given "exposure" only should also be presented with the full range of sentence types. For this "exposure" condition the original base language set plus additional longer sentences were used.

2. The pronouns 'ib' and 'et' were not used, nor were any transformed sentences

4. 2. 3 Design and Procedure

A between subjects design was adopted in which participants were randomly assigned to one of two input conditions: "instruction" or "exposure". Participants were seated individually in front of a computer screen on which the entire presentation was displayed in colour.

Participants were presented with a set of written instructions which introduced them to the concept of the "Nosmoish Language" (the name given to the miniature language in the present study). All participants were given the following introduction:

> The study involves some imagination on your part!
>
> I would like you to imagine that you are visiting a country called Nosmo (pronounced "Nozmo"). In this country a special language is used which is usually written down rather than spoken.
>
> The language consists of just 15 words. Each word is paired with a special shape.
>
> First you will be shown the shapes and their corresponding words *one* at a time. Try to remember which word is paired with which shape.

They were then given "vocabulary training and testing" (as described immediately below) followed by an "input stage" which varied according to input condition and finally a "testing stage".

Vocabulary training and testing

Each word of the language together with its accompanying referent shape was presented individually on the computer screen for a period of 5 seconds, (see Chapter 2, 'The Lexicon' for a list of the words and their referents). Participants were asked to try and learn the word/shape pairings.

After all fifteen words had been presented twice in randomised order, participants were tested. A multiple choice format was used whereby each shape was presented individually and a choice of four different words was presented below the shape. None of the incorrect choices were taken from the same word class grouping as the correct choice. Scores from these tests were noted and the process was repeated. Thirty eight of the forty participants scored 70% and above on the final test, the criterion set for continuing to the input stage. The two remaining participants who failed to reach this level were given one more vocabulary exposure after which both scored above 70% on the subsequent test. All participants then proceeded to the input stage.

Input Stage:

Participants from both input conditions were given the following information:

> Nosmoish, the written language used in Nosmo, is special in that it doesn't *mean* anything in the traditional sense but the words can be placed in 'sentences'. The order of the words in the sentences is not random but is based on particular Nosmoian word order rules.
>
> The shapes which are paired with the words help the Nosmoian people to remember this word order.
>
> **You want to learn the Nosmoish language and the word order so that you can produce your own sentences in the language later on.**

At this point the instructions given to the two conditions differed:

"Exposure" condition instructions and procedure:

Participants in the "exposure" condition were given the following information:

Unfortunately there aren't any trained teachers of Nosmoish but you can borrow a disc from the Nosmoish library containing possible sentences in the Nosmoish language.

While you are observing the sentences you do *not* have to *do* anything or *write* anything but remember that later you will want to make up some of your *own original* sentences.

See therefore, if you can work out for yourself what the Nosmoish word order rules are.

The participants were then exposed to the forty eight base language sentences and their accompanying shape referents (described above) for a period of 13 seconds with an inter-stimulus interval of 1.75 seconds. This process was repeated three times but, between each exposure set, participants were given production practice in which they were asked to write down five sentences of their own which they felt conformed to Nosmoish word order rules (see Appendix A2 for copies of the "Nosmoish Language Practice Booklets" used).

"Instructed" condition instruction and procedure:

Participants in the "instructed" condition were given the following information:

Unfortunately there aren't any trained teachers of the Nosmoian language so you decide to enrol on a "Teach Yourself Nosmoish" Course. Learning is carried out using a ready made computer package which is available from the Nosmoian Library. Prior to your first lesson, you are required to learn the 15 words used in the language. Luckily you have already done this so you can now begin your first lesson.

Participants scrolled down the computer screen at their own pace and followed the instructions given below. A complete set of instructions can be found in Appendix A2, the following extracts are presented to give an overall impression of the method of presenting the rules. Each extract is presented in a separate box in the same format as presented to participants on the computer screen.

Prior to commencement, participants were given "Sheet 1" (see Appendix A2) on which the lexical items and corresponding geometric shapes were presented and the

"Nosmoish Language Study Booklet" (see Appendix A2). Both were presented face down. The instructions given were as follows:

Welcome to the Nosmoish Language Study Course.

You have already learnt the vocabulary of the Nosmoish language and the special shapes that help the Nosmoian people remember the correct word order.
You will now learn the secrets of the Nosmoish Word order rules!

Did you notice anything about the shapes? The shapes could be divided into different categories.
How many categories of shapes do you remember?

Stop here
until you have made a guess at the problem above
then scroll down to find out if you are right.

In fact there are **five** categories of shape: the five categories were: rectangles, triangles, thin rectangles, crosses and semi-circles.

As you know, each word was paired with a shape. The **category** of shape determines the **class** the word belongs to.
For example, words paired with rectangles are Class **A** words.

Now look at **Sheet 1.**

Note that *four* words are paired with a rectangle:
BIF HES MIK and RUD so these are Class **A** words
four words are paired with a triangle: **CAV LUM NEB SOG** these are Class **C** words
three with a thin rectangle: **KOR PEL TIZ,** these are Class **D** words
two with a cross **JAX and VOT** these are Class **E** words
and finally two with a semi-circle: **DUP and FAC** these are Class **F** words.
(For some odd reason there are no Class B words.)

Write down the **Class** to which the groups belong on **Sheet 1.**

Give yourself a couple of minutes to try to remember these.
Stop here
until you have finished the above task.

When you are ready, scroll down for the next instructions.

Now you will learn how this knowledge helps you to make sentences in Nosmoish.

At this point the word order rules were presented in a series of steps. This process began with the introduction of a single sentence construction: 'ADEC' and the simple explanation that an 'A' word begins the sentence and could be followed by a 'D' then 'E' then 'C' word (see below). After the presentation, participants were encouraged to make up and write in the study booklet their own sentences conforming to the new pattern before being introduced to further possible sentence constructions. Where possible, all instructions were designed to encourage participants to engage actively in the learning task, to check answers with Sheet 1 or to attempt to work out the possible rules for themselves. They were then given written feedback. The first set of word order rules are presented below:

A possible sentence in Nosmoish is:

BIF KOR JAX CAV

How is this possible?

Because the word order rules allow an A word to come first, followed by a D word, then an E word and ending with a C word or:

ADEC

Look at the following sentence:

HES PEL JAX LUM

does this sentence correspond to the same rules? **use Sheet 1 to help you.**

You should have found that **HES PEL JAX LUM** also has the pattern **ADEC**

Now turn to **Page One** of
"The Nosmoish Language Study Booklet".

Try making up four sentences of your own of this pattern and write them on Page One of the Booklet. **Use Sheet 1 to help you.**

If you remember, **BIF KOR JAX CAV** was the first example you were given. The grammatical pattern was **ADEC.**

BIF KOR JAX

is *also* a possible sentence in Nosmoish. Which class letter has been dropped?

Stop here
until you have guessed the letter.
Then scroll down for the answer.

The Class C word has been dropped.
This is because the rules of the language state that the **C word at the end of a sentence is optional.** This results in another possible pattern: **ADE**

Each sentence construction was presented to participants by building from the previous pattern. For example, as can be seen above, after the presentation of 'ADEC', 'ADE' was presented to introduce the optional nature of 'C' at the end of a sentence. Later instructions introduced the removal of the 'D' class word to produce 'AE' and 'AEC' to introduce the optional nature of 'D' after 'A'.

'ADCDFC' was then introduced to show how 'E' can be replaced by 'CDF' and to highlight the phrasal groupings of the B phrase. The extract showing the instructions for this rule is presented below:

From the above it also *appears* that there is *always* an E word.
However, the following patterns show this is *not* the case.
'E' can be **replaced** by something else, see below:

AD **CDF**C
AD **CDF**
A**CDF**
A**CDF**C

If you compare these patterns to those above (re-written below) you will notice that a sentence contains **either** an E word or a **CDF** group. **No sentence can include an E word as well as a CDF group but all sentences must contain either one or the other.**

So the following sentences patterns are possible:
AD **CDF**C or ADEC
AD **CDF** or ADE
A**CDF** or AE
A**CDF**C or AEC

This would produce the following possible sentences for the top two patterns:
AD **CDF**C: BIF KOR **CAV PEL DUP** LUM or
ADEC: BIF KOR **JAX** LUM

Turn to Page Four in your booklet and make up a sentence for each of the 4 patterns ADCDFC, ADCDF, ACDF, ACDFC . Write each sentence next to Part a).

When you have finished, write next to part b the same sentence but replace the CDF words with an E word.

Stop here
until you have completed Page 4
then scroll down when you have finished.

This was followed by the introduction of the word order 'ACFC', removing the 'D' class words. This indicated the optional positioning of a 'D' word following both 'A' and 'C' words and further served to highlight the grouping of the 'A' + 'optional D' class word and 'C + optional D' class word. Finally, the inclusion of an optional 'D' class word after the final 'C' word highlighted the existence of the 'C(D)' or 'C' phrase grouping at the end of the sentence as well as in mid-position. Regular revisions of each of the rules were made throughout.

Once all the rules had been presented, participants were given a short test presented on the final page of the study booklet; it consisted of a set of statements testing participants' knowledge of the entire set of rules of the language. Participants were to respond true or false. This page is shown below:

1. Every sentence must have at least one 'A' word.

2. Sentences may not contain more than one 'A' word.

3 There may be at most one 'C' word or 'C' + 'D' word combination at the end of a sentence.

3a. Every sentence must end in a 'C' or 'C' + 'D' word.

3b. Sentences may contain two C words or 'C' + 'D' word combination, one in mid-position, the other at the end.

4. Every sentence must contain at least one 'E' or 'F' word.

5. Sentences can contain more than one 'E' word.

5a. Sentences can contain more than one 'F' word.

6. A 'D' word cannot appear immediately after an 'E' or 'F' word.

6a. A 'D' word can appear immediately after an 'A' or 'C' word.

6b. 'D' words are compulsory after 'A' and 'C' words.

7. A 'C' word or a 'C' + 'D' word cannot appear before an 'E' word.

8. A 'C' word must occur before an 'F' word.

As can be seen, there are eight main statements. The wording of the statements which are numbered 1-8 was based closely on the description of the eight rules of the language described in the Morgan *et al* 1989 paper and presented in Study 1, Chapter 2. Four additional statements, labelled 'a' and 'b' were included:

1). 3a was included to test explicitly participants' understanding of the *optional* nature of the final C phrase;

2). 3b was included to test understanding that sentences may contain *two* 'C' phrases

3) the original description of Rule 5 was separated into two statements:

5 was included to test understanding that sentences could contain only one 'E' word.

5a was included to test understanding that sentences could contain only one 'F' word.

4) 6a and 6b were included to test understanding of and to highlight the positioning of the 'D' word after 'A' and 'C' words only and to emphasise their optional nature.

These additions were made to the original eight rules as we felt these points needed clear checking and emphasis and that the original eight rules failed to cover these points fully.

Both Instructed and Exposure groups were given input as described above, interspersed with written sentence construction exercises as described above. No correction or feedback was provided regarding the accuracy of the performance on any of the written sentence construction exercises. Breaks were given at set stages in the input phase to reduce effects of fatigue.

Testing Stage

Three types of test were given: i) Rules Tests

ii) Free Production tests.

iii) A Working Memory test

Time of Testing

Testing took place at two separate times:

1. Immediately after the input stage or "time one"
2. After a nine week break (summer vacation period) or "time two"

Testing at time one took place immediately after the input stage but participants were given a 15 minute break before commencing the test period and five minute breaks between each individual test. At time two participants were re-tested without any further language input with breaks of five minutes between each test. Details of the tests are presented below:

Rules Tests

At time one, three rules tests were presented (these were interspersed with two free production tests, see below). The rules tests were the same as those used and described in Study 1 (referred to there as Grammaticality Judgement Tests). They comprised thirty two test items, each item testing one of the eight rules of the language so that each test comprised four test items for each of the eight rules. The tests involved showing participants two sentences, one above the other and labelled 1 and 2 respectively. All the sentences were novel in that none of them had appeared in any input set. No geometric shapes were shown at this point. The two sentences were identical to one another with the exception that one of the two sentences broke one of the eight rules of the grammar and the other did not.

In test one and test two, only sentences of up to five words in length were used as test data (this restriction was originally introduced in Morgan and Newport (1981) due to the fact that their input contained only sentences of five words in length). Test three included an additional eight test items (see Appendix A2). Each item tested one of the eight rules of the language, but the items used were of six or the maximum seven words in length. These longer items were interspersed at regular intervals throughout the shorter test sentence items in test three only. The three tests were presented to participants in random order and were presented in paper booklets (for example see Appendix A2).

Two separate analyses were carried out on Test Three, one which removed the longer items leaving the shorter test sentence data only and the second where all data were used.

At time two, only tests 1 and 3 were presented for a second time in random order.

Free Production Tests:

At time one, two free production tests were given which were designed to ascertain whether or not participants were able to produce novel sentences of their own. One was presented after completion of the first rules test, the other after the second rules test. Each test was presented in the form of a three page booklet entitled the "Nosmoish Language Test Booklet" (see Appendix A2).

On each page participants were asked to make up eight sentences of their own, using any combination of words they thought conformed to Nosmoian word order and were advised that they did not need to include the shapes. On page two, participants were asked to make up five individual sentences but of a pre-specified length of two, three, four or five words. At time two, a shortened free production test was presented which required participants to produce five complete, novel sentences only. The same instructions were given as shown above.

Working Memory Test

A single test of working memory was presented (see Appendix A2), at time two, only known as the "ABC test" in which participants were presented with letters in the alphabet and were asked to find which letter or letters came next when told to move a prescribed number of places forwards or backwards. Full instructions are provided in Appendix A2.

4.3. Results

Results will be presented in the following order:

4.3.1 Results obtained immediately after input (time one)

1. Vocabulary Test
2. Rules Tests
3. Free Production tests

4.3.2 Results obtained after the nine week break (time two)

1. Vocabulary Test
2. Rules Tests
3. Free Production test
4. Working Memory test

4.3.3 Results comparing performance at time one and two.

1. Rules Tests only

4.3.1 Results obtained immediately after input (time one)

1. Vocabulary Tests

As stated above, all participants had to score above 70% correct in order to continue to the input stage. Thirty eight participants reached this level after two vocabulary exposures, the remaining two participants reached this level after three exposures.

2. Rules Tests

Three rules tests were given immediately after the input stage. They were presented to participants in randomised order. Tests 1 and 2 contained items up to 5 words in length, Test 3 contained some items of 6 and 7 words in length. Responses to the longer items were initially removed from the test 3 responses after which data from all three tests were analysed. Test 3 was later re-analysed including the data from the longer test items.

In the previous two studies (see chapters 2 and 3), two sets of analyses were carried out on the rules test data. One set measured performance overall across all rules, the other separated performance on the unconditional and conditional rules. It transpired that, where input conditions might appear to perform similarly overall, closer analysis revealed differences between input conditions only on specific rule types.

In the current study, two sets of analyses were carried out: the first separated performance according to unconditional and conditional rules, the second was a more detailed analysis which examined performance on each of the eight individual rules of the language. (It should be noted that in the previous two studies the Scheffe post hoc test was used because it had been adopted by Morgan et al, 1989. The test is known to be highly conservative.

Below is an overview of the analyses carried out (see Table 4.2).

Table 4. 2 Overview of analyses carried out on Rules Test data at time one.

Analysis type	Tests	Rules Analysed
a	1, 2 and 3*	unconditional and conditional
b	1, 2 and 3*	all eight rules
c	3** only	unconditional and conditional
d	3** only	all eight rules

Note: "3*" = test 3 with the longer items' data removed; "3**" = test 3 with the longer items' data included.

a) Tests 1, 2 and 3, unconditional and conditional rules.

Data comparing performance on the unconditional compared to conditional rules were analysed using a three factor analysis of variance (factors: input condition, rule type and test). (Test was included as a factor to ensure there were no differences according to test type).

A main effect of input condition was found ($F(1,38) = 4.47$; $p < .05$). Mean scores of participants in the instructed condition (mean: 77.20, st dev: 19.29) were found to be overall higher than those in the exposure condition (mean: 67.79; st dev: 19.58).

An interaction between input condition and rule type was also found ($F(1, 38) = 6.99$; $p < .05$). Follow up analyses revealed that participants from the instructed condition performed significantly better on the conditional rules of the language only (Newman-Keuls: $p < .001$). No differences were found on the unconditional rules, participants from both conditions performed well on this rule type. The mean scores for both input conditions on unconditional and conditional rules are plotted below, (see Figure 4.1).

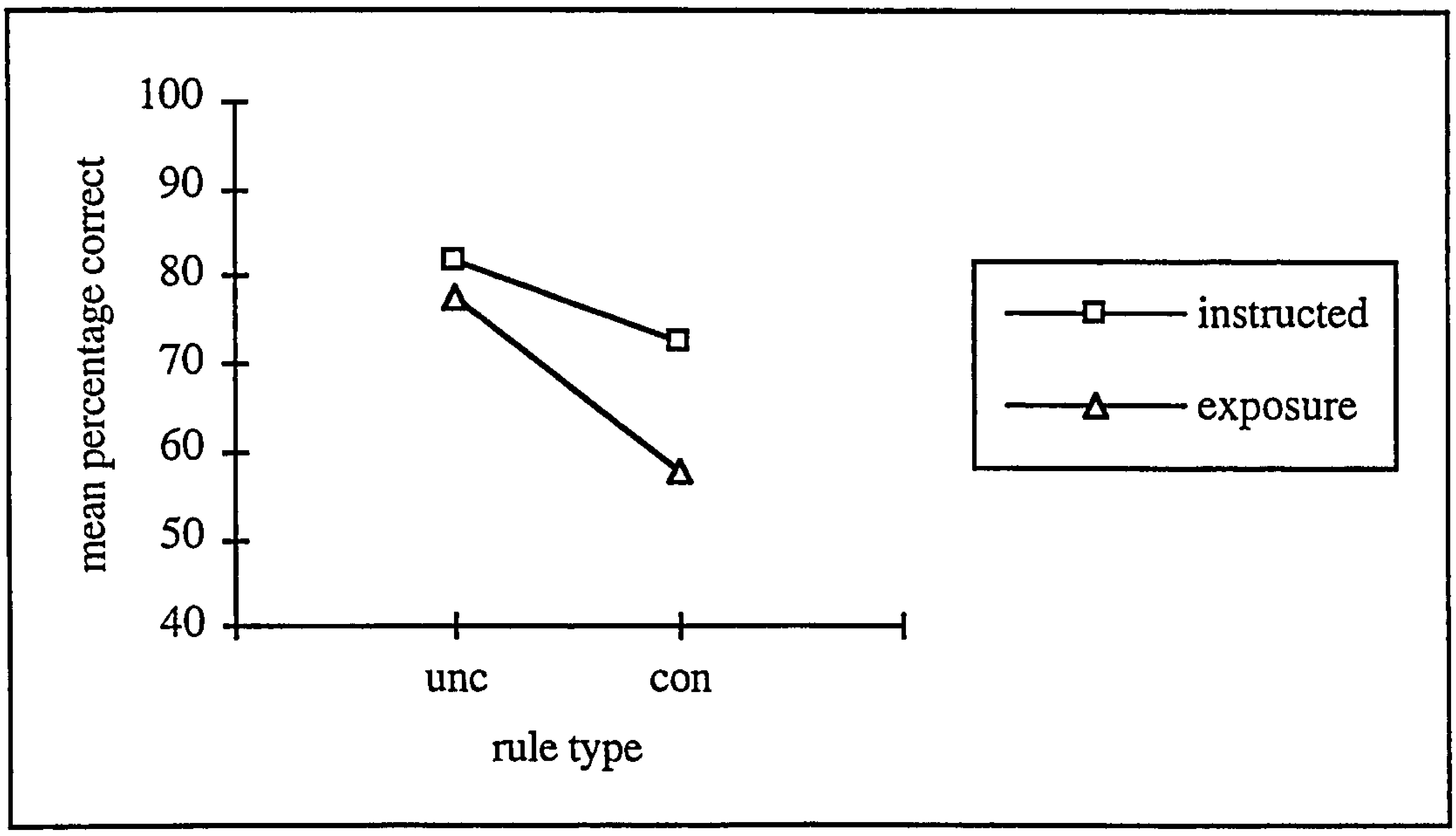


Figure. 4.1. Mean percentage scores on rules tests according to input condition and rule type.

A main effect of rule type was found (F(1,38) = 50.02; p < .00001), in which performance on the unconditional rules was found to be significantly higher (mean: 79.79, st dev: 17.63) than on the conditional rules (mean: 65.20, st dev: 19.55). Follow up analyses revealed that participants from both the instructed and exposure conditions performed better on the unconditional rules compared to the conditional rules (Newman-Keuls: p < .01, p < .001 respectively).

No effect of test type was found, there appeared to be no difference between test 3 (which had originally contained the longer sentences) and tests 1 and 2.

b) Tests 1, 2 and 3, all eight rules.

Data comparing performance on all eight rules of the language were analysed using a three factor analysis of variance (factors: input condition, rule type and test.). No main effect of input condition was found; the instructed group mean was higher, though not significantly higher than the exposure group mean (77.65 and 70.46 respectively). (It should be noted that, as stated above, a difference *was* found between the two input conditions in the analysis separating unconditional from conditional rules. However, rule 5, a hybrid rule, had been dropped from the data set as it was regarded neither as a purely unconditional or conditional rule. Rule 5 was *included* in the current analyses of all eight rules. Further analysis on the individual rules data after the removal of data measuring performance on rule 5 revealed an effect of input condition which approached significance ($F(1,38) = 3.77$; $p = .059$)).

An interaction between input condition and rule type ($F(7,266) = 3.30$; $p < .01$) was found. Follow up analyses revealed that participants in the instructed group performed significantly better than those in the exposure condition on rule 6 only (Tukey HSD: $p < .0001$). (Rule 6 contained a negative and a disjunctive and was potentially one of the most complex rules of the language.) No other differences between input conditions were found on any other individual rule. The mean scores for both input conditions on each of the eight rules of the language are shown below, (see Figure 4.2).

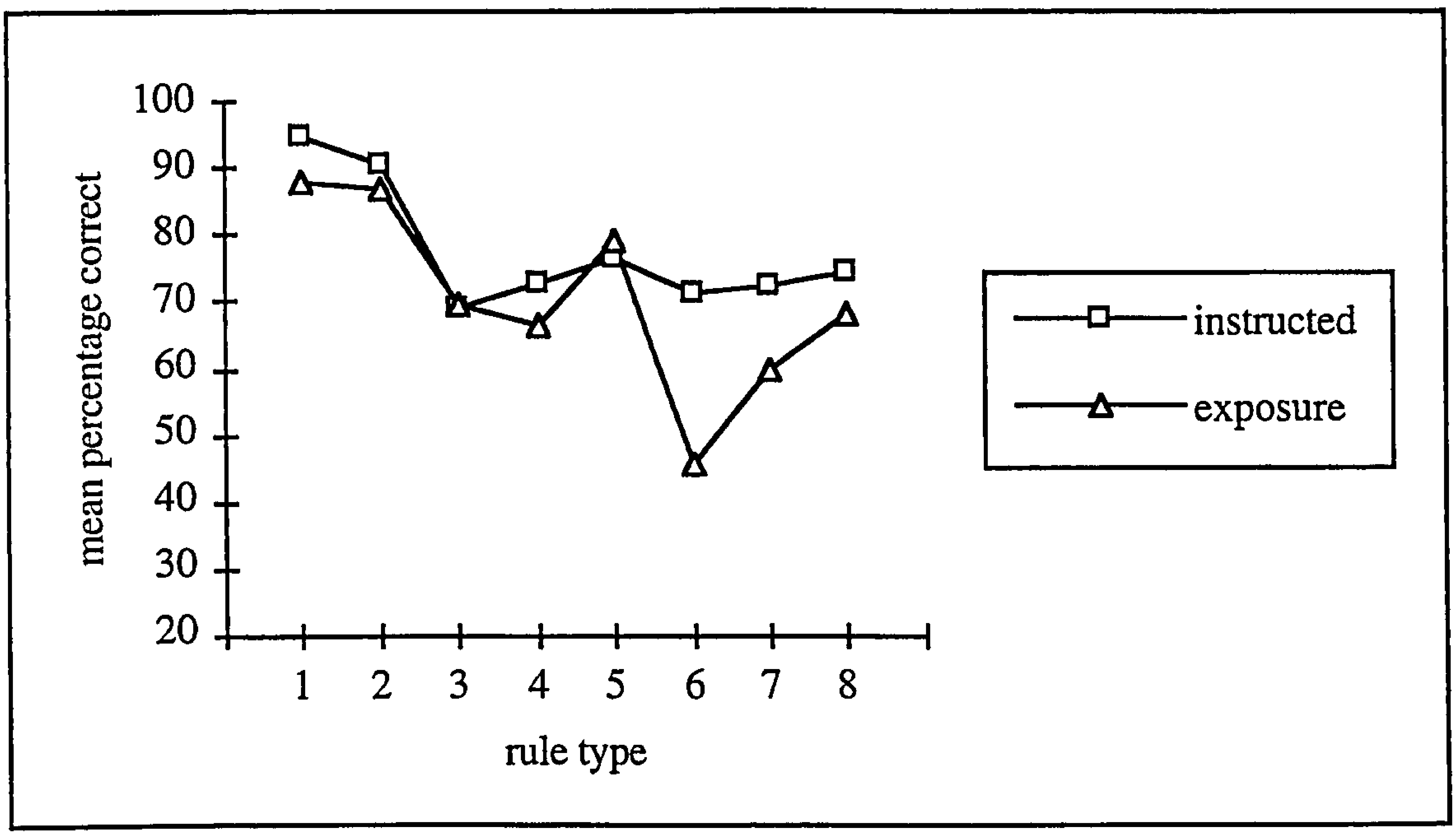


Figure. 4.2 Mean percentage scores on rules tests according to input condition and rule type.

The performances of participants in both input conditions were similar on all the rules of the language with the exception of rule 6. Mean scores of both conditions were highest on rules 1 and 2, no differences were found when comparing performance on rules 1 and 2 for either input condition.. Mean performance for participants in the exposure condition on rules 1 and 2 was significantly higher than on all the other rules with the exception of rule 5. Mean performance for participants in the instructed condition was similar except that performance on rule 1 was also significantly higher than on rule 5.

A main effect of rule type was found ($F(7, 266) = 21.09$, $p < .0001$) where performance overall on rules 1 and 2 was significantly higher than on all other rules and performance on rule 6 was significantly lower than all other rules except rule 7 (Tukey HSD: all values $p < .05$ or lower). The latter finding is likely to have been due to the poor performance of the exposure condition on rule 6 as described above. Closer analysis revealed that performance on rule 6 was significantly different from that on all other rules except rule 7 for the exposure condition only (Tukey HSD: all values $p < .01$ or lower). However, for the instructed condition, performance on rule 6 was different only from rules 1 and 2 (Tukey HSD: $p <. 001$, $p <.01$ respectively).

Performance on rule 7 was significantly poorer overall than rules 1, 2 for both input conditions and poorer than 5 for the exposure condition only (Tukey HSD: $p < .0001$, $p < .0001$, $p < .05$, respectively).

No effect of test type was found.

c) Test 3 only (including longer items), unconditional and conditional rules.

Data from test 3 alone, including responses to the longer items, were analysed using a two factor analysis of variance (factors: input condition and rule type (unconditional and conditional)). The findings mirrored those of the previous analyses. A main effect of input condition was found ($F (1,38) = 6.30$; $p < .05$). Mean scores of participants in the instructed condition (mean: 79.04, st dev: 15.74) were found to be overall higher than those in the exposure condition (mean: 67.91 ; st dev: 18.09).

An interaction between input condition and rule type was also found ($F (1, 38) = 4.48$; $p < .05$). Follow up analyses revealed that participants from the instructed condition performed significantly better than those in the exposure condition on the conditional rules of the language only (Newman-Keuls: $p < .001$). No differences were found on the unconditional rules. Mean and standard deviation scores are presented in table 4.2 below:

Table 4.3. Mean percentage and Standard deviation scores on Test 3 (including longer items) according to input condition.

	Unconditional Rules		Conditional Rules	
Input condition	mean	st dev	mean	st dev
Instructed	82.75	12.51	75.33	17.97
Exposure	76.5	18.92	59.33	12.59

A main effect of rule type was found, ($F(1,38) = 28.53$; $p < .00001$) in which performance on the unconditional rules was found to be significantly higher (mean: 79.62, st dev: 16.14) than on the conditional rules (mean: 67.33, st dev: 17.33). Follow up analyses revealed that only participants in the exposure condition performed better on the unconditional rules compared to the conditional rules (Newman-Keuls: $p < .001$). Those in the instructed condition performed better but not significantly better on the unconditional rules although the difference approached significance (Newman-Keuls: $p = .07$).

d) Test 3 only (including longer items), all eight rules.

Data from test 3, comparing performance on all eight rules of the language were analysed using a two factor analysis of variance (factors: input condition and rule type).

Again the findings mirrored those of the previous analyses.. No main effect of input condition was found; an interaction between input condition and rule type ($F(7,266) = 2.74$; $p < .001$) was found. Follow up analyses revealed that participants in the instructed group performed significantly better than those in the exposure condition on rule 6 only (Tukey HSD: $p < .01$). The mean scores for both input conditions on each of the eight rules of the language are shown below, (see Figure 4.3).

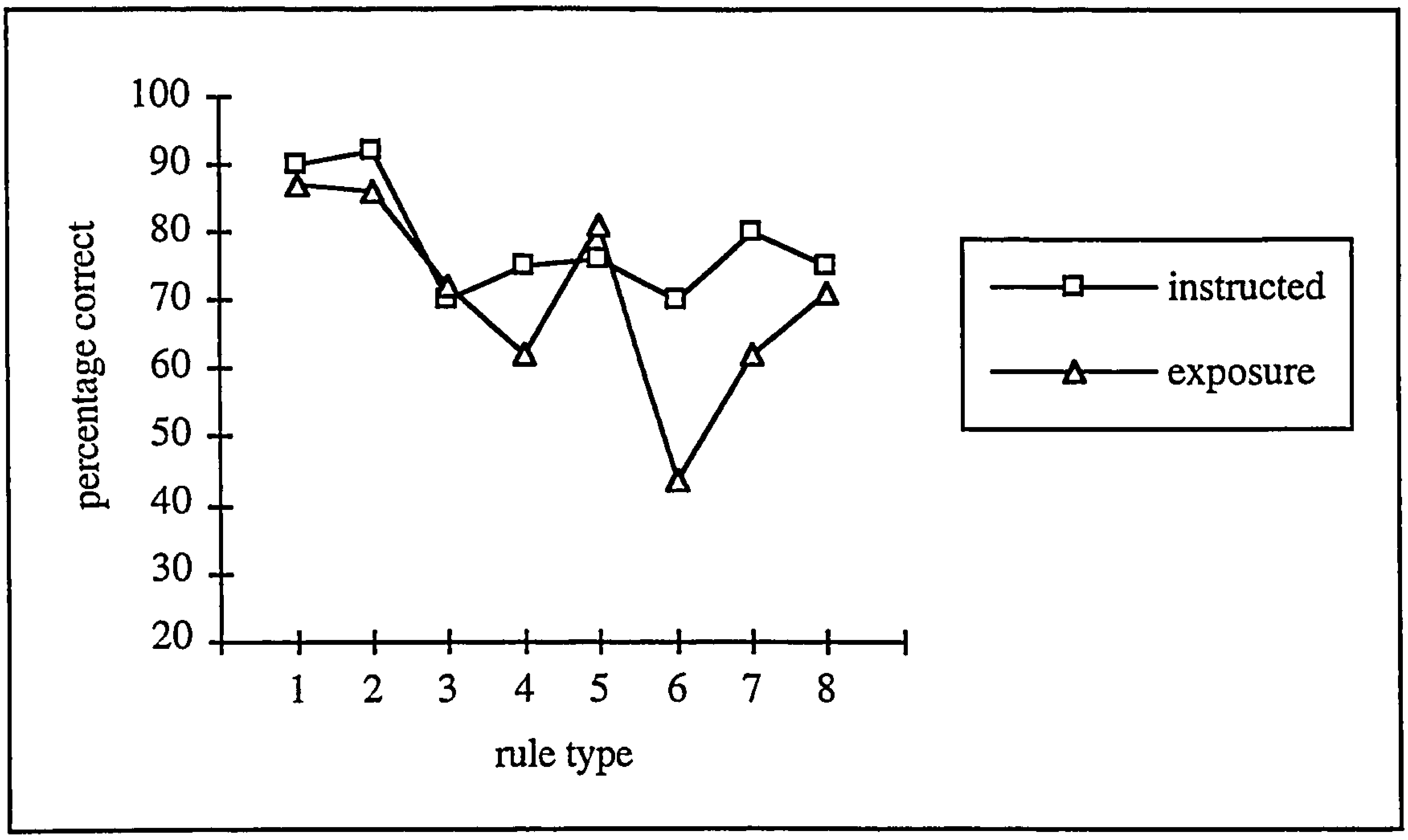


Figure. 4.3 Mean percentage scores on rules test 3 (including longer items) according to input condition and rule type.

A main effect of rule type was found ($F(7, 266) = 11.39$, $p < .0001$) where performance overall on rules 1 and 2 was significantly higher than on all other rules except rule 5 and performance on rule 6 was significantly lower than all other rules except rule 4 (Tukey HSD: all values $p < .05$ or lower). Closer analysis revealed that performance on rule 6 was significantly different from that on all other rules except rules 4 and 7 for the exposure condition only (Tukey HSD: all values $p < .001$ or lower). However, for the instructed condition, performance on rule 6 was different only from rule 2 (Tukey HSD: $p < .05$).

Performance on rule 7 was significantly poorer overall than on rules 1, 2 for both input conditions and poorer than 5 for the exposure condition only (Tukey HSD: $p < .001$, $p < .001$, $p < .01$, respectively).

Summary of Rules Test findings immediately after input.

a) Effects of Input Condition and Rule Type

The instructed groups' overall performance was found to be significantly higher than that of the exposure group only when analyses were carried out separating performance on the unconditional and conditional rules. However, this effect was lost when all eight rules were analysed. The former analysis had excluded data from rule 5; when these data were included, the overall difference between the two input conditions was no longer found to be significant .

A significant interaction between input condition and rule type (separating performance on unconditional and conditional rules) was found. Participants in the instructed condition outperformed those in the exposure condition on the conditional rules only. Further, more detailed analysis, examining performance on the eight individual rules revealed that the two input conditions could be separated on rule 6 only. Here the exposure group's performance appeared to drop dramatically rather than the instructed group's performance improve dramatically.

In summary it would appear that the performances of both input conditions on the rules tests were similar across many of the rules. The input conditions could be separated on rule 6 of the language only. This was possibly one of the most complex rules of the language. Participants from both input conditions performed better on rules 1 and 2 (both unconditional rules) compared to the other six rules of the language. Some difficulty was also experienced by the exposure group on rule 7.

(Note: an identical study was run prior to the current study where the rules tests were inadvertently presented in a non-randomised order. The current study was a re-run of this flawed study. However, it is interesting to note that the pattern of the results across the eight rules across all three tests was virtually identical to the pattern described above for the current study. The two input conditions could be separated on rule 6 of the language only and again there appeared to be a dramatic drop in performance by the exposure condition on this rule.)

b) Effect of Test Type

No effect of test type was found. The inclusion of longer test items into test 3 did not appear to have affected overall performances.

3. Free Production Tests.

The free production booklets were designed to ascertain whether participants could produce novel sentences of their own. Performance was measured in two ways: firstly, by recording the number of complete, grammatical sentences produced by each participant. Secondly, by noting the number of times each of the ungrammatical sentences produced (if there were any) broke one of the rules of the language.

For example: the sentence 'BIF KOR FAC' is incorrect because it breaks rule 8 of the language: "A 'C' phrase must occur before an 'F' word". The above sentence consists of an 'A' class word followed by a 'D' class word with a final 'F' class word. The 'F' class word must be preceded by a 'C' class word or a 'C' class plus 'D' class word (a 'C' phrase). to make the full 'B' phrase (see Chapter 2, Study 1, for phrase structure tree diagram).

Two sets of analyses were carried out, one examining the number of correctly produced sentences, the other examining the number of rule breakages made in the incorrect sentences.

a) Proportion of correctly produced sentences.

The total number of grammatically correct sentences from both free production booklets was recorded for each participant and the percentage correct (as a proportion of the number of questions in each booklet) was calculated. The data were then analysed using an independent groups two sample t test.

A significant difference was found between the performance of participants in the two input conditions, ($t(1,38) = 2.23$; $p < .05$). Participants in the instructed condition produced a significantly higher percentage of correct sentences (mean: 67.38, st dev: 20.36) than was produced by those in the exposure condition (mean: 48.92, st dev: 30.82).

b) Number of rule breakages.

All ungrammatical sentences were recorded and their grammatical structure assessed. If the word order broke one of the rules of the language this was noted. (A single ungrammatical sentence could break more than one of the rules.) The number of rule breakages was totalled for each participant. A two factor analysis of variance was performed (factors: input condition and rule type broken).

The effect of input condition approached significance ($F(1, 38) = 4.05$; $p = .05$). Participants in the instructed condition appeared to break the rules of the language on fewer occasions than those in the exposure condition (means: 3.08, 1.89; st devs: 3.66, 3.95 respectively). (However, it must be noted that a high number of participants did not break specific rules resulting in a zero score for that rule. This affected the distribution of and variance in the data and care should be taken in the interpretation of the outcome of subsequent statistical procedures.)

An interaction between input condition and rule type was found ($F(7, 266) = 3.15$; $p < .01$). Follow up analyses revealed that the sentences produced by participants in the exposure condition broke rule 6 significantly more frequently than sentences produced by those in the instructed condition (Tukey HSD: $p < .05$). No other differences in the number of rule breakages of any other specific rule was found. The mean scores are plotted below (see Figure 4.4).

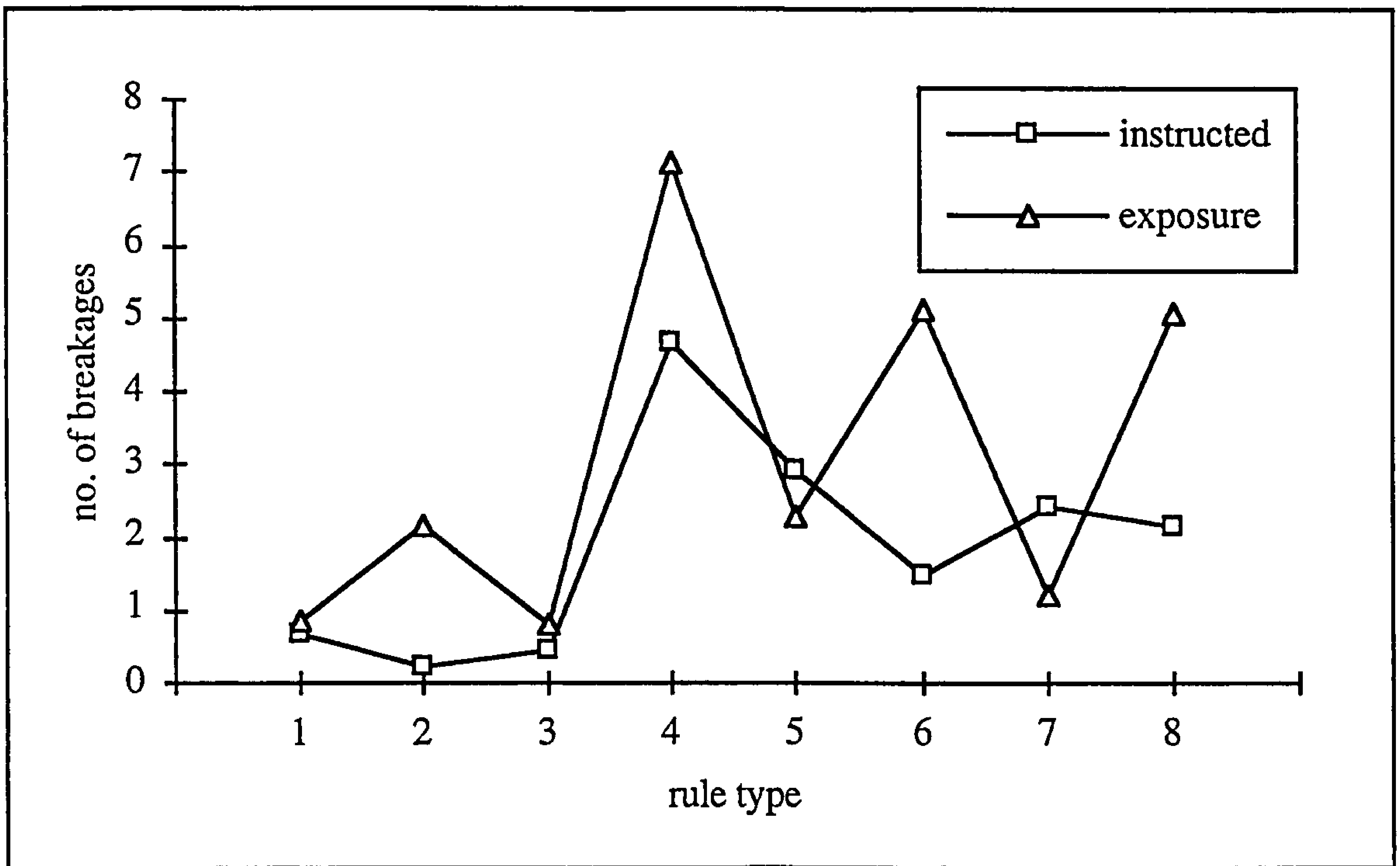


Figure. 4.4 Number of rule breakages. according to input condition.

Participants in both input conditions produced a high number of sentences which broke rule 4. Those in the instructed condition broke rule 4 significantly more frequently than rules 1, 2 and 3 (Tukey's HSD: all $p < .01$). Participants in the exposure condition broke rule 4 significantly more frequently than rules 1, 2 , 3, 5 and 7 (Tukey's HSD: all values $p < .01$ or lower).

4. 3. 2 Results (after nine week break)

Rules tests 1 and 3 were presented (for a second time) to participants in random order. A shortened Free Production test was given in between the Rules Tests and finally participants were presented with a Working Memory Test. (The test of working memory was introduced for reasons which are described below.)

1. Vocabulary Tests

None were taken.

2. Rules Tests

After the nine week break, 37 of the 40 participants returned (18 in the instructed condition and 19 in the exposure condition.) They were presented with Tests 1 and 3 (as described above) in random order. Below is an overview of the analyses carried out (see Table 4.4).

Table 4. 4 Overview of analyses carried out on Rules Test data at Time two.

Analysis no.	Tests	Rules Analysed
a	1 and 3*	unconditional and conditional
b	1 and 3*	all eight rules

Note: "3*" = test 3 with the longer items' data removed;

a) Tests 1 and 3, unconditional and conditional rules.

Data comparing performance on the unconditional compared to conditional rules were analysed using a three factor analysis of variance (factors: input condition, rule type and test.). No effect of input condition or test type was found, a main effect of rule type was found ($F(1,35) = 14.75$; $p < .001$) in which performance on the unconditional rules was found to be significantly higher than that on the conditional rules, (mean: 63.42, st dev: 14.87 mean: 54.84, st dev: 16.55). Closer analysis revealed that only participants in the instructed condition scored significantly higher on the unconditional compared to the conditional rules but their overall performance on both rule types was lower, though not significantly lower, when compared to that of participants in the exposure condition (this is presented below in Figure 4.5 under the heading "after nine weeks").

b) Tests 1 and 3, all eight rules.

A three factor analysis of variance was performed on data measuring performance on all eight individual rules. No differences according to input condition or test type were found but a main effect of rule type ($F(7,245) = 8.84) = p < .001$) was found. Closer analysis revealed that performance on rule 1 alone was significantly better than on all other rules (Tukey HSD : all below $p < .001$). No other differences in performance on the eight rules were found.

Summary of Rules Test findings after nine week break.

It would appear that participants had retained their knowledge of rule one of the language and were able to use it to make effective judgements on items testing this rule. Their performance on the other seven rules was significantly poorer and tended to indicate that they were generally unable to make accurate judgements on the remaining rules. The difference between input conditions on rule 6 was no longer evident nor was there any evidence of superiority of the instructed condition over the exposure condition on the conditional rules generally.

3. Free Production Tests.

One shortened free production test was given in which participants were asked to write five novel sentences of their own. The test was given after participants had been given one of the rules tests, so in effect they were re-exposed to sentences in Nosmoish prior to this test even though participants were not necessarily aware at this time which of these sentences were grammatical.

The number of grammatical sentences produced by participants from both input conditions was calculated. The scores were rank ordered and a Mann Whitney U-test was used to compare the ranks for the $n = 18$ (instructed condition) and the $n = 19$ (exposure condition). The results indicated a significant difference between the two input conditions ($U = 91.5$; $p < .05$). Participants in the exposure condition produced significantly more fully grammatical sentences than those in the instructed condition.

Table 4. 5 below shows the number of participants in each input condition that produced zero, 1 , 2, 3,4 or the maximum 5 correct sentences.

Table 4. 5 The number of correct sentences produced by participants in both input conditions.

	Input Condition	
No. of correct sentences	**Instructed**	**Exposure**
0 (zero)	8	1
1	7	9
2	0	4
3	2	3
4	1	2
5	0	0

Note: n = 18 instructed condition, n = 19 exposure condition.

4. Working Memory Test

Participants in the instructed condition outperformed those in the exposure condition at time one on rule 6 of the language only. It was felt possible that rule 6 might put an extra load on working memory as it was a relatively complex rule containing both a negative and disjunctive (Rule 6: "A D word cannot appear after an E or F word"). If participants in the instructed condition had better working memories than those in the exposure condition this might account for the difference on rule 6. Although participants were randomly assigned to the two input conditions, a two sample t test on the working memory scores revealed that those in the instructed had significantly higher working memory scores ($t(35) = 2.93$; $p < .01$).than those in the exposure condition.

However, if the learning of rule 6 had put a higher load on working memory compared to the other rules, higher correlations between working memory performance and scores on the rules tests might be expected for this rule alone compared to the other seven. Results of a Pearson Product Moment Correlation revealed non-significant correlations of $r = .46$ and $r = .42$ for the instructed and exposure conditions respectively when correlating rule 6 scores with those obtained on the rule tests immediately after input. Although these correlations were still quite high, correlations on other rules were also relatively high and no distinguishing pattern was revealed to account for the differences on rule 6.

4.3.3 Results comparing performances at time one and time two.

1. Rules Tests

a) Tests 1 and 3, unconditional and conditional rules.

A four factor analysis of variance was performed comparing data obtained immediately after testing with that obtained after the nine week break, (factors: input condition, time of testing, test type and rule type (unconditional compared to conditional)). A main effect of time of testing was found ($F(1, 35) = 54.96$; $p < .001$) in which performance overall was better at time one (mean: 73.97) than time two (mean: 59.10).

A three way interaction between input condition, time of testing and rule type was found ($F(1, 35) = 5.44$; $p < .05$). Mean percentage values for each input condition across the two times of testing according to performance on unconditional and conditional rules are presented below (see Figure 4.5).

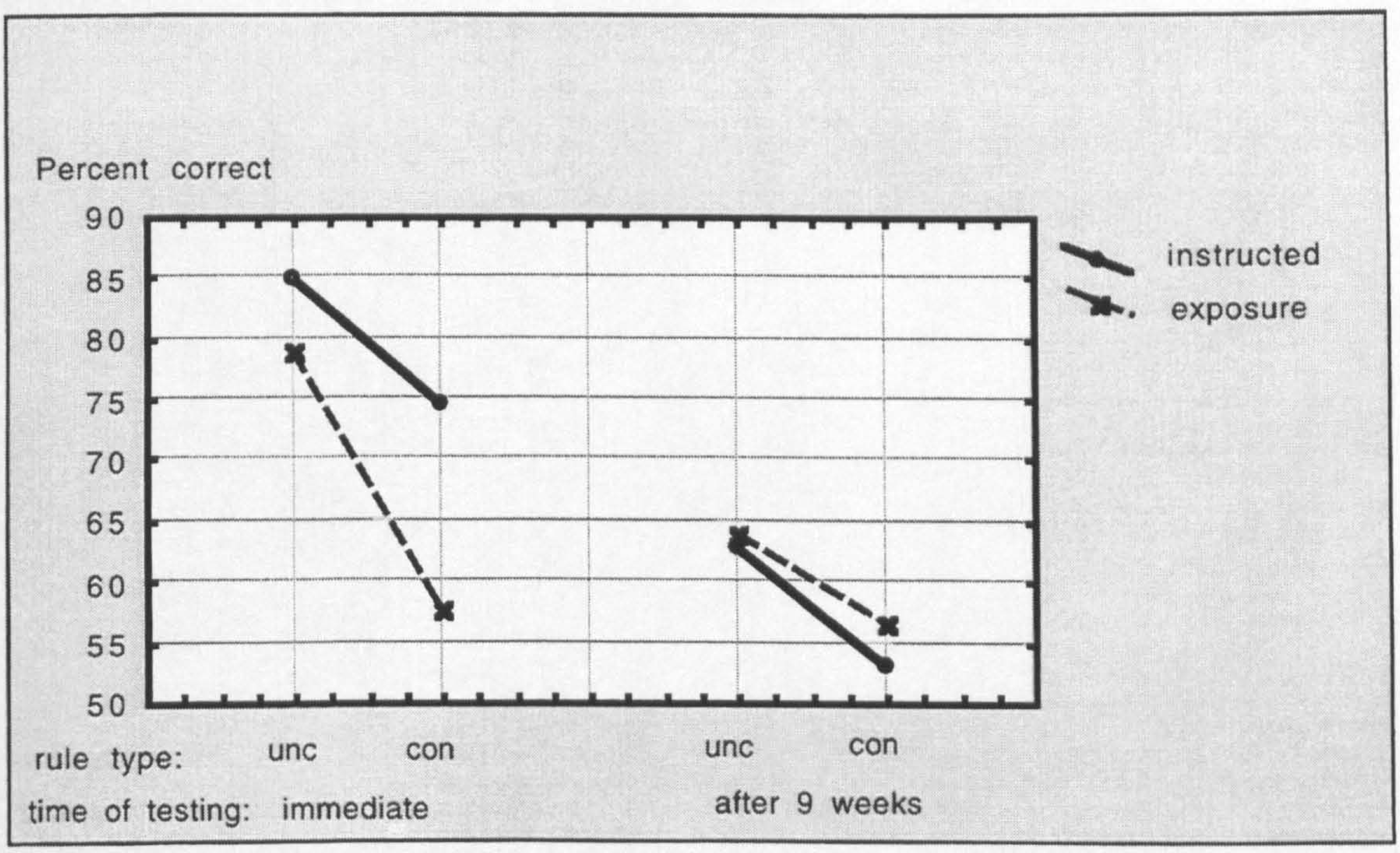


Figure. 4. 5 Mean percentage values for each input condition across the two times of testing according to performance on unconditional and conditional rules.

Follow up analyses revealed that scores differed according to input condition at time one only on the conditional rules, (Tukey HSD: $p < .001$). No other differences across input conditions were found. Performance dropped significantly from time one to time two on the unconditional rules for both input conditions and on the conditional rules for the instructed condition only (Tukey HSD: all at $p < .001$), (the exposure condition performance remained at the same relatively low level on the conditional rules as for time one).

b) Tests 1 and 3, all eight rules.

A four factor analysis of variance (factors: input, time of testing, test type and rule type (all eight rules) was performed. No main effect of input condition was found. A main effect of time of testing was found ($F(1,35) = 67.5$) in which performance at time one was found to be overall higher than at time two. An interaction between input and time of testing was found in which participants in the instructed condition performed significantly better than those in the exposure condition at time one only, (Tukey HSD: $p < .05$).

A main effect of rule type was found ($F(7, 245) = 16.54$; $p < .001$) in which overall performance on rules one and two was higher than on all other rules (Tukey HSD: all values $p < .0001$). An interaction between time of testing and rule type was found ($F(7,245) = 4.27$; $p < .001$) in which performances at time one on all rules, except 1, 6 and 7 were significantly higher than at time two (Tukey HSD all values: $p < .01$ or lower). Mean percentage scores are plotted below according to rule type and time of testing (see Figure 4.6).

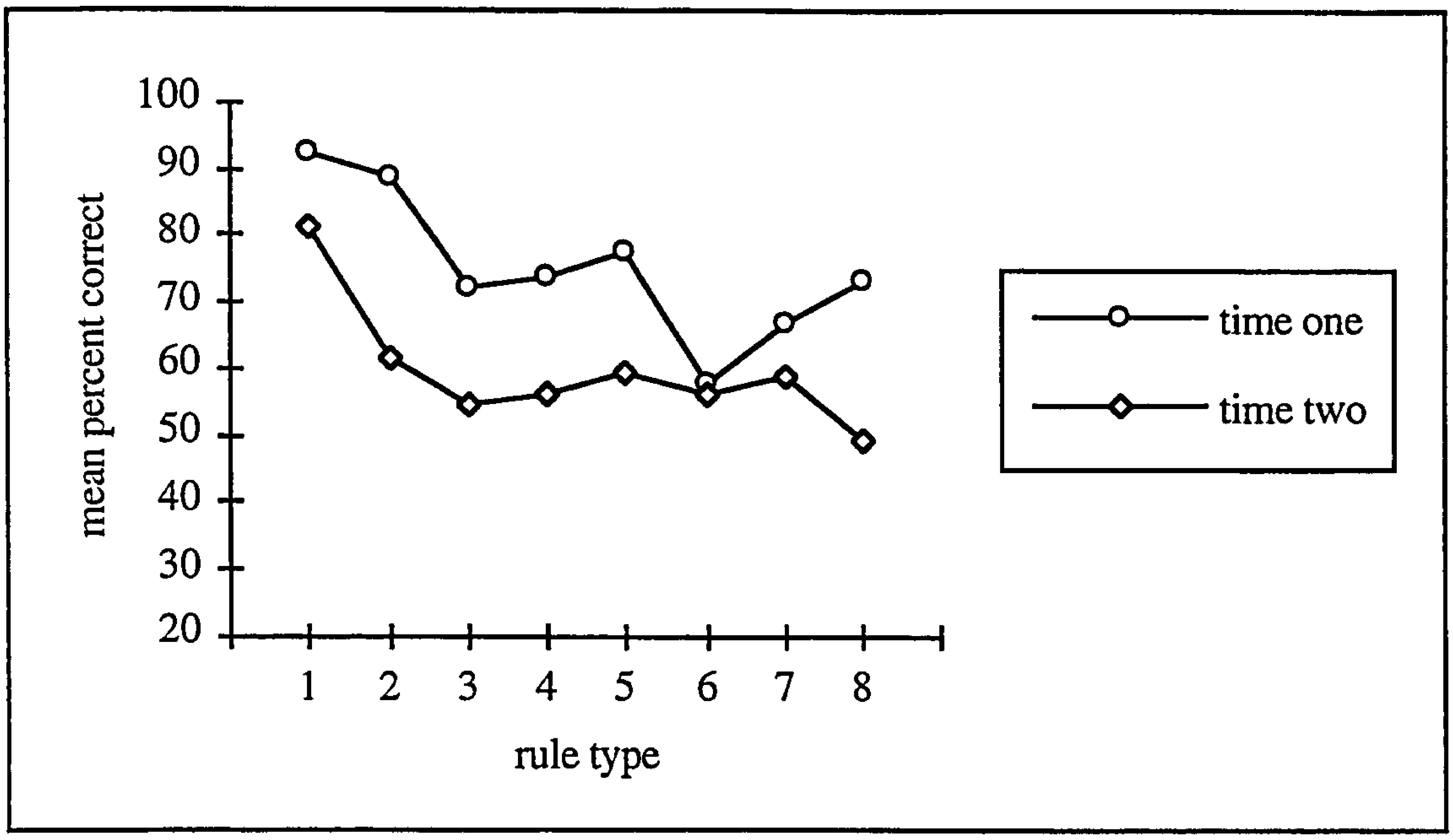


Figure. 4.6 Mean percentage values across the two times of testing according to performance on all eight rules.

Although no significant interaction between input condition, time of testing and rule type was found, closer inspection revealed that performance by the instructed condition dropped significantly from time one to time two on rules 2, 5 and 8 only (Tukey HSD: $p < .0001$, $p < .05$ $p < .001$ respectively) and performance on the remaining rules was lower but not significantly lower at time two. However, performance of participants in the exposure condition did not drop significantly from time one to time two on any particular rule. Figure 4.7 below plots mean percentage scores for each input condition against time of testing and rule type.

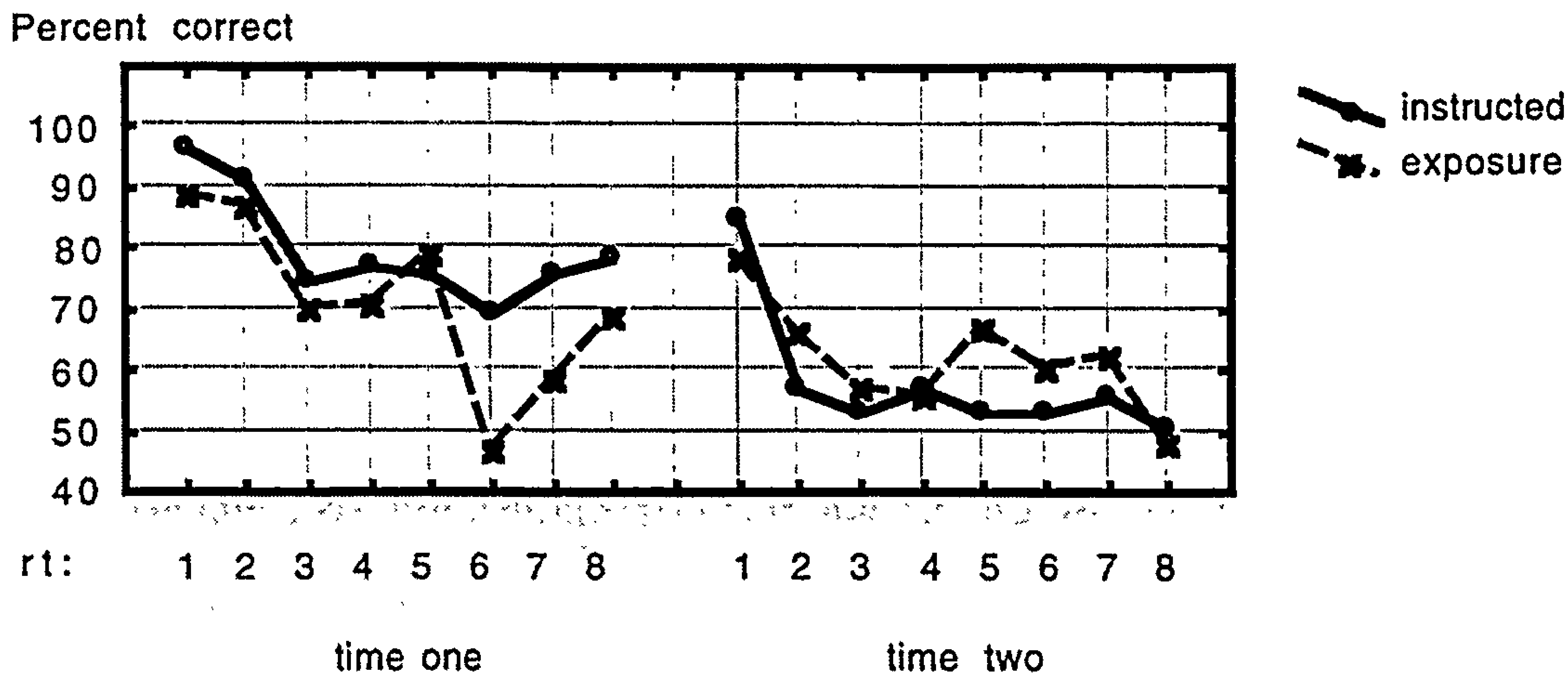


Figure. 4. 7 Mean percentage scores for both input conditions across the two times of testing according to performance on all eight rules.

Participants in the instructed condition performed above chance on all rules at time one but below chance on all rules except rule 1 at time two. Those in the exposure condition performed above chance on all rules except rule 6 at time one. At time two they performed at above chance on rules 1,2,5 and 7.

Summary of Rules Test comparison across time one and two.

Differences across input conditions occurred at time one only on the conditional rules, more detailed analysis revealed that this was chiefly due to differences in performance on rule 6 only. This difference disappeared after the nine week break.

Performance by participants in the exposure condition remained relatively stable across the two time periods whereas performance of the instructed condition fell across the two periods. No significant differences were found between the two input conditions at time 2.

4. 4 Discussion

In Study Three, two key questions were posed: Is there a difference in learning outcome when learners have been encouraged to deduce the rules for themselves compared to the learning outcome of those who have been formally taught rules? Is formal instruction only effective for simple rules or can complex rules also be taught?

Initial exploration of the data collected at time one appeared to indicate an overall positive effect of instruction: instructed learners outperformed exposure learners on both rules tests and free production tests. This finding was in line with that reported by De Keyser (1995) who found a positive effect of instruction but did not correspond with that of Shaffer (1989) who reported finding no difference between her deductive (instructed) and inductive (exposure) learners. The finding provided some support for Lightbown *et al's* (1980) claim that instruction is beneficial in carefully planned production: in Study Three none of the learners' responses were time constrained, learners could, therefore, take their time and plan their responses if they chose to do so.

Whilst the initial analysis indicated an overall positive effect of instruction compared to exposure, closer analysis of the rules tests revealed that learners in the instructed condition outperformed those in the exposure condition on the more complex, conditional rules only and not on the simpler, unconditional rules where the performance of learners in both conditions was relatively high. This finding did not support that reported by Pica (1985) who found a positive effect of instruction on simple rules only and provided only partial support for Robinson (1996) who found a positive effect of instruction on both simple and complex rules. It does provide some support for N. Ellis (1993) whose "rules and instances" learners (who he claimed had been taught the complex rules governing soft-mutations in Welsh) outperformed those who had been exposed to examples only. (However, as noted above, Ellis' definition of instructed learning did not involve the explicit teaching of rules and so direct comparisons with the current study cannot be properly made.)

More detailed analysis comparing performance on each of the eight rules separately indicated that the instructed learners outperformed those in the exposure condition on one conditional rule only: rule six. Furthermore, in the free production tests, learners in the exposure condition broke rule six on significantly more occasions than those in the instructed condition. No other significant differences between the two conditions were found on any other rule on either test. The advantage of the instructed learners over the exposure learners on rule six was only apparent at time one when learners were tested immediately after input. The advantage was no longer evident nine weeks later when no differences were found between the groups on this rule on either the grammaticality judgement or free production tests. This finding is in accord with that reported by Lightbown (1983) who found a positive effect of instruction which disappeared over time. The difference on rule 6 at time one could not be explained in terms of differences in working memory capacity of the learners in the two conditions as the correlations between working memory and performance on rule 6 were non-significant and no distinguishing pattern was revealed on rule 6 compared to the other rules.

In summary, whilst the preliminary findings appeared to indicate a positive effect of instruction compared with simple exposure on the acquisition of syntax, closer examination of the results indicated that this conclusion might have masked more subtle effects which only came to light when more detailed analysis was performed. The overall positive effect was only found when the analysis was performed on the rules grouped together into unconditional and conditional rule types: rule 5, the so-called hybrid rule was omitted from this analysis. When rule 5 was included the overall difference between the two groups was no longer significant. (Closer inspection of the data revealed that learners in both conditions performed well on this rule and the inclusion of the corresponding data would have drawn the two conditions together.) More detailed analysis on each of the eight rules separately revealed that the two conditions differed on rule six of the language only. The apparent advantage of instructed learners over exposure learners was not evident on any of the other rules. It could be argued therefore that, contrary to the conclusions arrived at earlier, there is more evidence to support the findings of Shaffer (1989) who found no difference between instructed and exposure learners than De Keyser (1995) or Robinson (1996).

Whilst instructed learners outperformed those in the exposure condition on one complex rule on both rules tests and the free production tests, performance of learners in both input conditions on the conditional rules was significantly lower than on the simple, unconditional rules. When the eight rules were examined separately it was revealed that all learners experienced more difficulty with rules 3, 4, 7 and 8 than rules 1 and 2. This final point raises the question of whether the grouping of rules into unconditional and conditional categories as a means for discriminating complexity is a valid one. It would appear that learners did not find rules 3 and 4 as simple as they did rules 1 and 2 and yet all four rules were categorised together. The next section of this discussion examines the general issue of complexity and how it relates to each of the eight rules. Rule 6 will then be examined more closely in a bid to determine the specific properties this rule contains which might account for the differences across the two conditions on this rule.

Rules and the issue of complexity.

The issue of rule complexity and the importance of determining what constitutes a complex second language rule has been discussed in the second language field but as Robinson (1996) noted, no clear set of criteria has been established for defining rule complexity. Researchers have presented a number of factors which they have claimed distinguish complex from simple rules: they include the visual and acoustic salience of the feature and the frequency of the feature in the input (Bardovi-Harlig, 1987) and the extent to which the rules could be articulated (Green and Hecht, 1992). Bialystok (1979) defined simple rules as those which related to single lexical items (for example "color adjectives come before the noun") and complex rules as those relating to general structures (for example "to form the passé composé use the correct form of avoir or etre plus the past participle of the verb" (examples taken from Robinson, 1996, p. 31). Finally, Krashen (1982) defined simple rules as those which are easiest to describe and remember.

Robinson concluded that in the absence of a clear set of criteria for determining rule complexity, the use of expert judgements was an acceptable method for distinguishing complexity as it had been used as a standard procedure in the field of problem solving. He adopted this approach in his own study where he asked experienced ESL teachers to rate the complexity of rules using both a rating scale and a Q-sort card methodology. He proposed that the teachers would use "predominately information-processing load criteria similar to those used by Krashen (i.e. ease of description and memorability)." (Robinson, 1996, p.33). Two rules were selected, a simple one which could in theory be reduced to a "simple rule of thumb" (Robinson, p34) and a complex one which could not be reduced in such a manner and would require far more extensive description. The rules also differed in terms of the extent to which the rules occur in other languages, the more complex one being possibly restricted to English.

Robinson used the term "rule" to describe pedagogic rules only i.e. those rules commonly cited by teachers to describe regularities in language (often simplified versions of linguistic rules). (It should be noted that the use of the term "rule" as a description of how language is represented in the mind is a highly contentious issue and subject to wide debate (Crick, 1995; Chomsky, 1986). Any reference to the term "rule" in this thesis refers to pedagogic type rules.)

In the current research, the miniature language adopted from Morgan *et al* (1989) had been organised into what were described as unconditional and conditional rules (see Table 2.1 above for a review of the eight rules.) The unconditional rules (rules 1-4) described "necessary aspects of the sentences" (Morgan *et al*, 1989, p.365) and the conditional rules (rules 6 -8) described "contingent properties of the sentences, such as "if an E word is present, it cannot be preceded by a C word." (p.365). Morgan *et al* later referred to the conditional rules as the "more complex" (p.368) rules and noted that these rules involved co-occurrence relations among form classes: the conditional rules established the extent to which words from different classes could occur together (for example, an F class word must be preceded by a C phrase). Morgan *et al* did not define the term "complex" but the implication seemed to be that it would be more difficult to note co-occurrence restrictions than features which simply had to be present in the input.

In Study Three, as stated above, it was found that learners in both conditions performed better on rules 1 and 2 of the language than on rules 3 to 8 inclusive. On the basis of this performance it seems reasonable to suggest that rules 3 to 8 are more difficult than rules 1 and 2. In the light of this, it would appear that the grouping of rules 1 and 2 with rules 3 and 4 might be inappropriate if they are assumed to be similar in terms of complexity (that is, if difficulty relates to complexity). Whilst Morgan *et al* had placed the rules into two categories based on the degree to which they involved restrictions on co-occurrence, this might not have been the best or only predictor of complexity.

Two questions remain: firstly, what made rules 3 to 8 more difficult than rules 1 and 2 and secondly, why did learners in the exposure condition experience special difficulty on rule 6? As was stated above, researchers in the field of second language have yet to reach any consensus regarding the setting of criteria for defining complexity. In the miniature language system used in this research, Morgan *et al* had defined complexity in terms of the presence or absence of a conditional denoting co-occurrence restrictions. A similar approach has been adopted by researchers in the field of reasoning (Evans, Newstead and Byrne, 1993). They highlighted a number of factors which they considered contributed towards the difficulty of solving reasoning problems: these included the use of conditionals and disjunctives (problems containing "or") and the presence of negatives. It is hypothesised that such factors might have contributed to the difficulty of learning the eight rules of the miniature language in the current study. In the next section of this discussion, the eight rules of the language will be examined in turn. They will first be categorised into factors which have been considered by both Morgan *et al* and the reasoning researchers to contribute to complexity (see Table 4.6 below). The rules will then be further examined on the basis of the factors which have been considered by second language researchers to affect complexity.

The first factor is whether or not the rule involved a conditional where emphasis was placed on restrictions on co-occurrences of specific features. As stated above, this was the criterion set by Morgan *et al* (1989) to distinguish simple and complex rules. They argued that rules 1-4 were unconditional and rules 6 - 8 were conditional. However, in the following examples it is apparent that rules 3 and 5 could also be included in the "conditional" grouping. Rules 3 and 5 - 8 are presented below and have been re-phrased using conditional sentences in which co-occurrence restrictions are highlighted. (To enable comparisons to be made between the rules using the original wording and the newly phrased rules, the originally worded rules are presented in brackets and are italicised.)

Rule 3: "If there is a C phrase at the end of a sentence you cannot have another C phrase." (*"There may be at most one C phrase at the end of a sentence."*)

Rule 5: "If a sentence contains an E word (or F word) it cannot contain another E (or F) word " (*"No sentence may contain more than one E or F word."*)

Rule 6: "If a sentence contains an E word or an F word it cannot be immediately followed by a D word" (*"A D word cannot appear after an E or F word."*)

Rule 7: "If a sentence contains an E word it cannot be preceded by a C phrase." (*"A C phrase cannot occur before an E or F word"*.)

Rule 8: "If a sentence contains an F word, it must be immediately preceded by a C phrase." (*A C phrase must occur before an F word."*)

(In principle all the rules could described in terms of a conditional: for example, all rules could begin: "If you have a sentence, then it must contain x ...." . However, rules 1, 2 and 4 do not involve any restrictions on co-occurrence of specific features and are therefore not included in the "conditional" category.)

If rules which fall into the "conditional" category are assumed to be more complex, then the difficulties experienced by learners on rule 3 might be explained: rule 3 falls into this category. However, the difficulties experienced on rule 4 cannot be explained in this way and neither can the *particular* problems experienced by learners in the exposure condition on rule 6. In summary, separation of the rules into unconditional and conditional aspects seems to have some limited predictive value in determining the difficulty of a rule. However, it appears that other factors need to be taken into consideration in order to explain the more detailed patterns of difficulty experienced by learners in the two conditions.

The second and third factors thought to contribute towards rule complexity were the presence of a disjunctive and a negative. The presence or absence of these factors in the eight rules of the language is presented in table 4.6. Rules 2, 3, 5, 6 and 7 contain a negative and rules 4, 5 and 6 a disjunctive. Only two rules contain both a conditional and negative: rules 3 and 7; none contain both a conditional and a disjunctive but rules 5 and 6 contain all three factors: a conditional, negative and a disjunctive. On the basis of this

Table 4. 6 Factors contributing towards complexity on each rule.

Rule No.	Description	Conditional (involving co-occurence of features)	Contains a negative	Contains a disjunctive	Beneficial to have knowledge of phrasal structure?	Visual salience of feature determined by position in sentence	Frequency of rule in the input	Extent to which the rule related to single lexical items
1	every sentence must have at least one A word	no	no	no	no	high	all	single
2	no sentence can contain more than one A word.	no	yes	no	no	high	all	single
3	there may be at most one C phrase at the end of a sentence	yes	yes	no	yes	low	half	general
4	every sentence must have at least one E or F word	no	no	yes	no	low	all	single
5	no sentence may contain more than one E or F word	yes	yes	yes	no	low	all	single
6	a D word cannot appear after an E or F word	yes	yes	yes	yes	low	half	general
7	a C phrasecannot occur before an E word	yes	yes	no	yes	low	half	general
8	a C phrase must occur before an F word	yes	no	no	yes	low	half	general

categorisation one might predict that rule 1 would be simplest as it contains none of the three factors: learners in both conditions scored very highly on this rule; rules 2, 4 and 8 might be expected to be the next simplest as they contain only one factor: a negative, conditional or disjunctive respectively. However, this predicted order was not borne out in the results: learners performed significantly better on rule 2 than rules 4 and 8. It would appear that some other factor is needed to distinguish rule 2 from 4 and 8. (Possibly negation has less impact on complexity than a conditional or a disjunctive. Future research might address this specific issue.) Rules 3 and 7 contained both a conditional and a negative. If the existence of two factors increases complexity one might expect learners to find these rules more difficult than those already described. This was the case but only when compared to rules 1 and 2: performance on rules 3 and 7 was not significantly different from rules 4 and 8 under either input condition: the rules seemed to be reasonably equal in terms of complexity. Finally, rules 5 and 6 were deemed the most complex as they contained all three factors. This might explain the difficulties experienced by those in the exposure condition on rule 6: it is possible that learners in the exposure condition were not successful in finding rule 6 because it was a particularly complex rule and as Reber (1994) claimed, looking for rules will not help if you cannot find them (this assumes learners in the exposure condition were actively searching for rules). However, rule 5 was categorised as being of equal complexity to rule 6 yet learners in the exposure condition did not experience the same degree of difficulty with this rule. This calls into question the extent to which the three factors can, in isolation, be used to explain the pattern of results. It is likely that other factors need also to be considered.

A fourth factor which might contribute towards rule complexity is the extent to which phrasal structure knowledge is required. The miniature language used in this study could be generated using phrase structure rules. Sentences could be divided into three phrases: an A, B and optional final C phrase. Knowledge of these phrasal groupings would, according to Morgan *et al,* facilitate the acquisition of the more complex rules. Close inspection of each of the eight rules (see Table 2.1) revealed that only rules 3, 6, 7 and 8 would benefit from the learner having knowledge of phrasal groupings. Rules 1, 2, 4 and 5 refer only to instances of individual word classes in the input, none of these rules relying on knowledge of phrasal groupings.

In the examination above the difference in performance by exposure learners on rule 5 compared to rule 6 could not be explained with reference to the three factors previously described. However, the two rules can be distinguished in terms of the extent to which knowledge of phrasal grouping is required. Rule 6 would benefit from knowledge of phrasal structure - knowledge which was imparted to the instructed group but not the exposure group. Rule 6 states that "a D word cannot appear after an E or F word" (note: this should read "*immediately* after"). To help learners with this rule it might be advantageous to know that the D word forms part of a C phrase and requires a preceding C word. Only a C phrase can appear after an E or F word. Knowledge of phrasal groupings might help learners notice that the D word has been presented without a preceding C word. Learners who have no knowledge of phrasal groupings might have to base their judgement on whether or not they recall seeing a D word immediately after an E or F word or they might be using a different strategy altogether.

In summary, the poor performance by learners in the exposure condition on rule 6 relative to their performance on the other eight rules might be explained in terms of a combination of the overall complexity of the rule (based upon the three factors described above) and the absence of knowledge of phrasal groupings which might hypothetically have been required on this rule. Rule 5, an equally complex rule, did not cause specific problems for the exposure learners possibly because knowledge of phrasal structure was not required. Learners in the instructed and exposure conditions did equally well on this rule but their performance was still significantly poorer than on rules 1 and 2, reflecting the complexity of this rule.

The overall superior performance on rules 1 and 2 compared to rules 3 and 5 - 8 can be explained in terms of the number of factors which were considered to contribute towards rule complexity. Rules 1 and 2 contained only one of these factors between them whereas the other rules (with the exception of rule 4) contained a minimum of two up to a maximum of four factors. (see Table 4.6). It is difficult to explain the poor performance on rule 4 except perhaps with regard to the salience of its position in the sentences. This leads the discussion on to the factors considered by second language researchers to contribute to complexity. These factors included: the salience of the visual display; the frequency of the rule in the input; the extent to which the rule related to single lexical items or general structures and the ease by which the rules could be described and remembered.

It could be argued that rules 1 and 2 were more visually salient as the A word to which they refer only ever occurred in sentence initial position. Those features relating to all the other rules were in mid- or last position. The features relating to rules 1, 2, 4 and 5 were present in all the sentences presented to the exposure learners whereas those relating to rules 3, 6, 7 and 8 were only present in twenty four of the forty eight base language sentences. Only rules 1, 2, 4 and 5 related to individual lexical items in the input whereas the other rules related to combinations of lexical items in relation to each other. If these factors are considered alongside those already presented it can be seen that rules 3, 4, 5, 6, 7 and 8 would be expected to be more difficult to learn than rules 1 and 2. Rule 4 can only be distinguished from rule 1 and 2 in terms of its less salient position in the sentence. Only rule 6 contains all the factors hypothesised to contribute towards complexity.

Why did the exposure group have specific problems on rule 6?

Given the mounting evidence it would appear that rule 6 was in fact one of the more complex rules and that it was likely that this created problems for the group whose remit had been to search for the rules. As Reber claimed, looking for rules will not help if you cannot find them. Those in the instructed group had also experienced problems with this rule relative to their performances on rule 1 and 2 but they at least maintained above chance performance. The question is why was did the exposure learners experience more difficulty with this rule compared with those in the instructed condition? why did this difficulty disappear after nine weeks?

As stated in the introduction to this chapter, it is common for researchers to make claims about the kind of learning, whether implicit or explicit, learners engage based only upon the kind of input and type of instruction the learners have received. Up until now I have refrained from speculating on how the learners might have approached the learning task. I *have* commented on possible reasons why learners in the two input conditions differed on rule 6 and not rule 5. I suggested that the instructed learners might have benefited on rule 6 only because this rule requires knowledge of phrasal structure whereas rule 5 does not. Beyond this I have not made any claims as to how the learners approached their learning tasks. I would continue to argue that there is no way of knowing whether learners in this study learned the knowledge consciously or unconsciously.

However, it is interesting to note the rather unexpected and strange pattern in performance across the two times of testing by learners in the exposure condition. Their performance on rule 6 was noticeably poorer immediately after input than nine weeks later (changing from 47% to 60% accuracy). This effect was only observed on one occasion and a replication of the effect would be required to ensure it was a reliable one. However, in order to account for this rather unexpected improvement the following hypothetical account is presented. It is possible that learners had adopted a simple rule for making their choices on rule 6 but that the rule was wrong. The real rule might have been too difficult to spot given the lack of salience of the feature in the input, the fewer opportunities for seeing the rule in action (a C phrase followed an E or F word in only half the presentations) and the possibility that they had failed to notice the CD word grouping. If learners in the exposure group had adopted a simple rule of thumb policy, the question is, what was their policy?

There were thirteen items testing rule 6. In each case a correct sentence was presented in which the sentence ended with either an E or F word or ended with an E or F word followed by a C or CD combination. Possible correct sentence examples: AEC, AECD, ACFC, ADCF, ADE

The incorrect sentences were made by placing a D word immediately after the E or F word as follows: AEDC, ACFDC, ADCFD, ADED..

Exposure group learners might have adopted a number of possible strategies at time one. One policy might have been to only accept longer sentences. However, if they had done so they would not have reached the levels of performance reached on the other rules where both longer and shorter sentences were correct. Secondly, they might have adopted a policy of only accepting sentences ending in C or D and rejecting sentence ending in E or F. This is possible as in their input only twenty sentences ended in E or F compared to twenty eight sentences ending in C or D. If they had adopted this "rule of thumb" this would have led them to reject grammatical sentences on six of the thirteen test items. If they then guessed on the other items where both ended in a C or D this would possibly account for the poor performance on this rule. Learners might have forgotten their own rule and resorted to guessing at time two.

Of course, this is purely conjecture and there is no way of knowing exactly which policy or rule of thumb learners did adopt or even if they adopted any system at all. The important point is that learners might not learn the rule that has been written by the teachers of a system and as such the extent to which that written rule is complex or simple may have no bearing on whether or not it is learned. It is always possible that learners work out rules of thumb or adopt a heuristic or short cut which they use which might result in either the right answer or a consistent but wrong answer. In order to determine what is actually going on in the head of the learner one can at least ask. How representative the answers are of the real basis for learners' judgements is impossible to say but it would be one way of determining whether learners are, at the very least, aware of any rules they are using.

Conclusions.

In conclusion, instruction compared to exposure appeared to facilitate only the learning of rule six. A number of factors which are considered to influence rule complexity were examined and it was found that rule six contained all the factors. It was also noted that rules 3 - 8 were more difficult for learners in both input conditions and that the original classification adopted by Morgan *et al* for distinguishing rule complexity was insufficiently accurate. Overall it was judged that rules 3 and 5- 8 were more complex than rule 1 and 2 and that instruction did not raise performance on these more complex rules to the level reached on the simpler rules nor did it raise performance on these complex rules to a level above that reached by learners who received no instruction.

How can performance on these more complex rules be improved? Is instruction only really effective on the most highly complex rules where rules of thumb possibly adopted by uninstructed learners simply will not work? In order to answer the first of these two questions, one can consider two possible avenues: the first is the extent to which aptitude impacts on complex rule learning: would such expert learners benefit more from instruction compared to learners who have no strong background in language learning. Would they be more successful in learning the complex rules of the language?

Secondly, can complex rules only be acquired unconsciously or implicitly as argued by Krashen (1981) and Reber (1994). Would performance be improved if learners made no attempts to work out the rules but were exposed to the system and learned it without conscious effort?

In Study Four of this thesis, the first of these approaches was examined whereby Hungarian teachers of English were tested under the identical conditions to those described in Study Three. The questions posed were: Do learners who have good metalinguistic skills and heightened grammatical sensitivity profit more from either one of instruction or exposure input ?Do learners who have good metalinguistic skills and heightened grammatical sensitivity perform better on the more complex rules? Would these high aptitude learners learn the complex rules to the level attained by non-expert learners on the simple rules and would they benefit more from any particular type of input.

Finally, in Study Five, an "implicitly" oriented condition was introduced to see whether, as claimed by Krashen and Reber, learners in this condition would be more successful at learning the complex rules. Is it background expertise or type of input which matters most in complex rule learning?

Chapter Five.

Study Four.

5. 1 Introduction.

In Study Three, two key questions were posed: the first addressed the extent to which learning outcome differed depending on the type of input received. It was found that the instructed learners outperformed those in the exposure condition on rule 6 only, one of the most complex rules of the language. This difference disappeared after a nine week break. Learners in both conditions performed significantly better on rules 1 and 2 than on all other rules except rule 5. After thorough examination of the factors which were considered to contribute towards rule complexity, it was decided that rules 1 and 2 should continue to be classified as simple rules but that rules 3 and 4 should be combined with rules 5 - 8 and re-classified as complex rules.

The second question addressed in Study Three referred to the degree to which formal instruction was effective in the teaching of complex rules. It was noted that receiving input which contained formal instruction was, for the majority of complex rules, no more effective than receiving input which contained no such instruction. Only on the most complex rule did instructed learners outperform exposure learners. Performance on the complex rules was poorer in both conditions than on the simple rules. The question that remained was whether performance on the complex rules could be improved and if so, how?

Two possible avenues of research were presented. The first of these involved examining the role of the "learner" and the second involved a further manipulation of the "type of input" received. Study Four examined the first of these avenues and addressed the following questions: was the difficulty experienced by learners on the complex rules related to some attribute of the learners themselves? Did learners simply lack the ability to discern the grammatical features in the input even in the case where the rules of the language were stated explicitly? Would learners who are more sensitive to grammatical structure and features in the input perform better than those who are less sensitive and would there be a corresponding improvement in performance on the complex rules?

Would such "grammar sensitive" learners benefit more from formal instruction or exposure?

A large body of research has been carried out to discover what makes a "good language learner". A number of tests of "aptitude" have been designed which are claimed to measure the basic cognitive abilities underlying aptitude for L2 learning. The Modern Language Aptitude Battery (MLAT, Carroll and Sapon, 1959) is one of the most widely known and used of these tests. One component of the MLAT is a test of grammatical sensitivity which measures the ability to detect the grammatical function of words in sentences. Robinson (1997) used the MLAT in a study he performed to examine the relationship between aptitude, input condition and rule awareness on performance on easy and difficult second language rules. His main concern was to investigate the extent to which aptitude related to performance under conditions which required either a conscious focus on form (for example formal instruction or instruction to rule search) or which required learners to perform a different task (for example to memorise sentences) but which supposedly did not require a conscious focus on the underlying form. Robinson had noted Krashen's claim that aptitude tests draw on abilities which are under conscious control and as such he predicted that individual differences in aptitude would correlate only with performance on tasks which had required conscious focus on form. Robinson set out to test this claim. He measured aptitude by focusing on three components of the MLAT, one of which was a measure of grammatical sensitivity. He reported a significant correlation between grammatical sensitivity and performance on both simple and complex rules when learners had received formal instruction (supposedly where focus on form had been conscious). This finding was in accordance with that predicted by Krashen. However, under the "implicit" input condition (where supposedly no conscious focus on form should have taken place) the same positive correlations between aptitude and performance were found. This finding was not in accordance with that predicted by Krashen. Of more relevance to the current study was the finding that in the condition where learners had been told to search for rules, Robinson found a significant correlation between grammatical sensitivity and performance on the simple rules but no significant correlation between grammatical sensitivity and performance on the hard rules. He suggested that the correlation between grammatical sensitivity and performance in the implicit condition on both simple and complex rules might have been due to learners in this condition adopting a conscious, analytical, rule search approach to learning. However, this does not explain why in the original rule search condition a significant correlation was found between grammatical sensitivity and performance but on the simple rules only. Robinson argued that "looking for rules that are easy will work if the learners are sufficiently sensitive to the grammatical regularities of the structures to be learned." (Robinson, 1997, p. 76.) He made no comment on why learners' grammatical sensitivity did not correlate with performance on the complex rules under the original rule search conditions. In the current study I am interested in comparing the differential effects on learning under instructed and exposure (instructions to rule search) conditions. I will therefore focus on the findings related to these two input conditions only.

In Study Three learners were not given tests of language aptitude due to limitations in the amount of time available for testing. However, they were asked to state their level of language learning experience and ability. The learners in Study Three varied widely in terms of their language learning experience: only a tiny minority were experienced language learners. It is not possible, therefore, to assess the degree to which these learners were "grammatically sensitive". If grammatical sensitivity interacts with input type (of interest here is the comparison between instruction and exposure type input), then, based on Robinson's findings one would predict that learners who are highly grammatically sensitive might benefit from instructed input on both complex and simple rules but under exposure conditions might perform less well on the complex rules. To establish if this might be the case, and to see if performance on the complex rules could be improved under these conditions, Study Four was performed.

In Study Four, a group of Hungarian teachers of English as a Second Language were recruited. The teachers were highly proficient speakers and writers of English performing at near native speaker level. They also taught English and they commonly did this by providing their students with metalinguistic descriptions of language rules. In summary, the learners recruited in Study Four were special because they were not only good language learners (having an excellent mastery of English as a second language, acquired after the age of seven and above), but they were also good language "describers". I would argue that the ability to talk about language and describe grammatical features most certainly requires a very high degree of grammatical sensitivity and metalinguisitic awareness. According to the findings of Robinson such learners might be predicted to reach relatively high levels of performance on both complex and simple rules under conditions of formal instruction. The same learners might be less successful on the complex rules under rule search conditions.

Whilst very little experimentally based research has been performed to investigate the interaction between aptitude and input condition, some important related findings have emerged. Nation and McLaughlin (1986), using an artificial grammar system very similar to that used by Reber (1967, 1980) compared multilingual, bilingual and monolingual learners under both "explicit" (rule search) and "implicit" (instruction to pay close attention to the strings) conditions. They suggested that multilingual learners would use different strategies in learning the system than less expert learners because their experience would enable them to adopt more automatic processing strategies which required less "processing energy". They reported finding no differences between learners in the three conditions under rule search conditions but they did find a difference under "implicit" conditions. Of interest in the current study is their claim that the learners in the three conditions performed similarly under the "explicit" rule search conditions: this could in theory be due to the similarity of performance on the complex rules which do not appear to be related to aptitude under these particular input conditions. However, the language system used in the Nation and McLaughlin study did not discriminate between difficult and easy rules so any direct comparison between the studies cannot be made.

In a second, related study (Nayak, Hansen, Kruger and McLaughlin, 1990) using the same miniature language system that has been used in the current research, multilingual and monolingual learners were compared under conditions instructing them to rule search or memorise the miniature language sentences. Interestingly, no differences were found between the learners' performances overall, but on the rule search task, the multilinguals outperformed the monolinguals on both simple and complex rules but the effect was strongest on the simple rules. If multilingual learners are considered to have higher grammatical sensitivity than monolingual learners then this study provides tenuous support for the findings of Robinson (1997), who reported a similar effect on the simple rules only.

In Study Four, Hungarian teachers of English were presented with the identical input to that provided in Study Three. Two questions were posed: "Do learners who have high grammatical sensitivity and good metalinguistic skills, profit more from conditions of instruction or exposure? Do learners who have good metalinguistic skills and heightened grammatical sensitivity perform better on the more complex rules? In view of Robinson's and Nayak *et al*'s findings the tentative prediction is that learners in the instructed condition will perform better on the complex rules than those in the rule search condition but that learners in both conditions will perform similarly on the simple rules.

5. 2 Method

5. 2. 1 Participants

Participants were fourteen Hungarian teachers of English whose command of English was virtually fluent. They were in the process of completing their studies at Hungarian Universities and teaching at secondary schools. Their metalinguistic knowledge was excellent as was their command of a second and (for some) a third language. They were in England on a course for non-native English Language Teachers. They received £5 in payment for participation.

5. 2. 2 The Miniature Language

The language used in this study was constructed in exactly the same way as described in Study 3, Chapter 4.

5. 2. 3 Design and Procedure

The design and procedure were identical to those described in Chapter 4 with the exception that only one free production test was used and its length was reduced to minimise the effects of fatigue (see description below). Participants were randomly assigned to either the instructed or exposure input condition.

Testing Phase

Three types of test were given: i) a Vocabulary Test

ii) Rules Tests

iii) a Free Production Test

Vocabulary Tests

The procedure adopted for vocabulary training and testing was identical to that described in Study Three, Chapter Four.

Rules Tests

The rules tests given were exactly as described in Study 3, Chapter 4.

Free Production Tests:

Only one free production test was given, its format was exactly as described in Study 3, Chapter 4 with the exception that the final page was omitted. Participants completed one page between each of the three rules tests.

Time of Testing

Testing took place at two separate times:

1. Immediately after the input stage or "time one"
2. After a nine week break or "time two".

The Hungarian group were to return to Hungary immediately after participation in the study and as a result were asked to complete the second testing phase in their home country. The testing materials were placed in a sealed envelope and the participants were asked to carry out the tests in a specified order on a designated day, nine weeks after the input stage. It was not possible to control the conditions of the later testing procedure.

Only four participants in the instructed condition returned the testing materials compared to all seven in the exposure condition. Data from one of the participants in this condition could not be included (see explanation below). As a result, only three participants remained in the instructed condition. In view of the very small sample size it was considered inappropriate to carry out further analyses of the data from the second time period.

5. 3 Results

Only results obtained immediately after input were included in the analyses and they are presented in the following order:

1. Vocabulary Tests
2. Rules Tests
3. Free Production test

5. 3. 1 Vocabulary Tests

All participants had to score above 70% correct on the vocabulary test in order to continue to the input stage. Thirteen participants reached this level after two vocabulary exposures, the remaining participant reached this level after three exposures.

5. 3. 2 Rules Tests

Three rules tests were given immediately after the input stage exactly as described in Study 3, Chapter 4. Two sets of analyses were again carried out: the first separated performance according to "unconditional" and "conditional" rules, the second was a more detailed analysis which examined performance on each of the eight individual rules of the language. (Note: whilst it has been made clear earlier that the rationale for dividing the rules into unconditional and conditional rules has been questioned, it was decided to continue analysis on this basis to enable comparisons to be made between the different studies.) Below is an overview of the analyses carried out (see Table 5.1).

Table 5.1. Overview of analyses carried out on Rules Test data at time one.

Analysis no.	Tests	Rules Analysed
a	1, 2 and 3*	unconditional and conditional
b	1, 2 and 3*	all eight rules
c	3** only	unconditional and conditional
d	3** only	all eight rules

Note: "3*" = test 3 with the longer items' data removed; "3**" = test 3 with the longer items' data included.

a) Tests 1, 2 and 3, unconditional and conditional rules.

One participant in the instructed condition misunderstood instructions on the rules test booklets. Although the problem was noticed and corrected before completion of the remaining tests, the data from this participant were removed from the overall analyses leaving six participants in the instructed condition and seven in the exposure condition.

Data comparing performance on the unconditional compared to conditional rules were analysed using a three factor analysis of variance (factors: input condition, rule type and test.). No effects of input condition or test type were found.

A main effect of rule type was found ($F(1,11) = 56.30$; $p < .0001$), in which performance on the unconditional rules was found to be significantly higher (mean: 74.19, st dev: 12.59) than on the conditional rules (mean: 56.19, st dev: 16.41). Follow up analyses revealed that participants from both the instructed and exposure conditions performed better on the unconditional rules compared to the conditional rules (Newman-Keuls: $p < .001$). No interaction between input condition and rule type was found. Mean percentage scores for both input conditions on each rule type are shown below (see Figure 5.1).

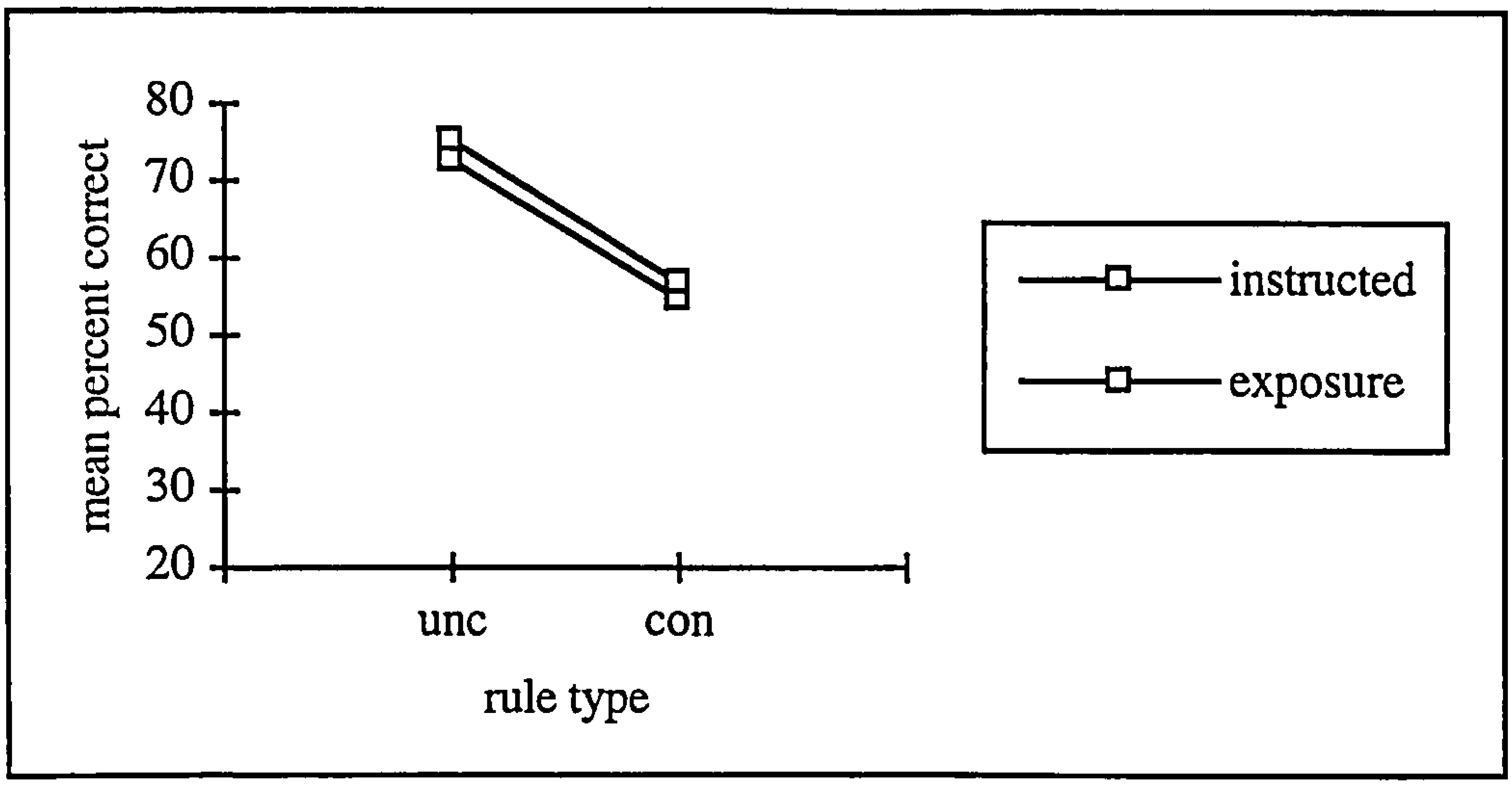


Figure. 5.1. Mean percentage scores on rules tests according to input condition and rule type.

b) Tests 1, 2 and 3, all eight rules.

Data comparing performance on all eight rules of the language were analysed using a three factor analysis of variance (factors: input condition, rule type and test.). No main effect of input condition was found.

An interaction between input condition and rule type was found ($F(7, 77) = 2.83$; $p < .05$). The mean scores for both input conditions on each of the eight rules of the language are shown below, (see Figure 5.2).

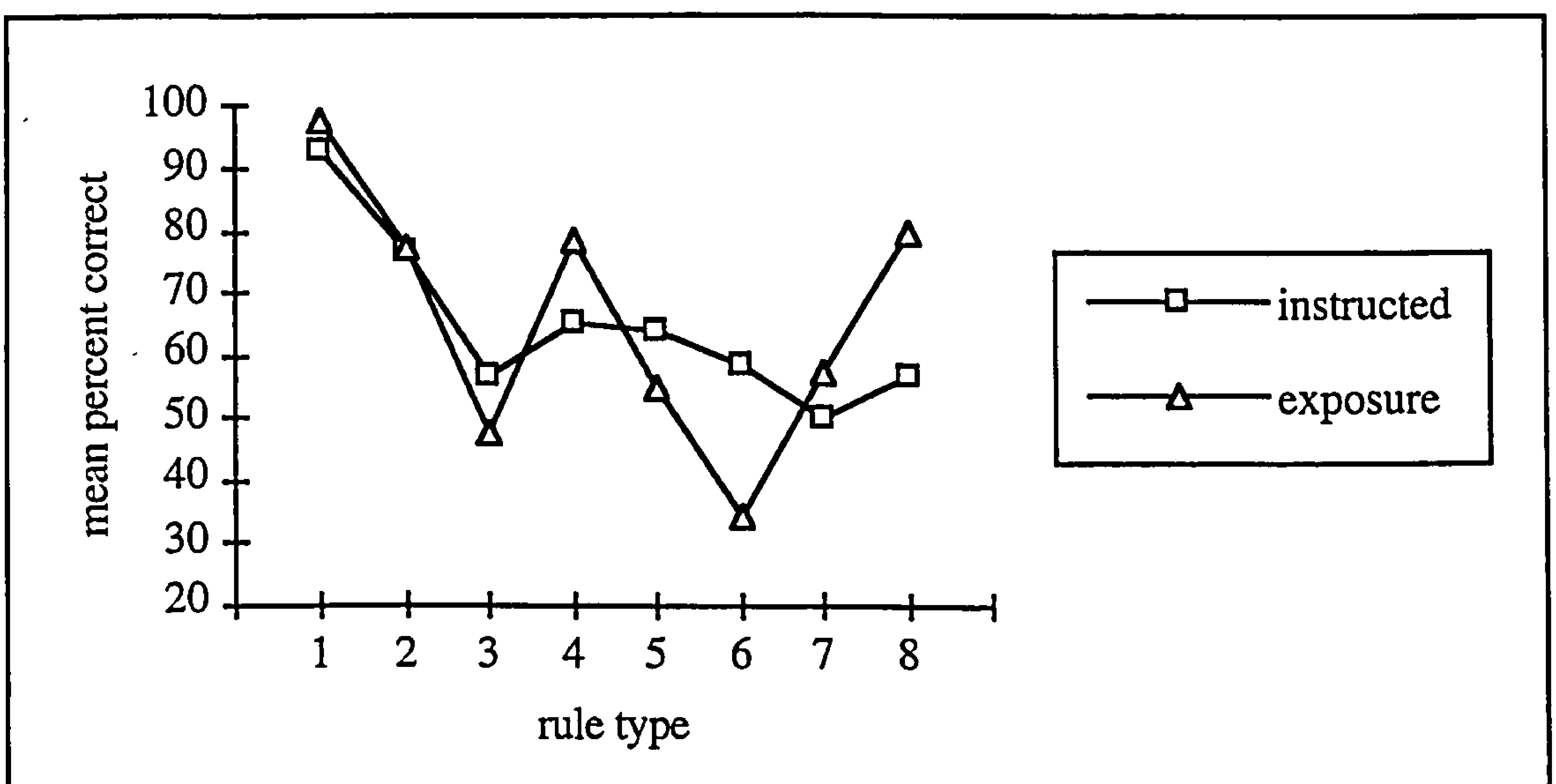


Figure. 5.2 Mean percentage scores on rules tests according to input condition and rule type.

Follow up analyses revealed no difference between input condition on any particular rule but a drop in performance on rule 6 by the exposure group was evident. A two sample t test was performed comparing the mean scores according to input condition on rule six only. A significant difference was found (t (11) = 1.82; $p < .05$) in which participants in the instructed group performed significantly better on rule 6 (mean: 59.72, st dev: 21.99) than those in the exposure condition (mean: 39.28, st dev: 18.45) .

Mean performance for participants in the instructed condition was higher on rule 1 than on rules 3, 6, 7 and 8 (Tukey HSD: all values $p < .05$). No other differences in performance across rule types were found for this condition. Mean performance for participants in the exposure condition was significantly higher on rule 1 than on rules 3, 5, 6 and 7 and higher on rule 2 than rules 3 and 6 (Tukey HSD: all values $p < .001$). Performance on rules 3 and 6, for this input condition only, was significantly lower than on rules 1, 2, 4 and 8 (Tukey HSD: all values $p < .001$).

A main effect of rule type was found ($F(7,77) = 13.49$, $p < .000001$) where performance overall on rule 1 was significantly higher than on all other rules except rule 2 and performance on rule 6 was significantly lower than all other rules except rule 3, 5 and 7 (Tukey HSD: all values $p < .05$ or lower). No effect of test type was found.

c) Test 3 only (including longer items), unconditional and conditional rules.

Data from test 3 alone, including responses to the longer items, were analysed using a two factor analysis of variance (factors: input condition and rule type (unconditional and conditional)). No effect of input condition was found. A main effect of rule type was found, ($F(1, 11) = 12.53$; $p < .01$) in which performance on the unconditional rules was found to be significantly higher (mean: 76.53, st dev: 9.87) than on the conditional rules (mean: 57.94, st dev: 15.95). No interaction between was found between input condition and rule type. Mean percentage scores for both input conditions on each rule type are shown below (Figure 5.3).

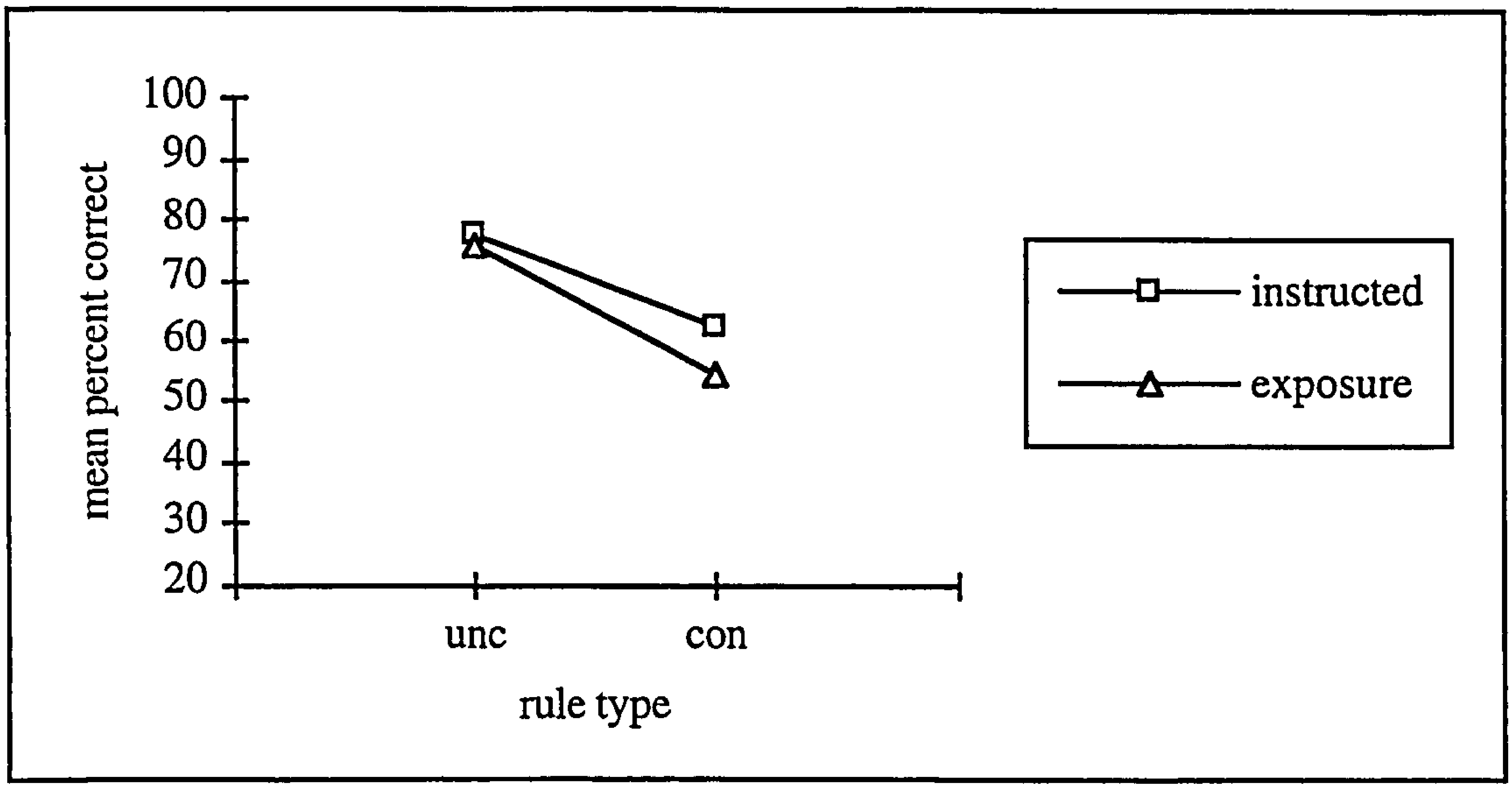


Figure. 5.3 Mean percentage scores on rules tests according to input condition and rule type.

d) Test 3 only (including longer items), all eight rules.

Data from test 3, comparing performance on all eight rules of the language, were analysed using a two factor analysis of variance (factors: input condition and rule type).

No main effect of input condition was found; an interaction between input condition and rule type ($F(7, 77) = 2.54$; $p < .05$) was found. The mean scores for both input conditions on each of the eight rules of the language are shown below, (see Figure 5.4).

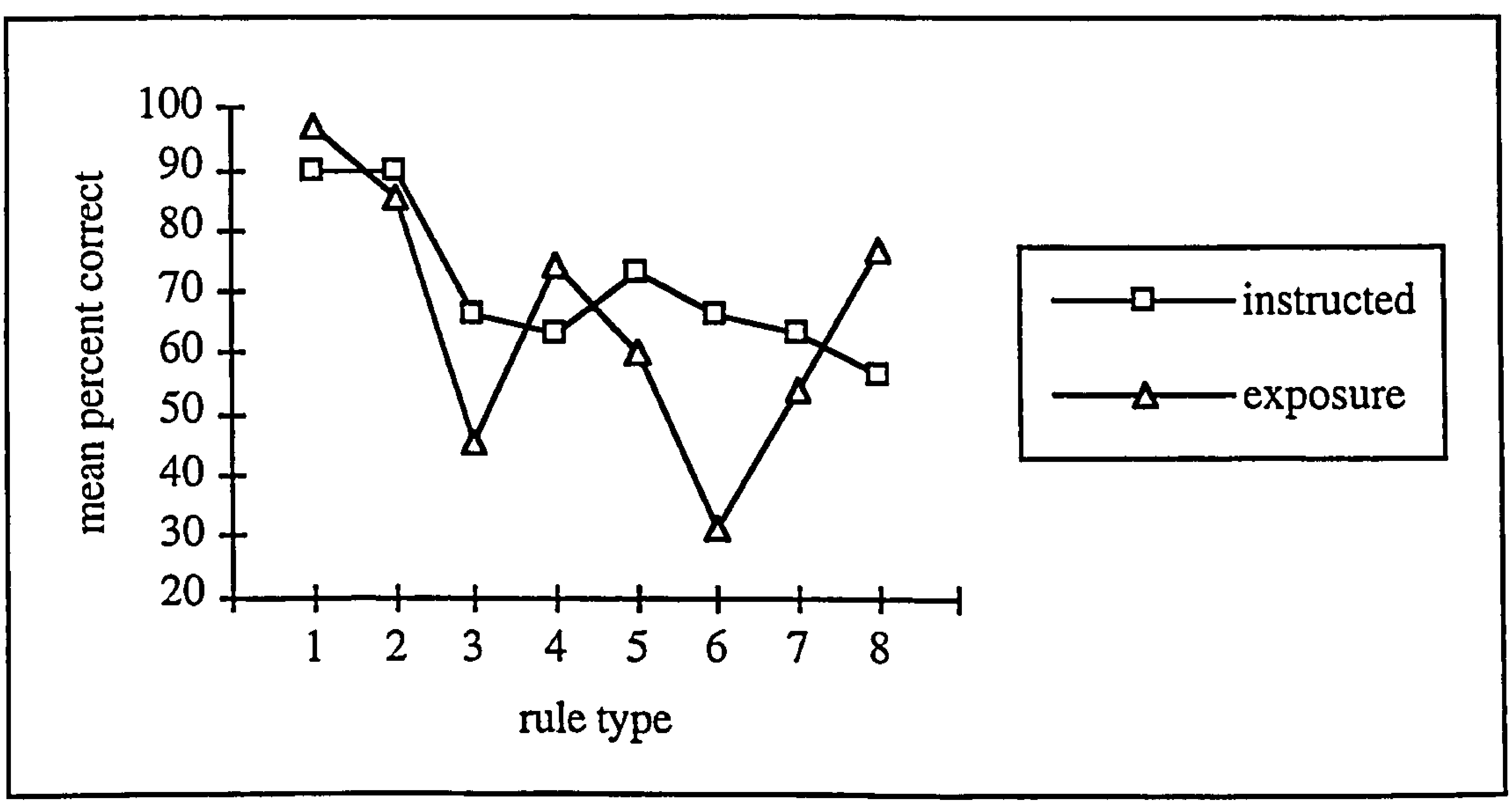


Figure. 5.4 Mean percentage scores on rules test 3 (including longer items) according to input condition and rule type.

Follow up analyses revealed no difference between input condition on any particular rule but a drop in performance on rule 6 by the exposure group was again evident. A two sample t test was performed comparing the mean scores according to input condition on rule six only. A significant difference was found ($t\ (13) = 2.6$; $p < .05$) in which participants in the instructed group performed significantly better on rule 6 (mean: 66.66, st dev: 20.65) than those in the exposure condition (mean: 31.42 , st dev: 27.94) .

A main effect of rule type was found ($F(7, 77) = 7.22$, $p < .00001$) where performance overall on rule 1 was significantly higher than on all other rules except rule 2 and performance on rule 2 was significantly higher than rules 3, 6 and 7 rules (Tukey HSD: all values $p < .05$ or lower). Closer analysis revealed that performance on rule 6 was significantly lower than that on all other rules except rules 3, 5 and 7 for the exposure condition only (Tukey HSD: all values $p < .05$). However, for the instructed condition, performance on rule 6 was not different from any other rule.

Summary of Rules Test findings.

a) Effects of Input Condition and Rule Type

The instructed groups' overall performance was not found to be significantly higher than that of the exposure group. Only when analyses were carried out separating performance on rule 6 were any differences found. Here the exposure group's performance appeared to drop dramatically rather than the instructed group's performance improve dramatically.

b) Effect of Test Type

No effect of test type was found. The inclusion of longer test items into test 3 did not appear to have affected overall performances.

5. 3. 3 Free Production Test.

The free production exercise was designed to ascertain whether participants could produce novel sentences of their own. Performance was again measured in two ways: firstly, by recording the number of complete, grammatical sentences produced by each participant. Secondly, by noting the number of times each of the ungrammatical sentences produced (if there were any) broke one of the rules of the language.

Two sets of analyses were carried out, one examining the number of correctly produced sentences, the other examining the number of rule breakages made in the incorrect sentences.

a) Proportion of correctly produced sentences.

The total number of grammatically correct sentences from the free production booklet was recorded for each participant and the percentage correct (as a proportion of the number of questions in each booklet) was calculated. The data were then analysed using a two sample T test.

No significant difference between the performance of participants in the two input conditions was found although the effect of input approached significance (t (9.36) = 1.47; $p = .08$; instructed mean: 16.16, st dev: 3.31; exposure mean: 12.14, st dev: 6.25).

b) Number of rule breakages.

All ungrammatical sentences were recorded and their grammatical structure. assessed. If the word order broke one of the rules of the language this was noted. (A single ungrammatical sentence could break more than one of the rules.) The number of rule breakages was totalled for each participant. A two factor analysis of variance was performed (factors: input condition and rule type broken).

No effect of input condition was found. A main effect of rule type was found ($F(7,77) = 2.63$; $p < .05$). Follow up analyses revealed that the number of breakages of rule one (of which there were none) differed significantly from the number of rule breakages of rules 4 and 6 only. Overall, rules 4 and 6 were the most frequently broken rules. (However, again it must be noted that a high number of participants did not break specific rules resulting in a zero score for that rule. This affected the distribution of and variance in the data and care should be taken in the interpretation of the outcome of subsequent statistical procedures.)

No significant interaction between input condition and rule type was found although inspection of the means shows the scores of participants in the two conditions coming apart on rules 5, 6 and 8. The mean scores are plotted below (see Figure 5.5).

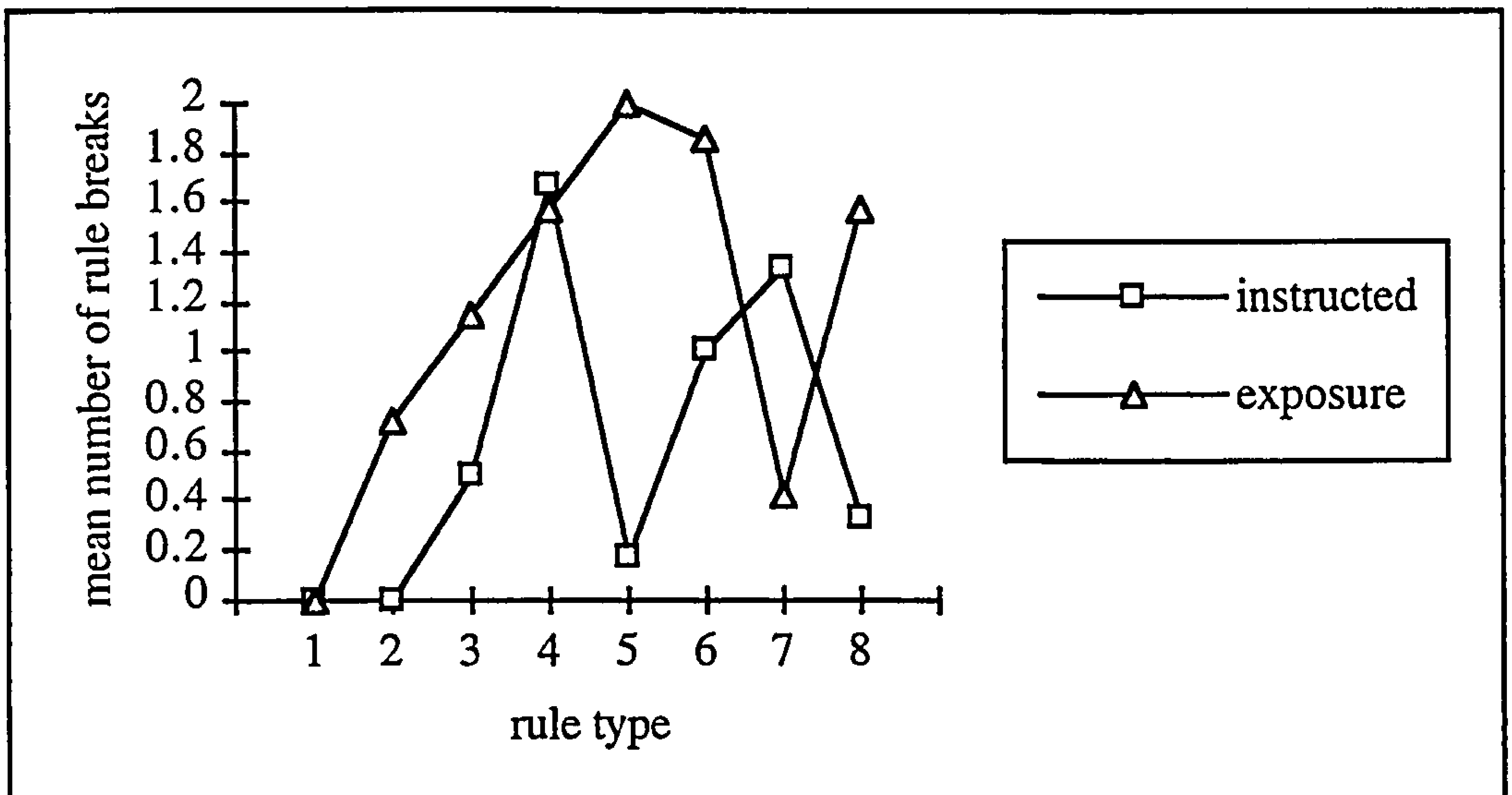


Figure. 5.5 Mean number of rule breakages. according to input condition.

Summary of Free Production Test findings.

Participants in the instructed condition produced slightly more grammatically correct sentences than those in the exposure condition although this difference was found not to be significant.

Rule one was not broken in any of the freely produced sentences, rule 4 was broken most frequently by participants in both input conditions and rules 5 and 6 by participants in the exposure condition only.

5.4 Discussion.

The questions posed in the current study were "do learners who have high grammatical sensitivity and good metalinguistic skills, profit more from either instructed or exposure input?" "Do learners who have good metalinguistic skills and heightened grammatical sensitivity perform better on the more complex rules?" It was tentatively predicted on the basis of Robinson's (1997) findings and more indirectly on those of Nation and McLaughlin (1986) and Nayak *et al* (1990) that the Hungarian learners who received formal instruction would perform better on the complex rules than those in the rule search condition but that there would be no difference between the learners from the two conditions on the simple rules. An inspection of the results revealed only partial support for this prediction. Learners in the instructed condition did not outperform those in the exposure condition on the complex rules (considered in the current research to be rules 3 - 8) but the learners in the two input conditions performed similarly on rules 1 and 2 (the simplest rules). The performance on complex rules 3, 6,7 and 8 was significantly poorer than on rule 1 in the instructed condition. Performance on rules 3, 5, 6 and 7 was significantly poorer than rule 1 in the exposure condition. This pattern of results would tend to indicate that those who have good metalinguistic skills and high levels of grammatical sensitivity experience similar difficulty on complex compared to simple rules regardless of the kind of input they have received.

The Hungarian teachers were initially recruited into the study to see if they would achieve higher levels of performance on the complex rules relative to performance on the simple rules than were reached by learners in Study Three. In Study Three performance on the complex rules lagged behind that reached on the simple rules. It was hypothesised that the Hungarian teachers' potentially superior metalinguisitic and grammatical sensitivity skills might facilitate their performance on the complex rules to the extent that performance on these rules might "catch up" with that achieved on the simple rules specifically under instructed conditions. As can be seen from the review of the results above, this did not occur. How similar were the results across the two studies? If the pattern in findings across the two studies was similar this would tend to suggest that the special attributes of the Hungarian learners do not have any differential effects on performance on syntax learning compared to performance patterns of those who do not enjoy these attributes.

In view of the fact that the Hungarian learners were tested at a different time from those in Study Three it was not possible to make statistical comparisons of the findings from the two studies. However, simple comparisons of each set of findings can be made without recourse to statistical testing: on the grammaticality judgement tests in the examination of performance on the "unconditional" and "conditional" rules (as defined by Morgan *et al* , 1989) the results from the two studies were the same whereby learners in both studies performed better on the unconditional (rules 1-4) than the conditional (rules 6-8) rules. In Study Three only, the instructed learners outperformed the exposure learners on the conditional rules only. This was found to be due largely to the poorer performance of the exposure learners on rule 6. When analysis was performed on all eight rules of the language separately, no overall effect of input condition was found in either of the two studies. An interaction was found between rule type and input in both studies. In Study Three a significant difference between instructed and exposure learners was found on rule 6 only. In Study Four, whilst an interaction was found, follow up analyses revealed no significant differences according to input condition on any particular rule. However, the trend in the data was the same: performance on rule 6 in Study Four was lower in the exposure condition than in the instructed condition and performance on rule 6 was found to be significantly lower than on all the other rules of the language with the exception of rules 5 and 7. In Study Three performance on rule 6 was significantly poorer than on all the other rules except rule 7. In summary, learners in the exposure condition seemed to struggle with rule 6 in both Studies Three and Four. No significant differences were found in either study on any of the other rules. In order to determine whether there was a similar pattern of mean scores on each of the eight rules across the two studies, a correlational analysis was performed. The mean scores of learners in the two instructed conditions on each rule correlated significantly ($r = .92$, $df = 6$; $p < .05$) as did the mean scores for learners in the two exposure conditions ($r = .71$, $df = 6$; $p < .05$).

A comparison of findings on the free production tests also revealed similarities in findings across the two studies: in Study Three learners in the instructed condition produced a higher proportion of correct sentences than those in the exposure condition and those in the exposure condition broke rule 6 more frequently than those in the instructed condition. In Study Four, the trend in direction of the findings was similar but no significant differences were found.

The similarity in the general pattern of findings was quite remarkable given the number of differences (some of which were intentional and some of which could not be controlled) which existed between the two studies: the learners differed in terms of their general language learning background and experience; the numbers of participants taking part differed (in Study Three there were forty participants whereas in Study Four there were only fourteen); the time at which learners were tested was different and finally the first language of the learners differed. All the instructions given to learners (regardless of their input condition) were in English. This might have accounted for the generally poorer performance exhibited by the Hungarian learners in both input conditions. However, the overall patterns of performance in terms of the levels achieved by learners on each of the rules relative to one another was very similar.

It would appear that learners who are "good language learners", those who have experience of describing language and who are likely to be particularly sensitive to grammatical features, perform no differently in terms of patterns of performance on simple and complex rules than those who have a more mixed language learning experience although more research making direct comparison of the two groups is required. Rule 6 was again a problem for learners who had been instructed to search for rules in the input. The overall performance on the complex rules was again poorer than on the simple rules.

In conclusion, in answer to the key question posed: "do learners who have high grammatical sensitivity and good metalinguistic skills, profit more from either instructed or exposure input?" the answer is: no more than learners who do not have such skills. In answer to the second question: "do learners who have good metalinguistic skills and heightened grammatical sensitivity perform better on the more complex rules?" the answer is also no. The Hungarian learners overall pattern of performance was very similar to that exhibited by learners in Study Three.

The question remained: how can performance on the complex rules relative to that on the simple rules be improved? In response to this question a second avenue of enquiry, outlined in Study Three, was pursued. This was the "implicit learning" avenue in which it was hypothesised that complex rules can only be acquired "unconsciously." The key question posed were: Can learners learn a language without conscious efforts to do so (relating to "c" type input) ? Are there specific areas of language which learners can only acquire or best acquire unconsciously? Is it possible to determine whether unconscious learning has actually taken place? These questions will be posed in the final study of this research: Study Five.

Chapter Six
Study Five

6.1. Introduction

In Studies Three and Four, instructed learners outperformed exposure learners on one rule of the language only: rule 6, the most complex of the eight rules. The pattern of performance of learners in the two input conditions was very similar on the remaining seven rules: learners in both conditions learning the more simple rules but struggling with the more complex. Results from Study Four indicated that heightened grammatical sensitivity and metalinguistic awareness did not facilitate learning of the more complex rules as had been tentatively predicted.

In view of the fact that instruction helped, but only to a limited degree, the extent to which the findings correspond to those of previous studies is not clear cut. The findings offer partial support to studies that found a difference between the two input conditions (Lightbown *et al*, 1980; Robinson, 1996) but also lend support to those that did not (Shaffer, 1989).

In Studies Three and Four learners were encouraged to look for rules or were explicitly taught the rules of the language. It was argued in Chapter Four that such a comparison was roughly analogous to that between naturalistic second language learners who make conscious efforts to learn the rules of the language and instructed second language learners . It was also acknowledged in Chapter Four that naturalistic second language learners might *not* make efforts to learn the rules of the language and that a further comparison should be made between instructed learners and those that are not told to look for rules in the input. The question was, would such conditions facilitate the acquisition of the complex rules? Research in the second language and artificial grammar fields indicated that they might.

In the field of second language acquisition it is often assumed that "naturalistic" learners acquire language without making conscious efforts to learn or look for rules in the input: the implication is that such learners learn without conscious awareness. A very large body of literature has been devoted to examining the issue of unconscious or "implicit" learning and some have argued that only under these conditions will learning of more complex rules or systems take place (Krashen, 1981, 1982, 1985, 1994; Reber, 1967, 1969, 1976 1989, 1994).

Krashen (1994) (reviewed in Chapter One) argued that linguistic competence developed only through unconscious "acquisition" through exposure to comprehensible input. He distinguished "acquisition" from "learning", the latter being described as a conscious process in which metalinguistic knowledge was developed. Explicitly learned knowledge had a limited use acting only as a monitor of the output of the acquired system: the learner must know the rule in order to operate the monitor. Krashen argued that in view of this only very simple rules of thumb could be learned: complex rules had to be acquired "implicitly". He adopted a strong non-interface position with regard to acquisition and learning in which he claimed that "learning" could not be converted into "acquisition" and that sub-conscious acquisition was dominant in second language performance.

Reber (1994) made similar claims regarding the learning of complex systems. On the basis of a long series of studies using artificial grammars (reviewed in Chapter Three), Reber formulated a theory of implicit learning. He defined implicit learning as: "the acquisition of knowledge that takes place largely independently of conscious attempts to learn and largely in the absence of explicit knowledge about what was acquired" (Reber, 1994, p. 5). Reber argued that complex systems could only be learned implicitly and that conscious attempts to crack the code of the complex system could be detrimental (Reber, 1976). Only when the rules of the language were "relatively uncomplicated" would conscious efforts to find the rules be effective (Reber and Allen, 1978; Reber *et al,* 1980).

Both Krashen and Reber have faced strong criticism: Krashen has been attacked for distinguishing "acquisition" from "learning" without having solid empirical evidence to support his claim. Some (McLaughlin, 1978, 1990; McLaughlin, Rossman and McLeod, 1983) have argued that such a distinction is empirically unfalsifiable because it is impossible to specify precisely which aspects of production have been acquired and which have been learned. Others (Gregg, 1984) object to Krashen's contention that learning cannot "turn into" acquisition or argue that he should simply not refer to unconsciousness or consciousness (Odlin, 1986). and should divorce the issues of explicit and implicit knowledge from the "notoriously slippery notion of 'consciousness' " (Odlin, p. 136).

Reber has also been challenged with arguments not dissimilar to those levelled at Krashen. The first related to his claim that implicit learning involves the unconscious abstraction of the underlying structure of the artificial grammar. This claim has been contested by a number of researchers (Brooks and Vokey, 1991; Vokey and Brooks, 1992; Perruchet and Pacteau, 1990, 1991). Brooks and Vokey (1991) argued that the ability to make grammaticality judgements was a consequence of learners identifying similarities between previously memorised strings and novel strings and was not due to learners unconsciously abstracting the underlying rules. However, Mathews, Roussel, Blanchard-Fields and Norris (forthcoming) reported that they had found evidence of learning which could not be accounted for on the basis of similarity to previously observed strings.

Perruchet and Pacteau (1990) also attacked Reber's claim that the learning which took place gave rise to unconscious abstract knowledge of the underlying structure: they argued that exposure to grammatical strings resulted only in knowledge of pairs of letters or bigrams. They exposed learners to either pairs of letters or complete strings of letters and found no difference between the performance of the two groups in classifying novel strings. Perruchet and Pacteau concluded that knowledge of bigrams was sufficient for accurate classification of novel strings and that above chance performance on classification tasks was not proof of ability to abstract complex structure. Reber (1990) dismissed Perruchet and Pacteau's claims arguing that their study was flawed methodologically and that their critique of the implicit learning literature was too narrow.

Reber was also challenged on the basis of his claim that knowledge acquired implicitly is completely unconscious. This was evident, he argued, in the way in which "subjects experience great difficulty verbalising or otherwise explicating that which is known" (Reber and Allen, 1978, p.190). Whilst learners could classify new strings according to whether or not they were grammatical at above chance levels, they could not describe how or on what basis they had carried out the classification. However, results from Reber's own laboratory (Reber and Lewis, 1977; Reber and Allen, 1978) showed that subjects were able to verbalise quite a number of the rules they had induced. Other researchers have reported similar findings (Dienes, Broadbent and Berry, 1991; Mathews, Buss, Stanley, Blanchard-Fields, Cho and Druhan, 1989).

One of the strongest attacks on the "unconscious knowledge" claim was made by Dulany, Carlson and Dewey (1984). They asked their learners, when presented with novel strings, to underline the part of the string that "makes it right" and cross out the part of the string that they thought violated the rules. Dulany *et al* claimed that this procedure would provide clear evidence of the learners' conscious knowledge of the rules. They reported that subjects' underlinings and crossings out were sufficient to account for the full set of classifications. However, Reber, Allen and Regan (1985) argued that the procedure adopted by Dulany *et al* was not the same as stating explicit rules and further claimed that the learners in the study might have been guessing where to underline (and cross out) based upon their implicit knowledge.

Reber, whilst conceding that learners could emerge from artificial grammar learning studies with a solid body of articulated knowledge, stated that learners also have a "solid but tacit" apprehension of the grammatical structure. His conclusion in the light of all the evidence presented was that "knowledge acquired from implicit learning processes is knowledge that, in some raw fashion, is always ahead of its possessor to explicate it." (Reber, 1989, p.229).

Whilst both Krashen and Reber have acknowledged that explicit knowledge can be utilised in second language learning and artificial grammar learning respectively, they have emphasised the primacy of implicit learning in both contexts and the limitations in the role of conscious, intentional learning and conscious knowledge. They argue that learning of more complex features can only take place implicitly.

One goal of the current study was to attempt to improve performance on the more complex rules of the language. In Studies Three and Four learners who received descriptions of the rules of the language were compared with learners who had not received any such description but who had been instructed to search for rules in the input. As stated above, an analogy could be drawn between these learners and real second language instructed and naturalistic learners who actively search for rules. It was found that neither group excelled on the complex rules of the language although the instructed learners achieved a significantly higher performance on the most complex rule. The problem was how to improve overall performance on the more complex rules. If Reber and Krashen are correct, one might expect such an improvement if learners learn implicitly. However, how can implicit learning conditions be induced?

Krashen argued that for unconscious acquisition to take place learners had to be exposed to comprehensible input and understand the message; it was not necessary to look for explicit rules or learn explicit rules because only the most simple rules of thumb were learnable. This implied that acquisition took place incidentally without intention to learn but that a focus on meaning was required.

According to Reber, implicit learning took place if the system to be learned was sufficiently complex and a firm attentional focus on the strings was made: intentional searching for rules was only effective if the underlying system was rendered salient and could be detrimental if the system was complex: "the subject in the learning phase of the experiment must not approach the stimulus materials as if they contained a code to be cracked" (Reber and Allen, 1978, p. 190).

It would appear that in order to induce implicit learning both Reber and Krashen would recommend a non-intentional approach: the learning task must be set up so that learners are not encouraged to rule search. The conditions of learning to be adopted in the current study, whereby learners would be exposed to input but not asked to search for rules, appeared to fulfil this criterion. However, a number of researchers using both artificial grammars and real language have reported finding no differences in performance between incidental (instruction to memorise) and intentional (instruction to rule search) learners (Abrams and Reber, 1988; Danks and Gans, 1975; Dienes, Broadbent and Berry , 1991; Dulany *et al*, 1984; Mathews *et al* , 1989; Robinson, 1996). Schmidt (1994, in N. Ellis, 1994) stated similarities in findings between incidental and intentional learners have been taken to indicate that all learners learn *incidentally*, independently of the instructions given. However, Perruchet and Pacteau (1991) have pointed out that the similarity in the findings could equally indicate that learners in both conditions had adopted an *intentional*, rule search approach to learning. (It is also possible that one condition adopted an explicit learning approach and the other an implicit learning approach but both led to similar levels of performance. Further, it is possible that learners adopted a mixture of approaches.)

The problem remains. How can an implicit approach to learning be guaranteed? It would appear that in manipulating the type of instruction given, one cannot infer a particular type of learning has been induced. Comparisons of performance of learners under differing instructional sets yield little if any information about the type of learning style adopted (a point previously made in Chapter One). There appears to be no simple solution to this problem and yet researchers regularly refer to learners as "implicit" learners solely on the basis of the type of instruction and input they have received, that input invariably involving an incidentally-oriented approach.

Whilst it is difficult to judge which type of learning has taken place, frequent attempts have been made to assess the degree to which the product of learning is consciously accessible. Reber (1989) stated that the knowledge which results from implicit learning is ahead of the learner's ability to explicate it and his theory of implicit learning rests upon this claim. If learners have learned implicitly then, according to Reber, one would expect learners to have difficulty verbalising what they know about the underlying rule system. If this is the case then in principle one could assess the extent to which implicit learning has taken place by adopting the same technique: one could ask learners to verbalise their knowledge of the system to determine the extent to which implicit learning was used. Learners might be considered as having learned implicitly if their ability to explicate the rules of the system lags behind their performance on those rules.

In summary, according to Reber and Krashen, complex rules are best learned under unconscious, implicit conditions. In order to induce such conditions Reber has argued that it is beneficial to avoid encouraging an intentional approach to learning the rules but attention to the letter strings themselves is considered important. If learners have learned implicitly then one would expect the learners' ability to explicate the rules to lag behind their performance.

In order to test Krashen and Reber's claim that implicit learning facilitates the acquisition of complex rules, two additional manipulations were introduced in the final study of this thesis. The first was a new input condition which was set up to induce learners to learn the miniature language without conscious effort to do so. Such an approach was modelled roughly on that of the naturalistic learner who makes no effort to learn the rules. Details of the precise conditions of input are presented below. The second was a verbalisation procedure (to be explained below) which was used to indicate the extent to which learners could describe what they knew of the rules of the underlying language system. Performance of learners in the new condition was compared with that of learners in the instructed and exposure conditions (the same conditions of input manipulated in Studies Three and Four). Learners in all three conditions were assessed according to their ability to verbalise the rules.

In the new input condition, efforts were made to induce implicit learning by setting up conditions of input which Reber and Krashen argued were necessary for implicit learning to take place: learners must be exposed to a sufficiently complex system, they must not make conscious efforts to learn the rules but they must pay attention to the strings and (in the case of real language learning) the meaning of the sentences. In order to decide precisely how such conditions could be replicated, an examination of the procedures adopted by Reber and other researchers to induce implicit learning was made. The most frequently adopted procedure was to ask learners to memorise strings of letters or sentences (Dienes et al, 1990; Dulany et al, 1984; Mathews et al, 1989; Nayak et al, 1990; Reber, 1967, 1969, 1976, Reber and Lewis, 1977; Robinson, 1996). Other researchers adopted a less directive approach asking learners to simply pay close attention to the stimuli (Nation and McLaughlin, 1986; Reber and Allen, 1978). In one study learners were presented with sentences taken from a miniature language and shown corresponding pictures (De Keyser, 1995) but the author provided no information regarding the precise instruction given to learners except that they received no explanation of grammar nor were they told that the sentences had grammatical rules. Finally, in some studies no rules were taught but learners were given example sentences and told to look for meaning (N. Ellis, 1993; Robinson, 1996). In all the conditions outlined above, learners were referred to as '"implicit" (with the exception of Robinson's meaning-focused learners who were described as "incidental" learners). In all cases learners were presented with either real language, an artificial grammar or a miniature language, all of which it must be assumed were considered sufficiently complex for implicit learning to take place. (It should be noted that the miniature language adopted in the current study has been used previously by Nayak et al (1990) to examine implicit learning.)

After examination of the above procedures, it was decided to adopt the memorisation procedure in the current research for the following reasons. Firstly, if learners followed the instruction to memorise it would ensure that they would pay attention to the sentences. Secondly, memorisation might reduce the likelihood of learners adopting a rule search approach: the act of memorising possibly reducing the attentional resources available for rule search. Thirdly, memorisation is the most widely used procedure for inducing incidental and implicit learning. Finally, memorisation was used by Robinson, (1996) who made comparisons very similar to those which are made in the current study. A brief review of his work and a comparison with the present study is presented later (see also Chapter 4).

It is acknowledged that whilst learners might be asked to memorise sentences they might not follow these instructions. Even if they do, learners might not necessarily learn incidentally as they might become consciously aware of rules or patterns in the input whilst memorising the sentences and make efforts to seek out further rules or patterns. Whilst it is impossible to prevent learners from adopting an intentional approach to learning (and some would argue that it does not matter even if they do, as it could be argued that the learners learn incidentally anyway, see above) every effort was made to conceal the fact that the sentences learners were shown were generated by an underlying grammar. Firstly, in the instructions given to learners the term "language" was never used. It was reasoned that if the learners approached the task as a language learning task, those that had even a rudimentary understanding of language would be aware that the language must have an underlying grammatical structure and might attempt to look for it. Instead words in the language were referred to as "nonsense syllables" and sentences were referred to as "syllable sets". Learners were asked to try and remember as many sets as possible and be prepared to write them down. In order to determine whether or not memorisation learners had guessed there was a system, at the end of the input stage and before the testing stage, they were asked to state firstly, the strategies they felt they had used to help them memorise the sets and after completing this were asked whether they thought there was an organised system determining the order of the syllables. They were then told there was a system and were asked to complete the grammaticality judgement task. Learners in the instructed and exposure conditions were given the same tasks.

In order to ascertain the extent to which the learners were able to describe the knowledge they had of the rules of the language, a procedure for eliciting this information was sought. A number of researchers (De Keyser, 1995; Dienes *et al,* 1991; Dulany *et al*, 1984; Nation and McLaughlin, 1986; Nayak *et al*, 1990; Reber, 1967, 1969, 1976; Reber and Allen, 1978; Robinson, 1996) have asked learners what they know of the rule system, the methods adopted for eliciting the information varying widely. Whilst Reber's theory of implicit learning rested on the disassociation between learners' descriptions and their performance, Dienes *et al* (1991) noted that Reber rarely gave a detailed analysis of the rules reported by subjects. Reber (1969) stated only that learners were not able to verbalise the rules and in Reber (1978) he referred to a post experimental debriefing but did not give any details of what form the debriefing took nor of the kind of rules described. In Reber (1967) he did include a brief description of post experimental interviews in which learners were first asked if they had any ideas about the rules. All the learners failed to respond so he then asked four leading questions relating to permissible positions of letters in the strings, for example: "what letter or letters can strings begin or end with?" "can sentences begin with a P? an S?". He reported that none of the learners could answer the first of the four questions but that all learners were "eventually prodded into answering the second and third questions" (Reber, 1967, p.859): these were: "can sentences begin with a P? an S? a T?" (etc.) and "can sentences end in a P, S, T etc." Only one learner correctly responded to the final question: "were there any recurrent themes or sequences of letters which seemed to reflect any rules?" This learner produced only one such sequence.

In later studies (Reber and Lewis, 1977; Reber and Allen, 1978) Reber and colleagues asked learners to report introspectively on various aspects of their experience: what they knew of the rules, what they thought they were doing during input, any mnemonics, strategies or "gimmicks" they had used, how they were "processing" the input and the kind of "general cognitive processes" they were aware of (Reber and Allen, p.

198). The instrospective reports were obtained either after each input set (Reber and Allen, 1978) or after the study had been completed (Reber and Lewis, 1977). However, as Berry (1994) pointed out, the feedback in the Reber and Allen reports was not analysed in a way which could be related to performance. Reber and Lewis (1977) also required learners to verbalise, during the classification stage, the reasons for their responses. Learners were asked to do this "whenever they could" (Reber and Lewis, 1977, p.338). In summarising the findings from this procedure, Reber and Lewis reported that learners could provide correct reasons for 84 of the 122 correctly rejected non-grammatical items. Reber concluded that "a sizeable minority of instances (31%) were correctly rejected but for irrelevant reasons" (Reber and Lewis, 1977).

Other researchers have also adopted post study introspective questionnaires (De Keyser, 1995; Nation and McLaughlin, 1986; Robinson, 1996) in which learners were asked about the approach to learning they had adopted (Nation and McLaughlin, 1986), their experience of the learning process and what they thought about the grammar rules (De Keyser, 1995). (Unfortunately at the time of writing it was not possible to describe the contents of Robinson's (1996) questionnaire as the appendices of the paper contained the Japanese version only.) It would appear that none of the questionnaires elicited the actual rules that learners could verbalise, at least not in any systematic way.

Some researchers have attempted to discover more about the type of strategies learners used by interrupting learners during the learning phase and asking them to explain, as if to a naive participant, "how to go about the task" (Nayak *et al*, 1990, p. 230). The verbalisations were then classified and four strategies identified. The verbalisations rarely involved descriptions of specific rules so the extent to which this procedure is effective in discovering what learners knew of the rules themselves is also questionable.

Whilst Nayak *et al*'s study was based on the concept of "yoking" whereby learners provide description for others (yoked learners) to follow, they did not actually use yoked learners. However, Mathews *et al* (1989) did make use of such learners. They argued that the use of retrospective reports might be invalid because learners might not remember the rules they had learned at the end of a study. Such reports might therefore be inaccurate or incomplete (Ericsson and Simon, 1984). Mathews *et al* collected verbal reports from learners, of their knowledge of the grammar, throughout training and these reports were used by other participants to classify strings. They found that learners were able to communicate much of their "implicitly acquired knowledge" (Mathews *et al,* p.1097) but that yoked learners did not perform as well as their experimental partners. Mathews *et al* concluded that this was evidence that some implicit knowledge is accessible to consciousness but that "not all or even most of implicit knowledge is accessible" (Mathews *et al*, p.1097).

From the above review of the studies, in which verbalisations of some kind have been recorded, only those of Reber and Lewis (1977) and Mathews *et al* (1989) appear to reveal any precise information of the knowledge learners could verbalise regarding the rules. In both studies the information was elicited close to the time of learning (Mathews *et al*) or at the time of making classification judgements (Reber and Lewis). Central to Reber's theory was the link between the ability to verbalise the rules and classification performance. It was therefore decided to adopt the procedure used by Reber and Lewis in which rules were verbalised at the point of making the classification decision. In the current study learners were asked to write down their reasons for making each judgement at the time the judgement was made. It is acknowledged that the use of such introspective reports is highly contentious, introspection having been discounted as 'notoriously' unreliable in a number of fields (Nisbett and Wilson, 1977; Seliger, 1983). For example, Evans and Over (1996) argued that the reasons provided for choices made in a reasoning task (Wason and Evans, 1975) were "evidently serving the function of rationalising choices caused by tacit processes". They argued that learners were providing reasons to justify decisions which had been made implicitly. If this is the case in the artificial grammar studies, then the ability to verbalise or not should not be used as a criterion for establishing whether or not implicit learning has taken place. Further research is required to clarify the position and the extent to which parallels can be made between research on standard reasoning tasks and studies using artificial grammars.

In conclusion, in the final study of this thesis Krashen and Reber's claims that implicit or unconscious learning facilitates the acquisition of complex rules was examined. A comparison was made between instructed learners, exposure learners and memorisation learners. Those in the instructed and exposure conditions were tested under identical conditions to those described in Chapter Four. Those in the memorisation condition were presented with the same set of sentences as those presented to learners in the exposure group but were not told a system existed and were not asked to look for rules. They were asked only to memorise the syllable sets.

After the input stage, learners in all three conditions were given a questionnaire in which they were asked to describe any strategies they had used to learn the rules or memorise the sentences. They were then asked to state the extent to which they believed an underlying system existed. In the testing stage learners were given two tests in random order. One was a free production test and the other a grammaticality judgement test. Whilst completing the grammaticality judgement test learners were asked to provide a reason for rejecting what they considered to be the incorrect sentence. In this way the extent to which learners could verbalise each of the eight separate rules of the language could be measured.

Robinson (1996) compared the same three input conditions but using natural language input. He reported that the instructed learners outperformed those in the rule search conditions on the complex rules and outperformed those in the memorisation condition (though not significantly). His findings did not support Krashen and Reber's prediction that complex rules are best acquired or learned implicitly. In the current study the same comparison was made using a miniature language methodology. Performances of learners in the three input conditions were compared to see if performance on the complex rules would improve in the absence of rule descriptions or encouragement to search for rules.

In Studies Three and Four it was found that instructed learners outperformed those in the exposure condition on rule 6 only. It was hypothesised that the two conditions might again differ significantly on this rule. It was suggested in Chapter Four that the difference on rule 6 might be due to the exposure learners formulating incorrect rules to make judgements on rule 6. To determine if this were the case, the reasons provided for incorrect judgements were examined to see if exposure learners tend to formulate consistent but incorrect rules on this item.

In this final study the following key questions were addressed: Are complex rules best acquired under implicit learning conditions? Can it be established whether or not implicit learning has actually taken place? Is implicit learning best induced under conditions to memorise?

6. 2 Method

6. 2. 1 Participants

Forty-five first year Psychology undergraduates studying at the University of Plymouth participated as part of a course requirement. No restrictions were applied regarding previous language learning experience. None of the participants had taken part in any of the previous studies.

6. 2. 2 The Miniature Language

The language used in this study was constructed in exactly the same way as described in Study 3, Chapter 4. The referent shapes were in colour rather than black and white, the shapes themselves were identical to those described in Study 1. All "A" Class referent shapes were in differing shades of green, the "C" class shapes were in red, "E" class shapes were in pink, "F" class shapes were in blue and the "D" class shapes were in differing shades of yellow. (See Appendix A2.)

6. 2. 3 Design and Procedure

A between subjects design was adopted in which participants were randomly assigned to one of three input conditions: "instruction", "exposure" or "memorisation", fifteen participants in each. They were seated individually in front of a computer screen on which the entire presentation was displayed in colour.

Participants were first presented with a written introduction to the study. Those in the instructed and exposure input conditions were given instructions identical to those described in Study 3 in which they were first introduced to the concept of the "Nosmoish Language" as follows:

The study involves some imagination on your part!

I would like you to imagine that you are visiting a country called Nosmo (pronounced "Nozmo"). In this country a special language is used which is usually written down rather than spoken.

The language consists of just 15 words. Each word is paired with a special shape.

First you will be shown the shapes and their corresponding words *one* at a time. Try to remember which word is paired with which shape.

Participants in the "memorisation" input condition were presented with a different introduction (see below):

This experiment involves the memorisation of sets of nonsense syllables.

Each nonsense syllable is paired with a distinct geometric shape (for example a rectangle, triangle etc.).

First you will be shown the nonsense syllables and their individual shapes one at a time. Try to remember which syllable is paired with which shape.

In this introduction reference was made only to "sets of syllables" rather than sentences and "nonsense syllables" instead of "words". The term "language" was not used in any instructions given to participants in the memorisation condition.

All participants were then given "vocabulary training and testing" (as described immediately below) followed by an "input stage" which varied according to input condition and finally a "testing phase".

1. Vocabulary training and testing

Each word of the language together with its accompanying referent shape was presented individually on the computer screen for a period of 5 seconds, (see Chapter 2, 'The Lexicon' for a list of the words and their referents). Participants in the instructed and exposure conditions were asked to try and learn the word/shape pairings. Participants in the memorisation input condition were asked to learn the nonsense syllable/shape pairings.

After all fifteen words (or nonsense syllables) had been presented twice in randomised order, participants were tested. The same multiple choice format was used as in Study 3, whereby each shape was presented individually and a choice of four different words were presented beneath it. None of the incorrect choices was taken from the same word class grouping as the correct choice. Scores from these tests were noted and the process was repeated. Forty three of the forty five participants scored 70% or above on the final test, the criterion set for continuing to the input stage. The two remaining participants who failed to reach this level were given one more vocabulary exposure after which both scored above 70% on the subsequent test. All participants then proceeded to the input stage.

2. Input Stage

Input differed according to input condition. The input given to participants in the instructed and exposure conditions was identical to that described in Study 3, Chapter 4.

As in Studies Three and Four participants in the instructed condition were given the following information:

> Nosmoish, the written language used in Nosmo, is special in that it doesn't *mean* anything in the traditional sense but the words can be placed in 'sentences'. The order of the words in the sentences is not random but is based on particular Nosmoian word order rules.
>
> The shapes which are paired with the words help the Nosmoian people to remember this word order.
>
> You want to learn the Nosmoish language and the word order so that you can produce your own sentences in the language later on.

Those in the exposure condition were given different information as follows:

> Unfortunately there aren't any trained teachers of Nosmoish but you can borrow a disc from the Nosmoish library containing possible sentences in the Nosmoish language.

While you are observing the sentences you do *not* have to *do* anything or *write* anything but remember that later you will want to make up some of your *own original* sentences.

See therefore, if you can work out for yourself what the Nosmoish word order rules are.

Participants in the memorisation input condition were informed:

In this section you will be presented with sets of nonsense syllables. Above each syllable will be presented its corresponding geometric shape. You have already learned the individual syllable/ shape pairings.

Your task is to try to memorise each set of syllables that you see.

Later you will be asked to try and write down sets that you have memorised.

The remaining input given to participants in the instructed and exposure conditions was exactly as described in Study 3, Chapter 4.

The input presented to participants in the "memorisation " condition was identical to that given to those in exposure condition with the exception of the wording of the instructions prior to exposure. Participants were asked only to "memorise each set of syllables". The participants were exposed to the forty eight base language sentences and their accompanying shape referents (described above). The process was repeated three times but between each exposure set, participants were asked to:

"Write down five syllable sets that you have memorised. You do not need to include the shapes, just write down the syllables. You can choose from any of the sets you have been presented."

Participants recorded their memorised sets in the "Memorisation Booklet" (see Appendix A2).

3. Testing Phase

Two tests were given after the input stage to all participants

i) A Rules Test

ii) A Free Production Test.

The tests required participants to either make judgements based on the underlying rule system or to produce sentences based upon that system. However, up to this point, participants in the memorisation condition had not been made aware that a rule system existed. In fact every effort had been made to conceal this fact in an attempt to encourage them not to actively or explicitly search for the rules.

It was necessary to inform these participants, prior to the testing phase, that a rule system existed. However, it was also important to discover whether or not participants in the implicit condition had already guessed that a rule system existed and as a result had actively engaged in a rule search. To address this issue, two "mid-forms" were created which were given to participants prior to the testing phase. Mid -form 1 was designed firstly, to discover any strategies that participants felt they had used to help them learn the language or memorise the syllable sets and secondly, to assess the extent to which participants thought there was an organised system determining the ordering of the words. Mid-form 2 was designed to inform participants that an underlying rule system actually existed.

Mid-form 1 was given immediately after completion of the input phase. The form was given to each participant but the wording differed slightly depending on the input condition to which the participant belonged. An outline of each is shown below:

The task given in mid-form 1 to participants in the instructed and exposure conditions was as follows:

Please answer the following questions in the order presented. Do not change any of your answers once you have completed that question and do not turn back to read previous sections.

Write as fully as possible, if you require any more paper please tell the experimenter.
1. Please describe any **strategies** you used to help you work out what the Nosmoish word order rules were:

If you have finished this question please turn over the page now.
2. Do you think there was an organised system determining the **ordering** of the words? Please indicate your answer by circling the number which reflects the degree to which you feel there was or was not an organised system determining the order of the words.

no organised system				organised system
1	2	3	4	5

where 1 = no organised system at all determining the order of syllables where 5 = a fully organised system determining the order of syllables

Circle one number only.

The task given in mid-form 1 to participants in the memorisation condition was as follows:

1. Please describe any **strategies** you used to help you memorise the syllable sets:
If you require more paper please ask now before turning over.

If you have finished this question please turn over the page now.

2. Do you think there was an organised system determining the **ordering** of the syllables in the sets that you have memorised? Please indicate your answer by circling the number which reflects the degree to which you feel there was or was not an organised system determining the order of the syllables in each set.

no organised system				organised system
1	2	3	4	5

where 1 = no organised system at all determining the order of syllables
where 5 = a fully organised system determining the order of syllables

Circle one number only.

Participants were given a five minute break and then given mid-form 2. This form was specifically designed to inform participants in the memorisation condition that there was an organised system determining the order of the syllables. They were given the following information:

There was an organised system. This system comprised a set of rules which determined the possible order of syllables each set. All the syllable sets were governed by the same set of rules.
You could think of each syllable set as a group of words organised into a sentence. The sentence doesn't mean anything in the traditional sense but the order of the words in the sentences is governed by these word order rules.
You are now required to carry out some tasks which require you to make decisions based on these word order rules.
Don't worry if you are unsure about the rules, in this case try to make your decisions based upon what you feel is correct.

Although participants in the instructed and exposure conditions had already been made aware of the existence of the set of rules, they were also presented with mid-form 2 as follows:

As you are undoubtedly aware, there was an organised system. This system comprised a set of rules which determined the possible order of words in each sentence. All the sentences were governed by the same set of rules.

As you were told earlier, the sentence doesn't mean anything in the traditional sense but the order of the words in the sentences is governed by these word order rules.
You are now required to carry out some tasks which require you to make decisions based on these word order rules.
Don't worry if you are unsure about the rules, in this case try to make your decisions based upon what you feel is correct.

Those in the exposure condition were presented with the following mid-form 2:

There was an organised system. This system comprised a set of rules which determined the possible order of words in each sentence. All the sentences were governed by the same set of rules.
As you were told earlier, the sentence doesn't mean anything in the traditional sense but the order of the words in the sentences is governed by these word order rules.
You are now required to carry out some tasks which require you to make decisions based on these word order rules.
Don't worry if you are unsure about the rules, in this case try to make your decisions based upon what you feel is correct.

After completion of both mid-forms, participants were given a rules test and a free production test as described below

Rules Test

One rules test only was presented which contained only shorter test items exactly as described in Study 1. An additional task was given to participants to complete after each pair of test items was presented. Participants were asked to try and indicate why they had rejected what they considered to be the incorrect sentence. This was to be carried out by asking participants to explain in their own words why the sentence was wrong.

The task was added to the rules test in order to assess a number of factors. Firstly, to ascertain whether or not participants were able to verbally express reasons for their judgements; secondly to determine the extent to which the reasons provided mapped on to the rules of the language as described in Study 1 and thirdly, whether participants' reasons described a rule system under which they had operated which "worked" but which was not based on the rules of the language. Finally, it could be used to assess the extent to which participants were able to make correct judgements but were not able to express their reasons for those judgements. The full set of instructions is presented below:

You will be presented with sentence pairs, one sentence above the other. One of the sentences follows the word order rules, the other breaks a rule.

Please carry out the following for each sentence pair:

1. **Put a tick** against the sentence in each pair that you think has the **correct word order**
2. Try and indicate **why you rejected the incorrect** sentence by explaining in your own words why it is wrong

Free Production Test

One free production test was given exactly as described in Study 4, Chapter 5.

Time of Testing

Testing took place immediately after the input stage, once the mid-forms had been completed. Participants received either the rules test first followed by the free production test or vice versa. A coin was tossed to determine the order for each individual participant.

6. 3 Results

Results will be presented in the following order:

1. Feedback from mid-form 1.
2. Vocabulary Test
3. Rules Test
4. Free Production test

6. 3. 1 Feedback from mid-form 1.

As stated above, mid-form 1 was designed i) to discover any strategies that participants felt they had used to help them learn the language or memorise the syllable sets and ii) to assess the extent to which participants thought there was an organised system determining the ordering of the words. (Mid-form 2 was designed simply to inform participants that an underlying rule system actually existed.)

Results obtained from mid-form 1 are presented below.

i) Strategies participants felt they had used to help them learn the language or memorise the syllable sets.

Participants produced a varying number of strategies: some produced just one overall strategy, others provided detailed accounts of the rules they had discovered whilst others described specific procedures they had used to try and learn the language or memorise the nonsense syllable sets. Whilst not all the above are strictly "strategies" for learning, as some descriptions were of actual rules rather than of the strategies used to learn the rules, the term will be loosely applied to the descriptions given.

The strategies provided by each participant were examined and divided into rough groupings. These are presented below, divided according to input condition and are accompanied by the number of participants who cited this particular strategy (see Table 6.1). (Note: individual participants might have mentioned their use of a particular strategy more than once but only one use of this strategy is recorded below.)

Table 6.1 Strategies described by participants in each of the three input conditions.

Strategies described by Instructed Condition	No. of participants	Example:
Word order rule is stated	4	"'E' was the same as 'CDF'"
Refer to how they learned word /shape pairing.	4	" 'KOR' - yellow and thin - think 'corn'"
Reference to strategies for memorising specific word orders e.g. "ADEC" "AE"	7	"I can only remember each rule by starting at the beginning - 'ADEC' then applying 'ADE', 'AE' etc."
Reference made to method of repeating word orders to aid memorisation.	3	"..other than that I just used rote rehearsal in my head"
Connection is made between word/shape and class.	2	"I used word and shape association with class type .."
Strategies described by Exposure Condition		:
Word order rule is stated using reference to actual words	9	"Every Nosmoish sentence has at least two words"
Word order rule is stated using reference to shapes	12	"All three pillars i.e. KOR, TIZ and PEL may be used in any sequence."
Word order rule is stated using reference to colours.	10	" The easier strategy was to think of a 5 word sentence in which the 2nd and 4th words were red, the middle word blue (either DUP or FAC) ..."
Strategies to learn the word orders: mentions letters within the words in determining word order	3	"RUD DUP" go together because two 'D's"
Strategies described by Memorisation Condition		
Word order rule is stated using reference to actual words	2	"Telling stories e.g. *a lot of first shapes Hes, Bif, Rud* were given names - made into agents for doing things.."
Word order rule is stated using reference to shapes	3	"It was obvious that square symbols started but any symbol could end"
Word order rule is stated using reference to colours.	9	"Famous people e.g. 'RUD VOT' = Ruud Gullit (Dutch Football player)."
Strategies to learn the word orders: mentions letters within the words in determining word order	12	"Devised short phrases whose words began with the same letter (e.g.. Robert Peel's compact disc = rpcd)
Refer to attempts to memorise whole sets by rote learning.	6	"Tried to memorise shape order+ word order"
Looked for words which appeared together or to which they referred as "simple combinations".	5	"Tried to recall certain pairs / small blocks , which tended to occur together."
Use of "distinctive" shapes	2	"Identifying unusual shapes e.g.. VOT and JAX"

Participants in the instructed condition supplied less information on their mid-forms than those in the exposure and memorisation conditions. Participants from all three input conditions cited actual rules they had learned. The majority of these participants were from the exposure condition and they tended to refer not only to the *word* orders but also to the shape and colour orders. Only four participants from the instructed condition and only five from the memorisation condition described any "rules".

Participants from the instructed and memorisation conditions referred to techniques they had employed for learning the word /shape pairings, the majority of these participants coming from the memorisation condition who produced some highly imaginative descriptions of how they linked the two.

Participants from all three input conditions described strategies for learning the word or syllable orders but the methods used differed from condition to condition. Those in the instructed condition tended to refer to strategies for learning the class letter orders (e.g. ADEC, AE etc.) often by building from one order to another. Those in the exposure condition commonly referred to letter patterns they felt occurred in the words themselves which they felt might determine the overall word order. Participants in the memorisation learning condition described rhymes and story lines which they had produced from the syllables themselves (often the first letter of each syllable) to help them memorise the actual syllable sets. Participants from all three conditions occasionally linked the syllables or words or class letters to English words and attempted to make grammatical English sentences which acted as mnemonics to learning the word order.

Some participants from the instructed and memorisation conditions stated that they had tried to simply memorise either the class letter orders (in the case of the instructed condition) or the syllable sets (memorisation condition) although some felt that this strategy didn't always work when the sets became more lengthy and complex.

Participants in the memorisation condition referred to grouping two syllables together and highlighted certain syllables as being distinctive.

ii) The extent to which participants thought there was an organised system determining the ordering of the words.

Participants were asked to circle a number on a scale of 1 - 5 which reflected the degree to which they felt there was an organised system governing the word or syllable orders. "1" reflected the opinion that there was no organised system and " 5 " reflected the opinion that there was an organised system.

It was expected that all participants in the instructed condition would circle "5" since they had been taught the rules of the language, but that those in the exposure condition might be less certain of whether the system was organised, particularly if they had experienced any difficulty working out the rules for themselves. In the case of participants in the memorisation condition, if the conditions of learning had been truly "implicit" to the extent that participants had not consciously engaged in a rule search because they were not aware at any time that a rule system existed, then they might be expected to circle "1" or "2" more frequently.

Figure 6. 1 below illustrates the frequency of each circled response on a scale of 1-5 according to input condition.

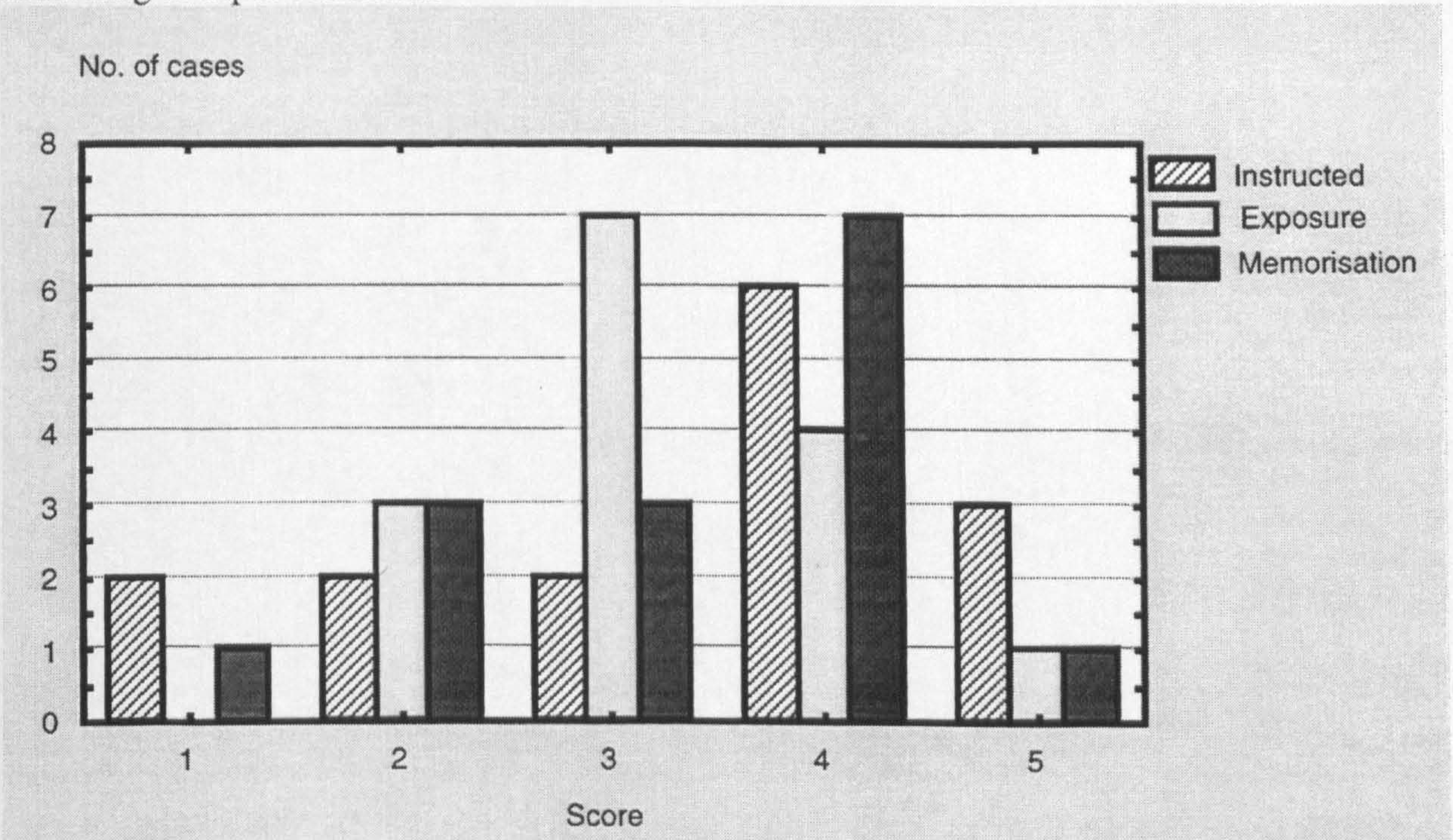


Figure 6.1 The extent to which participants from each of the three input conditions judged there to be an organised system.

Note: where "1" = no organised system, "5" = organised system.

Unexpectedly, only three participants in the instructed condition circled "5" to indicate they felt there was an organised system and surprisingly two participants circled "1" indicating that they thought there was no organised system. Of the remaining ten participants four circled a "3" or "2" indicating some doubt over the existence of an organised system.

In the exposure condition, the majority of participants circled the middle figure "3" which indicated some uncertainty over whether or not a system existed but none indicated that they felt there was no organised system.

In the memorisation condition, half the participants circled "4" or above indicating a strong feeling that a rule system existed, the other half circled "3" or below indicating the opposite. Possible reasons accounting for the performance by participants in the instructed condition on this question will be covered in the discussion,

6. 3. 2. Vocabulary Tests

All participants had to score above 70% correct in order to continue to the input stage. Forty-three participants reached this level after two vocabulary exposures, the remaining two participants reached this level after three exposures.

6. 3. 3 Rules Test

One rules test was given immediately after the input stage. Two sets of analyses were carried out on the rules test data: one set which examined participants' abilities to make accurate grammaticality judgements, the other which examined the reasons made by participants for those judgements.

i) Grammaticality Judgement data analyses:

Data from the grammaticality judgement tasks were analysed twice. Firstly, the data were separated into performance on the originally defined "unconditional" rules (rules 1-4) and "conditional" rules (rules 5-8: Morgan *et al,* 1989). This analysis was performed purely for comparative purposes to enable rough comparisons to be made between this study and Studies Three and Four. rules. Secondly the data were examined by separating performance on each of the eight individual rules of the language. These two analyses are presented below.

a) Unconditional and Conditional rules.

Data comparing performance on the unconditional (rules 1-4) compared to conditional rules (5-8) were analysed using a two factor analysis of variance (factors: input condition and rule type). No effect of input condition was found. Mean scores of participants in the three input conditions are shown below (see Table 6.1)

Table 6.2: Mean percentage correct on rules test according to input condition.

Input condition	Mean percentage score	Standard Deviation
Instructed	78.12	4.37
Exposure	75.62	7.12
Memorisation	68.75	3.94

A main effect of rule type was found ($F(1, 42) = 55.1$; $p < .001$), in which performance on the unconditional rules was found to be significantly higher (mean: 81.38, st dev: 17.24) than on the conditional rules (mean: 63.51, st dev: 19.64). Participants from all three input conditions performed better on the unconditional compared to conditional rules. (Newman-Keuls: instructed and exposure conditions: $p < .001$, memorisation condition: $p < .05$). The mean scores for the three input conditions on the unconditional and conditional rules are plotted below (see Figure 6.2).

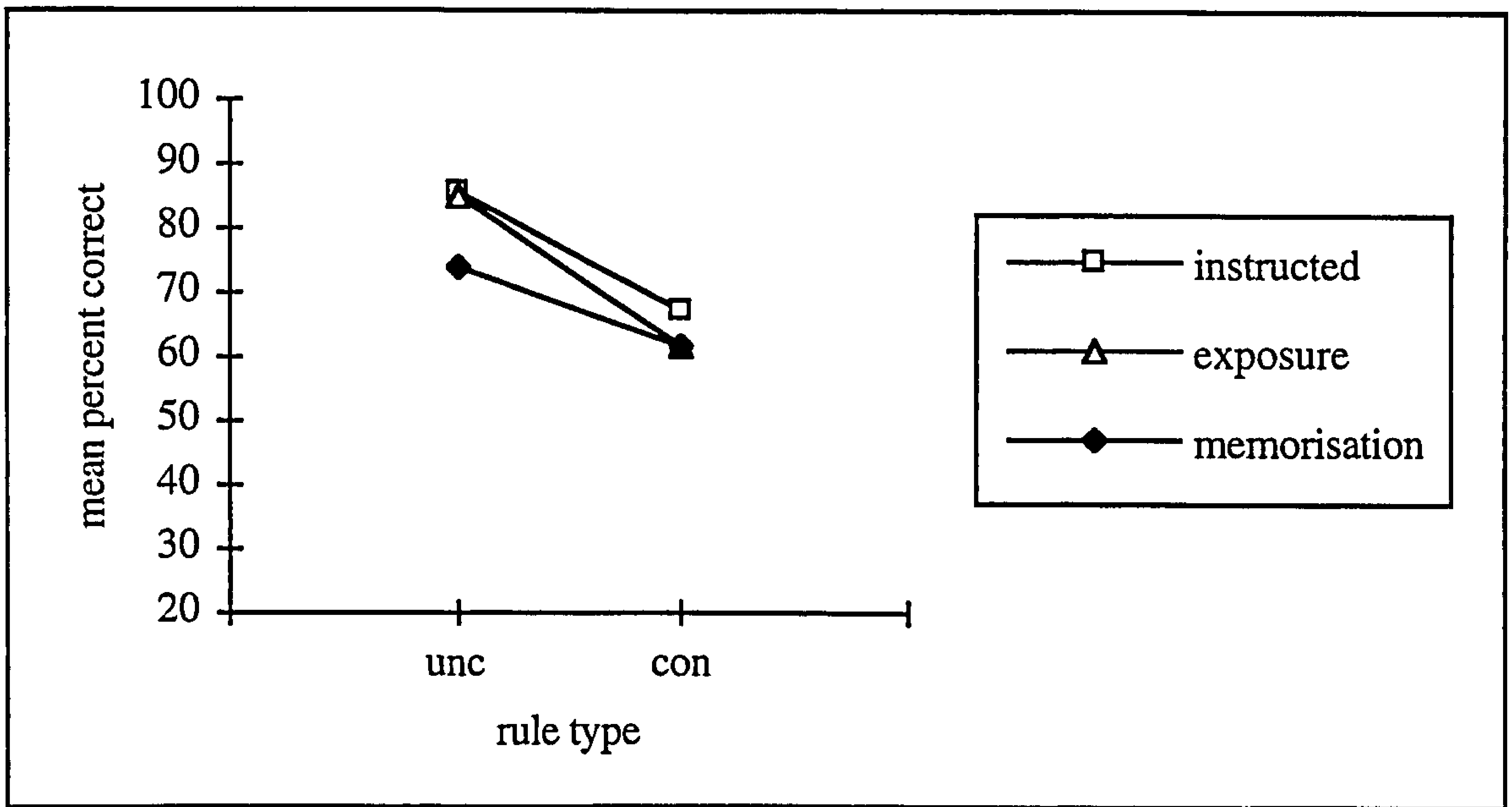


Figure 6.2. Mean percentage scores on rules tests according to input condition and rule type.

b) All eight rules.

In all previous studies, the instructed and exposure condition performances were found to be different on rule 6 only. In view of this consistent finding, it was hypothesised that a difference between the two conditions would occur on this rule. A one tailed t test was performed comparing performance of learners in the instructed and exposure conditions on rule 6 only. Again, performance by participants in the exposure condition was significantly lower on rule 6 compared to performance on this rule by participants in the instructed condition ($t(28) = 1.70$, $p < 0.05$, one tailed).

The data comparing performances of all three input conditions on all eight rules of the language were analysed using a two factor analysis of variance (factors: input condition and rule type). No main effect of input condition was found. An interaction between input condition and rule type ($F(14, 294) = 2.29$; $p < .01$) was found. Follow up analyses revealed that participants in the instructed and exposure conditions performed significantly better than those in the memorisation condition on rule 3 only (Tukey HSD: $p < .001$). Follow up tests revealed no other differences between input conditions on any other individual rule. The mean scores for both input conditions on each of the eight rules of the language are shown below, (see Figure 6. 3).

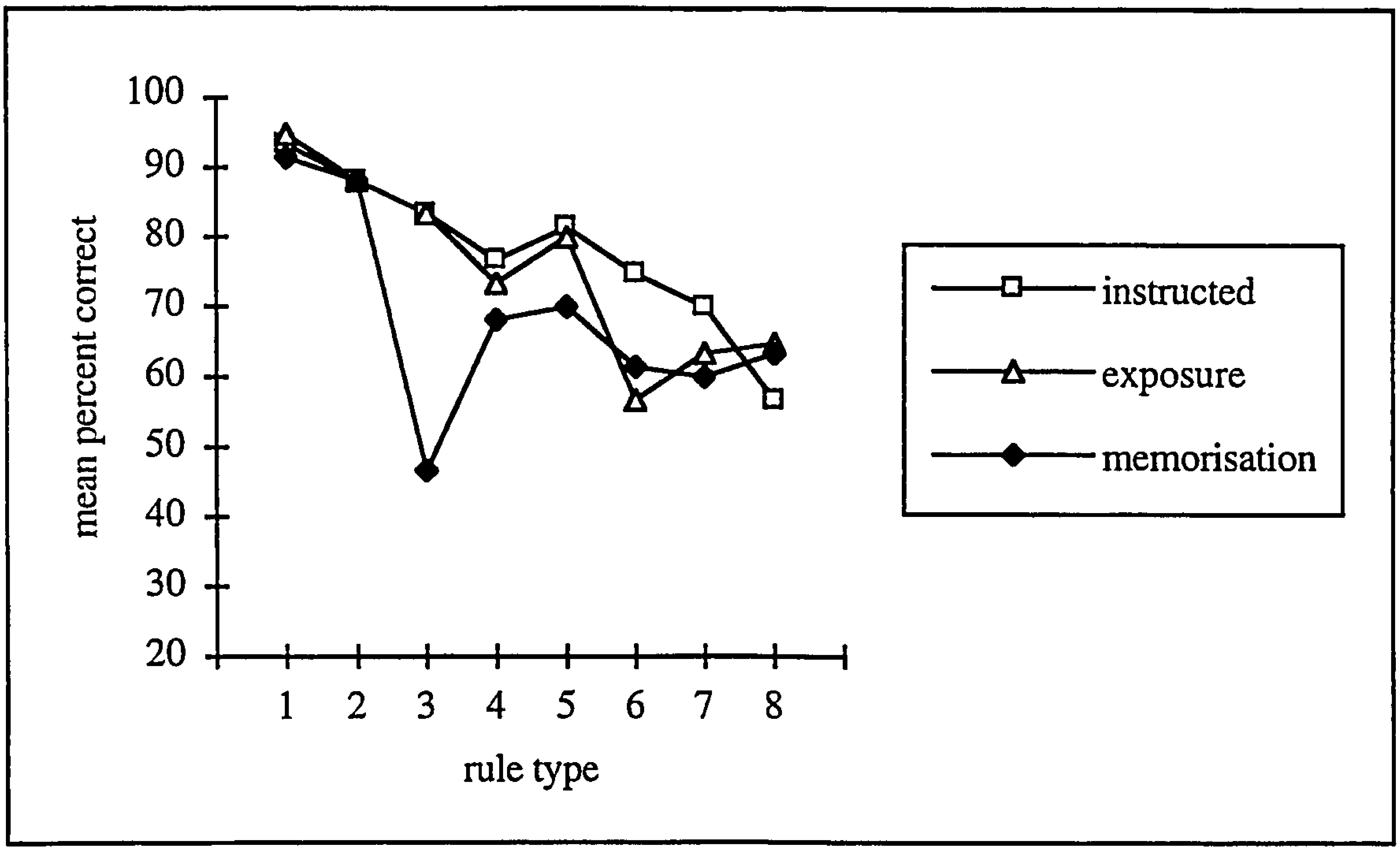


Figure. 6.3 Mean percentage scores on rules tests according to input condition and rule type.

Performance of participants in all three input conditions was virtually identical on rules 1 and 2. Mean performance for participants in the instructed condition on rule 1 was significantly higher than their performance on rule 8 only (Tukey HSD: $p < .001$). Mean performance for participants in the exposure condition on rule 1 was significantly higher than on rules 6, 7 and 8 (Tukey HSD: $p < .001$, $p < .01$, $p < .05$ respectively) and significantly higher than 3, 6 , 7 and 8 for participants in the memorisation condition (Tukey HSD: $p < .001$, $p < .05$, $p < .01$, $p < .05$ respectively).

A main effect of rule type was found ($F(7, 294) = 14.12$, $p < .001$) where performance overall on rule 1 was significantly higher than on all other rules except rule 2. Performance on rule 2 was significantly higher than all other rules except rule 5 (Tukey HSD: all values $p < .01$). Performance on rule 8 was significantly poorer overall than rules 1, 2 and 5 (Tukey HSD: $p < .001$, $p < .001$, $p < .01$, respectively).

To examine whether subjects were performing at above chance levels on the rules test (in this case scoring significantly above 50%), a single sample t test was used to compare each group's scores on each of the eight rules against a mean of 50.

The instructed group failed to perform at above chance levels on rule 8 only; the exposure group failed to perform at above chance levels on rules 6 and 7 only and the memorisation group on rules 3, 6 and 7 only. This highlights once more the difficulty experienced by the exposure group on rule 6 in particular and by the memorisation group on rule 3. Rule 7 appears to have presented both these groups with problems yet the instructed group alone failed to reach above chance levels with rule 8 in this study.

Summary of Rules Test

No overall effect of input condition was found. All participants performed well on rules 1 and 2. Participants in the instructed and exposure conditions outperformed those in the memorisation condition on rule 3 only; those in the instructed condition outperformed those in the exposure condition on rule 6. Performance on rules 4, 5, 7 and 8 was similar for all three input conditions.

In summary, performances of all three input conditions on the rules test were similar across many of the rules. The main separation across input conditions appears to be on rules 3 and 6 only.

ii) 'Reasons' data analysis

As stated above, participants were asked not only to judge which sentence in each pair had the correct word order but also to try and indicate why they had rejected what they considered to be the incorrect sentence. They were required to do this by providing a "reason" why they thought the "incorrect" sentence was wrong.

The reasons supplied by each participant were collated and a random sample was first selected. Each reason in the sample was examined individually and a set of rough categories was created to which the reasons were assigned. The categories defined the extent to which the reason accurately described the rule violation according to the eight rules of the language. Eight categories were created (see Table 6.3).

Table 6.3 Definition of categories: the extent to which the reason supplied accurately described the rule violated .

Category	Definition
A	Reason given describes adequately the rule violated as described in the eight rules of the language.
B	Reason given describes a rule which, although partly correct does not account completely for the underlying rule violation as described in the eight rules of the language. The reason proposed shows that the participant has an insight into the general area of the violation and has formulated a rule which though possibly incomplete or over encompassing (when compared to the eight rules of the language), has enabled them to make a correct judgement.
C	Reason describes a rule which is incorrect but a correct judgement has been made. If this rule were applied to all sentences, it could lead to the rejection of a grammatically correct sentence.
D	No reason provided even though the correct judgement was made.
E	A reason is provided which is impossible to judge in terms of its adequacy in describing the rule violation.
F	Participant stated they had based judgement on what sounded or felt correct.
G	Participant stated they had based judgement on what they thought they had seen before or on what they said was "familiar".
H	No reason was provided or a reason was provided which was incorrect. In both cases the incorrect grammaticality judgement had been made.

In categories A - G, the *correct* grammaticality judgements had been made on the items. (However, whether or not the rule produced by the participant had been consciously applied prior to making the judgement is impossible to ascertain.)

In Category H, an *incorrect* grammaticality judgement had been made. In some cases a rule had been supplied which if applied would lead to an incorrect decision. (Again, it is uncertain whether the participant had consciously applied the rule before making the judgement.) Since the application of the rule would lead to an incorrect grammaticality judgement, the reason describing that rule was consequently incorrect. Category H also included items which were judged incorrectly but for which no reason had been supplied.

Examples of reasons given in each category will be presented in full detail later. Firstly the procedure that was used to categorise the reason data set is described below:

Procedure for categorising reason data set.

Once the categories had been determined, the procedure for categorising the entire reason data set had to be established. Initially, two raters were presented with a sample of reasons which had been randomly selected from the entire reason data set. They were asked to assign each reason to one of the eight categories. (Due to the complexity of the rating task, both raters had to be expert in the language. For a novice rater, this would have involved a lengthy training period to reach the required level of expertise. In view of this, the author (rater "a") and the director of studies of the PhD thesis (rater "b") took on the roles of raters.)

The extent to which the raters were in agreement in their categorisation of the sample was calculated using Cohen's Kappa. The percentage of agreement across the two raters was 77.08%. This figure, when corrected for chance reduced to 71%. The degree of agreement was judged to be rather low and reflected the difficulty of the task of judging the adequacy of the reasons provided. (This will be discussed in more depth below.) In order to overcome the problem, the items on which agreement had not been made were re-examined by both raters and a final category for each item in the sample was agreed jointly.

The above process would have been carried out on all the remaining items in the reasons data set but time restrictions meant this was not possible. It was decided that one rater only would categorise the remaining items. In order to decide which of the two raters should be used for the complete rating task, the two raters' initial categorical ratings on the sample were compared to the final agreed ratings on the sample. The percentage of agreement was calculated using Cohen's Kappa and revealed that, when comparing rater "a" ratings with the "agreed" ratings, the percentage agreement was 92%, dropping to 90% when corrected for chance. For rater "b", the percentage agreement was 84% dropping to 81% when corrected for chance. Rater "a" therefore completed the ratings for the remaining items.

The results of the ratings for participants from each of the three input conditions will be presented below. First, a set of examples will be presented showing typical reasons provided which fell under each of the six categories.

Examples of reasons given in each category:

Category A

Definition:

"An accurate reason is given which fully describes the rule violation as described in the eight rules of the language."

Example: Participants were presented with the following test items:

1. HES TIZ SOG KOR DUP
2. HES TIZ DUP

The first sentence is correct, the second is incorrect because it violates rule 8: "A C phrase must occur before an F word." In the second sentence "DUP", an F word, is preceded by "TIZ" a D word. It should be preceded by an C phrase (a C phrase comprising a C word followed by an optional D word).

An example of a Category A reason:

"DUP needs to follow a red"

Here there is a clear indication that the participant has learned the rule regarding the necessity of having a C word (in this case described by the colour of the C word's referent shape: a red triangle) before the "F" word "DUP".

(It should be noted that in order to be assigned to an A category, the reason need not refer directly to the class of the word. (i.e. A, C, F etc.). Participants in the exposure and memorisation conditions were not provided with information regarding word class in this form but they frequently referred indirectly to the word class by mentioning the referent shape.

Category B

Definition:

"Reason given describes a rule which, although partly correct does not account completely for the underlying rule violation as described in the eight rules of the language. The reason shows the participant has some insight into the general area of the violation and has formulated a rule which though possibly incomplete or over encompassing, has enabled the participant to make a correct judgement."

Example: Participants were presented with the following test items:

1. RUD CAV FAC
2. RUD CAV FAC TIZ

The first sentence is correct, the second is incorrect because it violates rule 6: "A "D" word cannot appear after an "E" or "F" word." In the second sentence "TIZ", a "D" word should not come immediately after "FAC", an "F" word

An example of a Category B reason:

"The 2 syllables were not paired with each other" *

*Note: "2 syllables" referred to FAC and TIZ which had been underlined.

Here, the participant has indicated clearly there is problem with the "FAC TIZ" ordering and suggests that they had not been paired together previously. A rule formulated which states: "FAC and TIZ never occur in this order" would "work", i.e. it would enable judgements to be made regarding grammaticality but on this specific combination of words only. It does not clarify that the participant has understood that other "F" word followed by "D" word combinations are also illegal.

Category C

Definition:

"Reason describes a rule which is incorrect but a correct judgement has been made. If this rule were applied to all sentences, it could lead to the rejection of a grammatically correct sentence.

This category also includes
Example: Participants were presented with the following test items:

1. BIF SOG TIZ DUP JAX
2. BIF SOG TIZ DUP

The second sentence is correct, the first is incorrect because it violates rule 5: "No sentence may contain more than one "E" or "F" word." In the first sentence "DUP" is an "F" word and "JAX" is an "E" word. Sentences may only contain one or the other.

An example of a Category C reason:

"No sequence ended with JAX"

In fact sentences can end in "JAX", an "E" word, and participants in this condition (the memorisation condition in this case) had been exposed to sentences ending in "JAX". In this particular example, the participant had chosen the correct answer but for the wrong reason.

Category D

Definition:

"No reason provided even though the correct judgement was made."

The participant gave a correct response but supplied no reason.

Category E

Definition:

"A reason is provided which is impossible to judge in terms of its adequacy in describing the rule violation."

Example: Participants were presented with the following test items:

1. RUD VOT LUM
2. RUD VOT JAX LUM

The first is correct, the second is incorrect because it violates rule 5: "No sentence may contain more than one E or F word." In the second sentence "VOT" and "JAX" are both "E" class words. Only one of these was required.

Examples of a Category E reason:

"It needs something to break it up."
"It doesn't look right."

It is impossible to ascertain from these reasons exactly which rule the participant thought had been violated.

Category F

Definition:

"Participant stated that they had based their judgement on what sounded or felt correct".

The participant simply chose the correct item and justified it by stating, for example:

An example of a Category F reason:

"it sounds right"

Category G

Definition:

"Participant stated that they had based their judgement on what they thought they had seen before or on what they said was "familiar".

The participant chose the correct item and justified it by stating, for example:

An example of a Category G reason:
"I think I remember seeing the top one"
"the second sentence sounds familiar"

Category H

Definition:
"No reason was provided, or a reason was provided which was incorrect. In both cases the incorrect grammaticality judgement had been made."

Example: Participants were presented with the following test items:

1. RUD CAV TIZ FAC PEL
2. RUD CAV TIZ FAC

The second sentence is correct, the first is incorrect because it violates rule 6 ""A "D" word cannot appear after an "E" or "F" word." In the first sentence "PEL" , a "D" class word comes immediately after "FAC", an "F" class word.

An example of a Category H reason:

"Sentence ends in FAC"

Here the participant appears to have the impression that sentences are ungrammatical if they end in an "F" class word.

Note: Reasons were also categorised under Category F if no reason was provided for the incorrect response.

Summary:

Once all the reasons had been categorised, analyses were carried out to determine the extent to which participants from each of the three input conditions were able to provide accurate reasons for the grammaticality judgements they had made. Each category reflected the extent to which the reasons provided mapped onto the eight rules of the language. Reasons categorised under Category A mapped most directly onto the eight rules, those under Category B might not describe exactly the rule underpinning the violation as described in the standard eight rules of the language, but indicated that participants had formulated their own rules which, if systematically applied, would generate the same correct judgements.

Reasons categorised under both category A and B would indicate that the participant had potentially made their judgement with a rule in mind (or alternatively had justified their decision by subsequently referring to this rule, this will be discussed further in the Discussion section). Either way, a rule had been stated explicitly and the application of this rule would always lead to a correct grammaticality judgement.

Reasons categorised under Category C also indicated that the participant had potentially made the judgement with a rule in mind but the rule they had formulated was incorrect even though the participant had made the correct judgement. Similarly, reasons categorised under Category H *for which a reason had been supplied* (see Category H example above) indicated that participants may have made the judgement with a rule in mind but any rule given was incorrect and any judgement was incorrect.

Where no reason was provided yet a correct judgement had been made, the non-response was categorised under Category D. It is impossible to determine whether or not participants responding in this manner had formulated any explicit rule, whether they had "guessed" the answer without examining the sentences in detail or whether they could not formulate a rule explicitly but that their judgement was based on an implicit or intuitive "feeling".

Reasons categorised under Category E indicated that the participant felt they had judged the item based upon a "feeling" for what was correct. It is impossible to determine whether or not participants responding in this manner could formulate an explicit rule if encouraged or whether they simply had no idea of the rule. Finally, reasons categorised under Category F indicated the participant felt they had judged the item based upon what they had seen before or what was familiar. All participants had been told prior to the rules tests that the test items were all novel items. It is impossible to determine whether or not participants fully understood that the items were novel and were looking for identical sentences to those they had seen before, or whether they were referring to phrasal groupings within the novel sentences that they had seen before.

Analyses.

The mean percentage of reasons assigned to each of the six categories by participants in the three input conditions was calculated . The percentages for each input condition are presented in Figure 6.4. below.

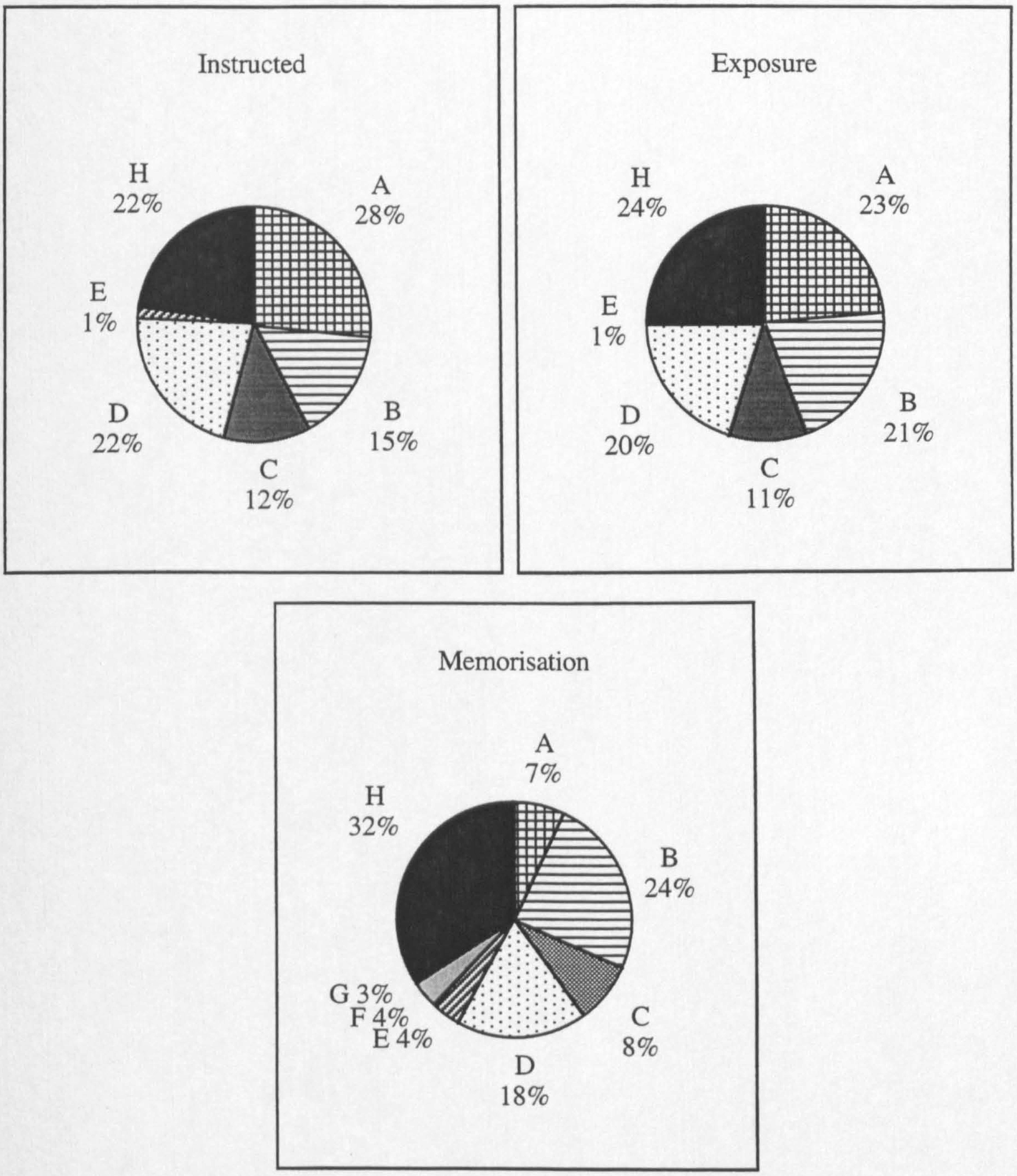


Figure. 6.4. The mean percentage of reasons assigned to each category according to the three input conditions.

Note: where A, B, C, D, E, F, and G = correct judgements made and adequacy of reasons describing rule violations vary (see above); H = incorrect judgements made, reason not always supplied, any reason which was given is incorrect.

Inspection of the pie charts in Figure 6.3 reveals a similarity in the instructed and exposure condition charts when comparing the percentage distribution of reasons assigned to each category . They differed slightly in the weighting of percentages on categories A and B only: in the instructed condition, 43% were in category A or B with slightly more in category A than B yet, in the exposure condition 44% were in category A or B: roughly half of those in A and half in B.

The memorisation condition distribution appears to differ from the latter two conditions on categories A and B in particular. Fewer reasons supplied by those in the memorisation condition were in Category A or B (31%) and the bulk of these were in Category B.

Participants in the memorisation condition appear to have produced slightly fewer category C reasons (correct judgement, incorrect reason) than those in the instructed and exposure conditions and substantially more category H reasons (incorrect judgement and incorrect reason). All three input conditions were similar in the percentage distribution of category D reasons (correct judgement, no reason given). Participants in the memorisation condition produced more category E reasons (correct judgement, reason unclear) than those in the other two conditions and were the only participants to provide category F and G reasons i.e. those in which they stated that they based judgements on "feel" or "familiarity".

In order to make statistical comparisons of the data across the input conditions, taking into account the rule type violated, analyses were performed on each category individually. Firstly, the number of times a participant gave a Category A reason was calculated. This figure was then divided by the total number of correct judgements the participant had made. The resulting figure provided a measure of the proportion of correctly judged items for which the participant was able to supply a reason which mapped directly onto the eight rules of the language. The same process was carried out on the data from categories B, C, D, E and F. Analyses were then performed comparing the data from participants across all three input conditions for each separate category.

Analysis of category H data, on which participants had made an incorrect grammaticality judgement were analysed separately (see below).

Analysis of Category A data.

The proportion of correctly judged items for which participants provided Category A type reasons (i.e. reasons which mapped closely onto the eight rules of the language) was calculated for each input condition. As it was possible that the number of category A reasons provided would depend on the complexity of the rule violated, the proportion of correctly judged items on each individual rule was calculated.

A two factor analysis of variance (factors: input condition and rule type) was performed. A main effect of input condition was found ($F(2, 42) = 6.79$; $p < .01$). Follow up analyses revealed that the proportion of category A reasons produced by those in the instructed condition and exposure condition was significantly higher than that produced by those in the memorisation condition. (Newman-Keuls: all values $p < .01$). It would appear that where participants in the memorisation input condition provided correct judgements, they were less able to produce completely accurate reasons justifying those judgements compared to participants in the instructed and exposure conditions.

A significant interaction between input and rule type was found ($F(14, 294) = 3.48$; $p < .001$). Follow up analyses revealed that participants in the instructed and exposure conditions produced a significantly higher proportion of category A reasons than those in the memorisation condition on rules 1 and 2 only (Tukey HSD: all values $p < .01$). No other differences were found according to input condition on any of the remaining rules. The mean proportion of category A reasons produced according to input condition and rule type are plotted below (see Figure 6.5).

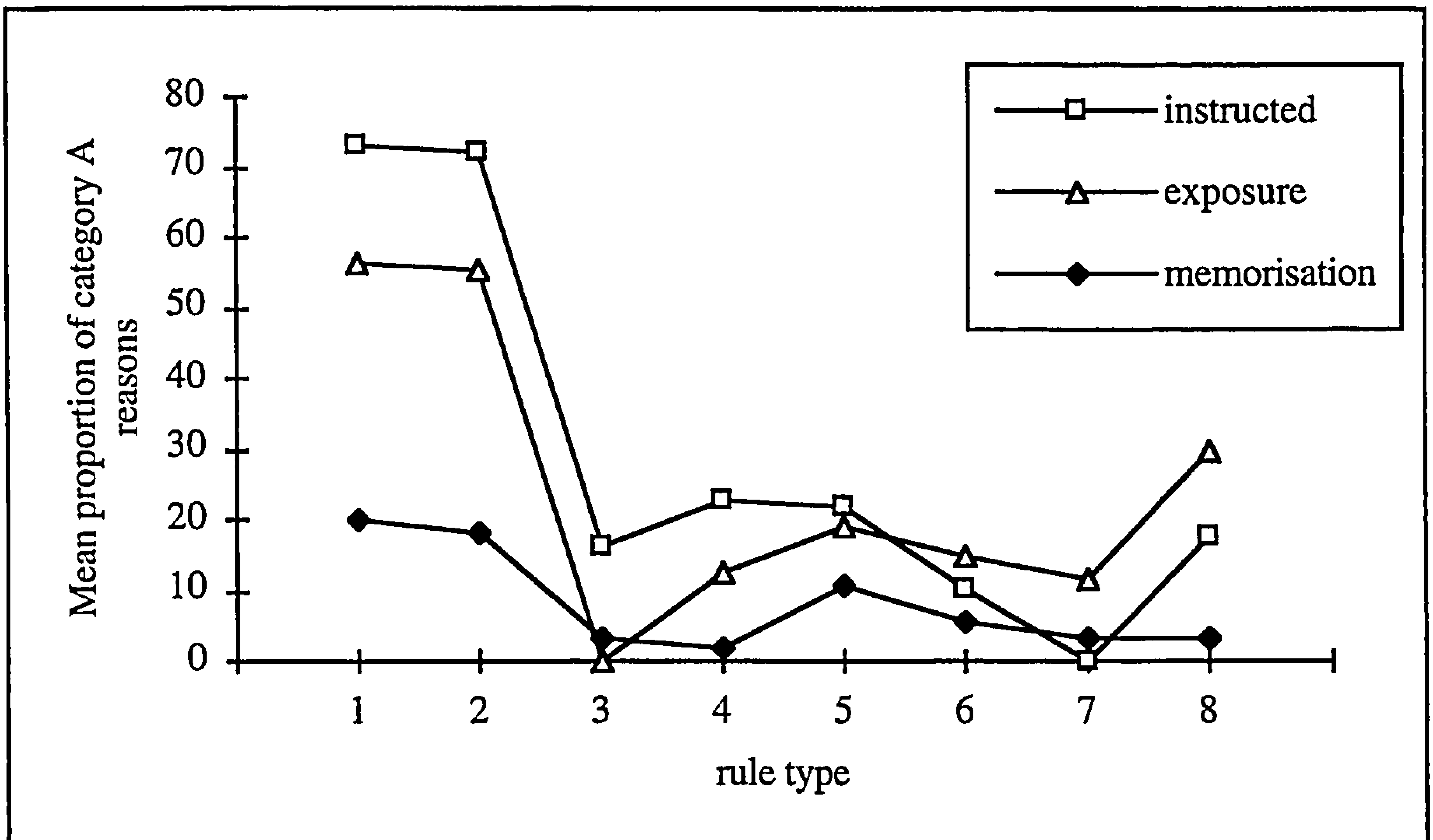


Figure. 6.5 Mean proportion of Category A reasons produced according to input condition and rule type.

The proportion of category A reasons produced by the instructed and exposure conditions only was higher on rules 1 and 2 than on all other rules (with the exception of rule 8 for the exposure condition; Tukey HSD: instructed condition: all values $p < .001$; exposure condition: all values $p < .01$.) The proportion of category A reasons produced by those in the memorisation condition did not differ across the eight rule types, the overall mean proportion of category A reasons being low across all eight rules.

A main effect of rule type was found ($F(7, 294) = 24.57$; $p < .001$) in which the proportion of category A reasons produced was higher on rules 1 and 2 than on all other rules (Tukey HSD: all values $p < .001$). This difference was largely due to the higher proportion of category A reasons produced by participants in the instructed and exposure conditions only.

Summary.

At this point it would appear that, compared to participants in the instructed and exposure conditions, those in the memorisation condition had difficulty justifying their judgements on rules 1 and 2 even though they were able to make accurate judgements of items testing these rules. However, this conclusion was based on the proportion of category A reasons provided and did not take into account the proportion of category B reasons i.e. those which did not map directly onto the eight rules of the language but which indicated that the participant had formulated some kind of explicit rule under which they reported they were operating which, if applied, would result in accurate grammaticality judgements.

In order to determine whether the input conditions differed in the extent to which participants could provide a justification for their judgements which would "work" i.e. would lead to consistently accurate judgements, the combined proportion of category A *and* B reasons was calculated for each input condition and analysis carried out on these data.

Analysis of Category A and B data.

The proportion of correctly judged items for which participants provided a Category A or B reason was calculated for each input condition. A two factor analysis of variance (factors: input condition and rule type) was performed. No effect of input condition was found nor was there any significant interaction between input condition and rule type. The mean proportion of category A and B reasons produced according to input condition and rule type are plotted below (see Figure 6.6).

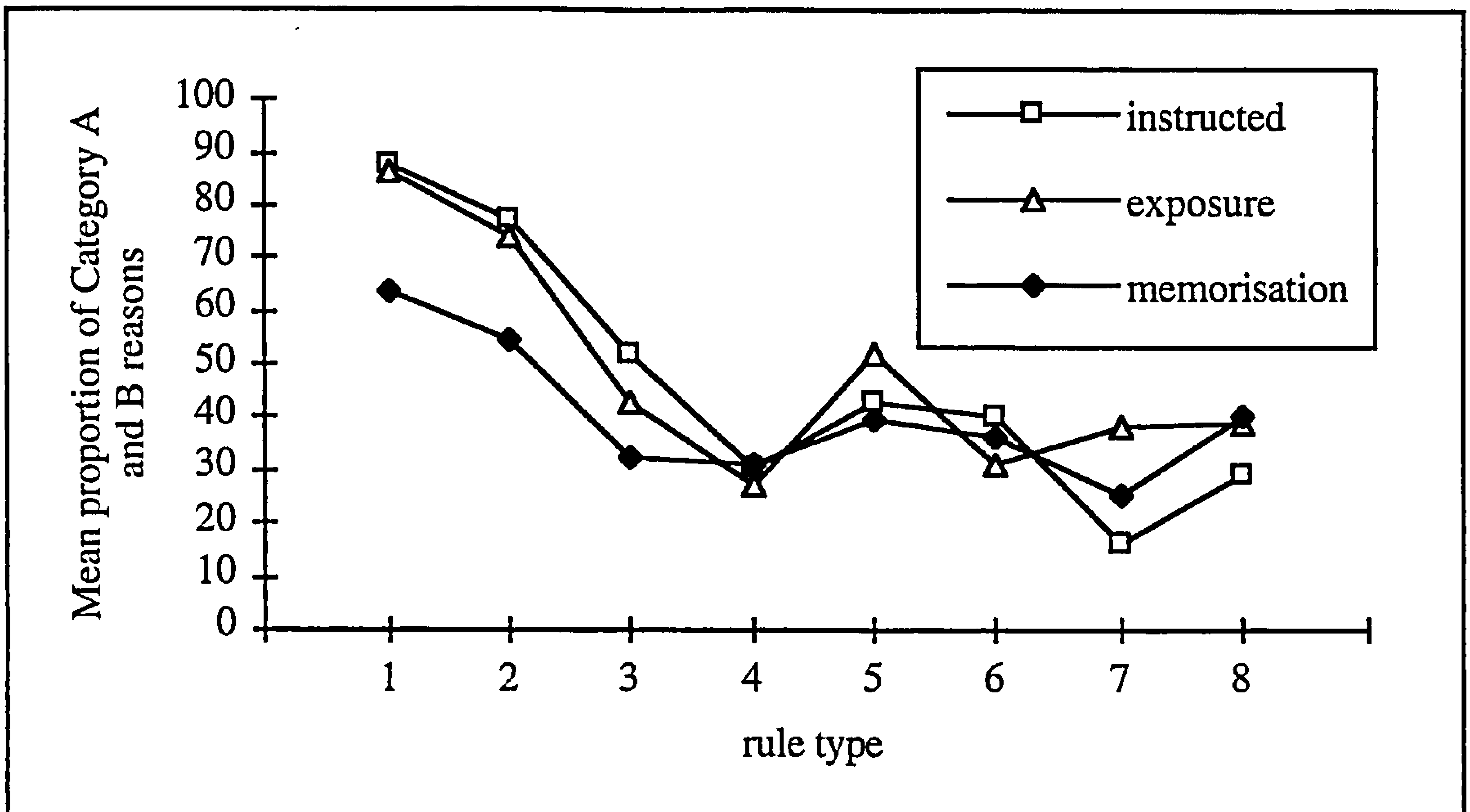


Figure. 6.6 Mean proportion of Category A and B reasons produced according to input condition and rule type.

No significant differences in the mean proportion of category A and B reasons were found according to input condition on any of the rules although the memorisation group still appeared to lag slightly behind the other two input conditions on rules 1 and 2.

A main effect of rule type was found ($F(7, 294) = 19.36$; $p < .001$). Follow up analyses revealed that rules one and two had a significantly higher proportion of category A and B reasons assigned to them than any other rules (Tukey HSD: rule 1 different from all other rules, all values : $p < .001$; rule 2 different from all other rules, all values: $p < .01$).

Summary

When category B reasons were included in the analyses, it appeared that participants in the memorisation condition were able to justify their decisions on a par with those in the instructed and exposure conditions. Participants in the memorisation conditions seemed to have problems specifying reasons which mapped directly onto the eight rules of the language, but the reasons they gave indicated that they were able to justify their decisions using a rule based system to a similar extent to those in the instructed and exposure conditions.

The proportion of category A and B reasons assigned to rules 3-8 was relatively low across all three input conditions. There was no difference in the mean proportion of category A and B reasons on rule 6 when comparing the instructed and exposure groups only, or on rule 3 when comparing the instructed and memorisation conditions.

Analysis of Category C data.

The proportion of correctly judged items for which participants provided a Category C reason (i.e. a reason which was incorrect but where a correct grammaticality judgement was made) was calculated for each input condition. A two factor analysis of variance (factors: input condition and rule type) was performed. No main effect of input condition was found nor was there any significant interaction between input condition and rule type. The mean proportion of category C reasons produced according to input condition and rule type are plotted below (see Figure 6.7).

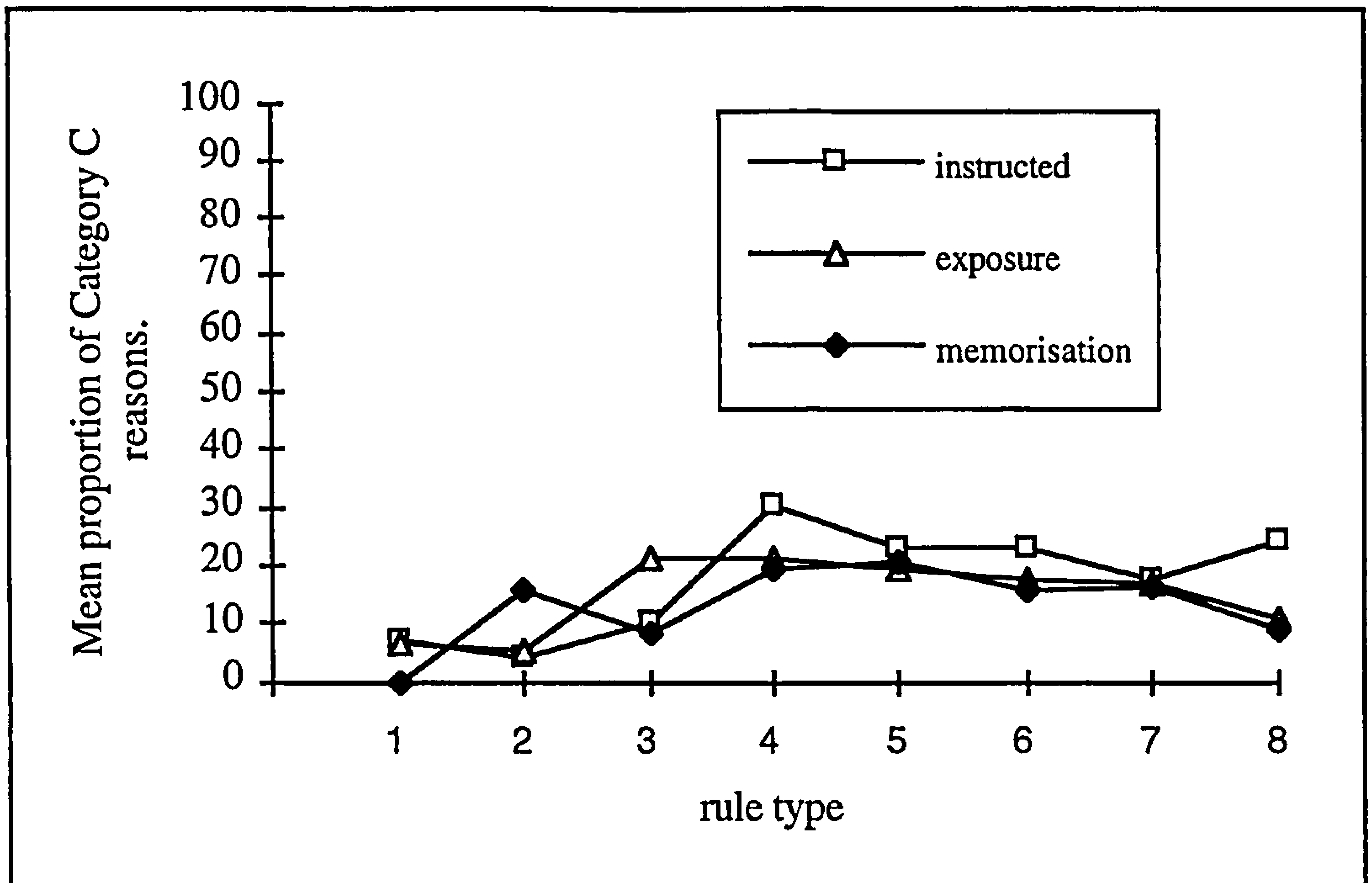


Figure. 6.7 Mean proportion of Category C reasons produced according to input condition and rule type.

A main effect of rule type was found (F(7,294)=2.93; $p < .01$. Follow up analyses revealed that rules 1 and 2 had a significantly lower proportion of category C reasons assigned to them than rule 4 (Tukey HSD: $p < .01$ and .05 respectively).

Summary

Overall, the proportion of category C reasons i.e. the proportion of reasons which were incorrect but where a correct judgement had been made, was relatively low across all eight rules. No significant differences on any rules were found across input conditions.

Analysis of Category D data.

The proportion of correctly judged items for which participants provided a Category D type reason (i.e. those where participants failed to provide a reason for a correctly judged item) was calculated for each input condition. A two factor analysis of variance (factors: input condition and rule type) was performed. No main effect of input condition was found nor was there any significant interaction between input condition and rule type. The mean proportion of category D reasons produced according to input condition and rule type are plotted below (see Figure 6.8).

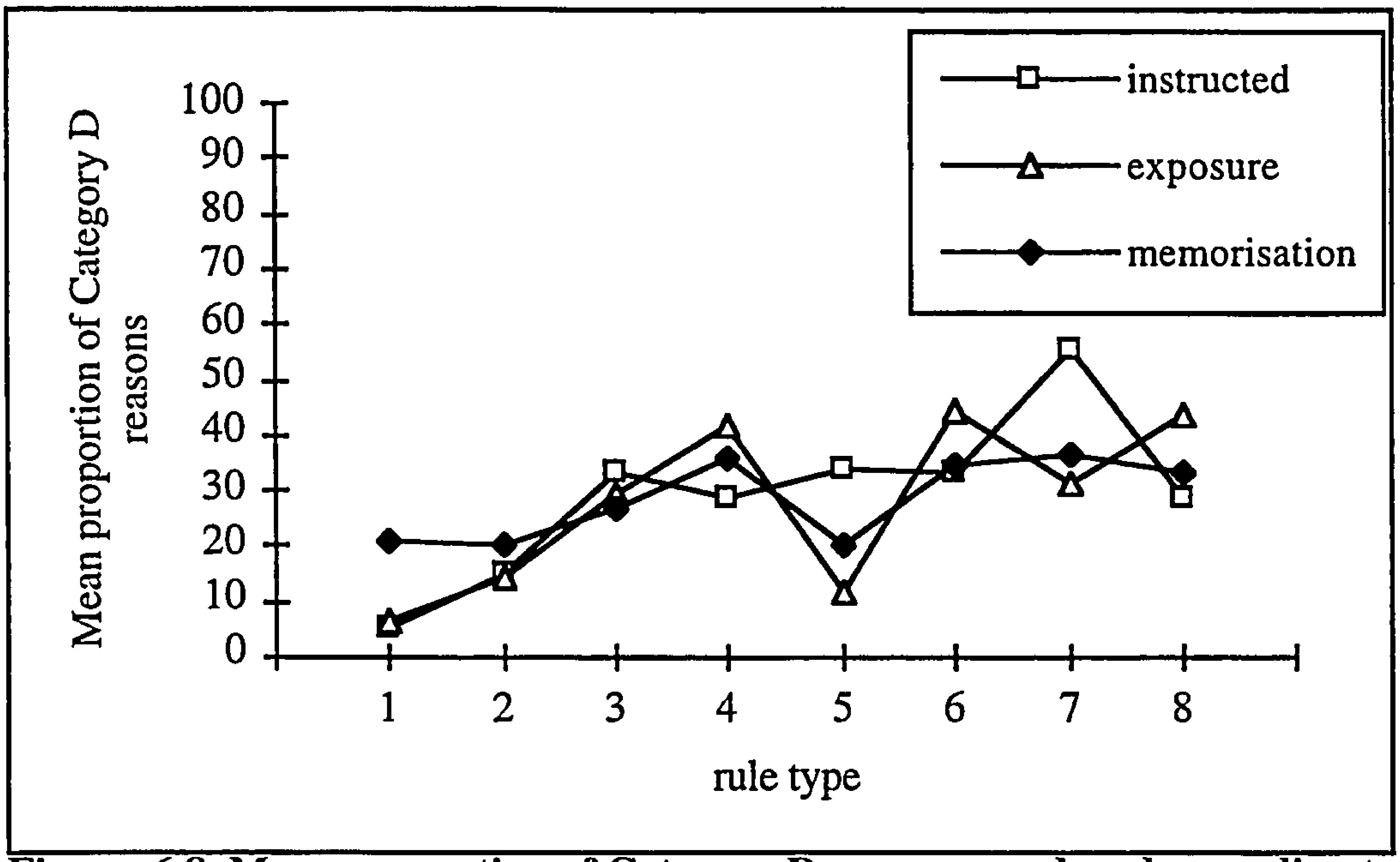


Figure. 6.8 Mean proportion of Category D reasons produced according to input condition and rule type.

A main effect of rule type was found (F (7, 294)= 7.06; $p < .001$). Follow up analyses revealed that rules 3, 4, 6, 7 and 8 had a significantly higher proportion of category D reasons assigned to them than rule 1 (Tukey HSD: all values $p < .05$) and rules 4, 6, 7 and 8 had a significantly higher proportion of category D reasons assigned to them than rule 2 (Tukey HSD: all values $p < .05$)

Summary

The proportion of category D reasons, i.e. those where participants failed to provide a reason for a correctly judged item, was overall lowest on rules 1, 2 and 5 and highest on rule 7 closely followed by rules 4, 6 and 8. No differences according to input condition were found.

Analysis of Category E data.

The proportion of Category E reasons (reasons which were impossible to judge in terms of their adequacy in describing the rule violation) was very small. Only five participants in the instructed condition, three in the exposure condition and seven in the memorisation condition produced category E reasons. The remaining participants produced no category E reasons. Only 1% of the total proportion of items tested were assigned category E reasons by learners in the instructed and exposure conditions compared with 4% by those in the memorisation condition. The high number of zero scores made further statistical analyses inappropriate. Consequently, no analyses were performed on these data.

Analysis of Category F data.

The proportion of category F reasons (judgements based upon "feel") was also very small. Only one participant in the instructed condition and one in the exposure condition produced category F reasons. However, seven participants in the memorisation condition produced category F reasons. Although the high number of zero scores made further statistical analyses inappropriate, it is interesting to note that the number of participants producing category F reasons was highest in the memorisation condition.

Analysis of Category G data.

The same problem with small numbers prevented detailed statistical analysis on category G data. Participants in neither the instructed nor the exposure conditions produced category G responses but five in the memorisation group did produce category G reasons (i.e. those which indicated participants had based judgements on "familiarity" of the item).

Analysis of Category H data.

As stated above, in Category H, an *incorrect* grammaticality judgement had been made for which either an incorrect reason had been supplied or no reason had been given. The number of reasons (or non-reasons) falling into category H is therefore the same as the number of incorrect judgements made.

Analysis comparing the number of *correct* judgements made according to input condition has already been performed (see above). No further analyses were necessary since the results obtained on the equivalent of the number of *incorrect* judgements would be identical to those obtained in the previous analysis on the correct judgement data. However, in Study Three and Four it was found that instructed learners outperformed those in the exposure condition on rule 6 only. It was hypothesised that the two conditions might again differ significantly on this rule. It was suggested in Chapter Four that the difference on rule 6 might be due to the exposure learners formulating incorrect rules to make judgements on rule 6. To determine if this were the case, the reasons provided for incorrect judgements were examined to see if exposure learners tend to formulate more consistent but incorrect rules on this item than those in the instructed condition.

Eight out of 15 learners in the instructed condition made errors on rule 6 items. Of the 15 reasons provided by these learners for their judgements, only 3 related to an incorrect formulation of a rule. In contrast, 14 out of 15 learners in the exposure condition made errors on rule 6. Of the 22 reasons they provided 10 were incorrect rules. Interestingly, the memorisation learners experienced problems with rule 3 but those in the instructed and exposure did not. A similar pattern in the reasons data emerged: 13 learners in the memorisation condition made errors on rule 3. Of the 30 incorrect reasons they provided, half of these were incorrect rules. Only 8 instructed and 6 exposure learners made errors on rule 3. Of the 10 reasons provided by the instructed learners, only 2 related to incorrect rules and of the 10 reasons provided by the exposure learners, none related to incorrect rules. Where learners have performed particularly poorly it would appear that they tend to have formulated incorrect rules for approximately half their incorrectly rejected items.

The same pattern of findings emerged on rule 6 for those in the memorisation condition. These learners also experienced some problems with rule 6 and again approximately half of the reasons they supplied related to incorrect rules.

6. 4 Free Production test

The free production exercise was designed to ascertain whether participants could produce novel sentences of their own. Performance was measured in two ways: firstly, by recording the number of complete, grammatical sentences produced by each participant. Secondly, by noting the number of times each of the ungrammatical sentences produced (if there were any) broke one of the rules of the language.

It should be noted that three participants, two from the instructed condition and one from the memorisation condition, misunderstood the instructions for the free production task. One of the instructed condition participants wrote the word class orders only e.g. ADEC, the other only completed one page of the task and the participant in the implicit condition wrote sentences in English. These participants' data were not included in the subsequent analyses.

Two sets of analyses were carried out, one examining the number of correctly produced sentences, the other examining the number of rule breakages made in the incorrect sentences.

a) Proportion of correctly produced sentences.

The total number of grammatically correct sentences from the free production booklet was recorded for each participant. A one factor analysis of variance (factor: input condition) was performed on the data. A main effect of input condition was found ($F(2,39) = 4.34$; $p < .05$) after which follow up analyses revealed that participants in the instructed condition produced significantly more grammatically correct sentences (mean: 13.61, out of a maximum of 21, st dev: 4.75) than those in the memorisation condition (mean: 7.28; st dev: 5.35; Newman- Keuls: $p < .05$) and more but not significantly more than those in the exposure condition (mean: 10.26; 6.37)

b) Number of rule breakages.

The ungrammatical sentences were recorded and their grammatical structure examined. If the word order of the incorrect sentence broke one of the rules of the language this was noted. It was possible that the word order in a single incorrect sentence could violate more than one rule of the language.

In the course of examining the incorrect sentences, there were found to be instances in which certain word order sequences although incorrect according to the phrase structure rules as described by Morgan *et al*, could not be described in terms of a violation of one of the eight rules of the language. For example, one participant produced the following sentence:

"RUD VOT NEB PEL TIZ"

The word class order of this sentence is 'AECDD'. The sentence is ungrammatical because there are two adjacent 'D' class words. The final phrase, a 'C' phrase, should comprise a 'C' word plus a single 'D' word, (not two 'D' words). Rule 3 states that "There may be at most one C phrase at the end of a sentence" but in the case above, the extra 'D' word does not constitute an extra 'C' phrase. Here there are simply two words of the same class next to one another. Neither rule 3 nor any of the other rules of the language have been violated and yet the sentence is not grammatically correct according to the phrase structure rules. An additional descriptive rule was created to enable the categorisation of other sentences with consecutive words belonging to the same word class "Sentences may not contain two or more consecutive words belonging to the same word class." This will be referred to as Rule 9 below.

A second example of an ungrammatical sentence in which the incorrect word class orders could not be described in terms of a violation one of the eight rules of the language is as follows: "RUD CAV SOG DUP"

The word class order of this sentence is 'ACCF' . The sentence is ungrammatical because there are two adjacent 'C' class words. However, the sentence is also ungrammatical because a 'C' class word also constitutes a full phrase (with or without a 'D' class word). The phrase structure rules do not allow for consecutive placing of phrases of the same type. Rule 9 was therefore extended to include this constraint. Rule 9 states "Sentences may not contain two or more consecutive words belonging to the same word class or two or more consecutive phrases of the same type."

A third and final example of an ungrammatical sentence in which the incorrect word class orders could not be described in terms of a violation one of the eight rules of the language is as follows:

"FAC RUD"

The word class order of this sentence is 'FA'. This sentence is ungrammatical because it violates rule 8: "A 'C phrase' must occur before an 'F' word". However, if this problem were corrected and a C phrase was positioned before the "F' word, the sentence would remain ungrammatical because of the positioning of the 'A' word "RUD". According to the finite state grammar and the phrase structure rules, the 'A' word should appear at the beginning of the sentence. However, the descriptive rules provided by Morgan *et al* stipulate only that every sentence must have at least one 'A' word and not more than one 'A' word (see rules 1 and 2, Chapter 2) and makes no reference to the position of the 'A' class word. A third new descriptive rule was therefore constructed: "'A' class words can appear only at the beginning of sentences." This will be referred to as Rule 10 below.

In summary, two new descriptive rules were created to enable categorisation of errors which could not be described in terms of a violation of the eight original rules of the language.

The total number of violations of each of the ten rules of the language was calculated for each input condition. This involved examining the incorrect sentences, locating the error or errors within the sentence and determining which of the ten rules had been broken. The high number of zero scores in some categories made further statistical analyses inappropriate, consequently, no analyses were performed on these data. The total number of times each rule was violated is presented below, separated according to input condition (see Figure 6.9).

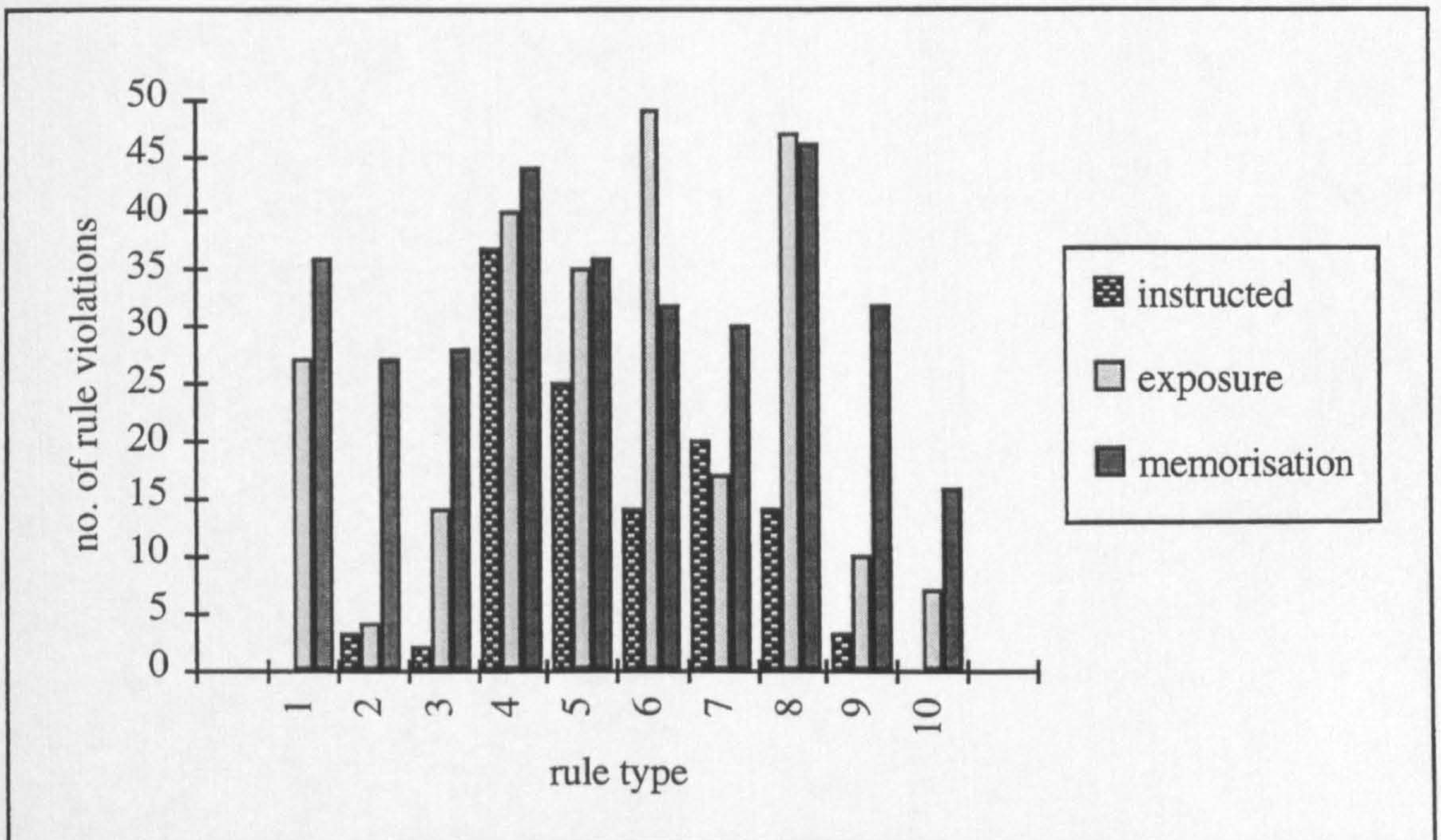


Figure. 6.9 The number of violations of each of the ten rule types separated according to input condition.

None of the participants from the instructed input condition violated rule 1 or rule 10. Twenty seven violations of rule 1 were made by participants in the exposure condition, but inspection of the raw data revealed that only three participants were responsible for these violations, each of them breaking rule one on nine occasions. The highest number of violations of rule 1 and rule 10 was produced by participants in the memorisation condition, just under half the participants in this condition broke these rules. Rules 2, 3, 7, 9 and 10 were also broken most frequently by participants in the memorisation condition.

Rule 6 was broken most frequently by participants in the exposure condition. Participants in this condition violated rule 6 more frequently than any other rule. Rules 5 and 8 were broken most frequently by participants in the exposure and memorisation conditions. Participants from all three input conditions violated rule 4 at around the same relatively high rate. The number of violations of this rule when averaged across all three conditions was highest on rule 4.

Examination of the overall frequencies of violations for each separate condition revealed that the instructed condition seemed to violate rule 4 most frequently when compared to the number of times they had violated the other rules. Those in the exposure condition violated rule 6 most frequently and those in the memorisation condition violated rules 4 and 8 most frequently although the overall distribution of rules violations for this group was uniformly high.

6. 5 Discussion

At the beginning of this chapter it was hypothesised that complex rules could only be acquired under unconscious, implicit, learning conditions (Reber, 1989, 1994; Krashen 1994). In order to induce such conditions, Reber argued that a non-intentional approach to learning should be encouraged but in which learners attention is drawn to the input materials. A memorisation procedure was adopted in an attempt to induce implicit learning and it was predicted that learners in this condition would outperform those in the instructed and exposure conditions on the complex rules. No such effect was found. Learners in the instructed and exposure conditions outperformed those in the memorisation condition on rule 3 of the language, this rule being judged as one of the more complex rules (see Chapter 4 discussion and below). No other differences were found between learners in the three input conditions on any particular rule with the exception that on rule 6, the most complex rule, the instructed learners outperformed the exposure learners. Learners in all three conditions performed well on the most simple rules, rules 1 and 2.

The results provide some support for studies which have found no difference between rule search and implicit learners (Abrams and Reber, 1988; Danks and Gans, 1975; Dienes et *al*, 1991; Dulany *et al*, 1984; Mathews *et al,* 1989; Robinson, 1996): in the current study, whilst rule search learners outperformed those in the memorisation condition on rule 3, no other differences were found between learners in the two conditions. These results also offer partial support for Robinson (1996) whose instructed learners outperformed his rule search learners on the complex rules overall. The results did not support his finding that instructed learners outperformed those in the other two conditions on the simple rules. The results offer partial support for Shaffer (1989) who found no difference between instructed and exposure learners: only on rule 6 was there a difference between the two conditions. The results are most similar to those reported in Study Three and Four of the current research, where the same pattern of findings between instructed and exposure learners was found.

It was suggested in Chapter Four that the difference on rule 6 in performances by learners in the instructed and exposure conditions might have been due to the exposure learners formulating incorrect rules to make judgements on rule 6. To determine if this were the case, the reasons provided for incorrect judgements were examined to see if exposure learners reported more incorrect rules on this rule than those in the instructed condition. It was found that approximately half the reasons provided by learners in the exposure condition related to incorrectly formulated rules whereas only three of the fifteen reasons provided by those in the instructed conditions related to incorrectly formulated rules. A similar pattern emerged when comparing performance on rule 3 and the reasons used to justify incorrect responses supplied by those in the memorisation condition. Only those in the memorisation condition provided reasons relating to consistent but incorrect rules. In summary, there appears to some evidence to suggest that part of the reason learners in the exposure condition experienced problems with rule 6 and those in the memorisation condition with rule 3 was because the learners had applied more simple rules having failed to notice the more complex rules.

Why did learners in the exposure condition induce incorrect rules for rule 6 items but not for rule 3? Why did those in the memorisation condition induce incorrect rules for both and why did those in the instructed condition induce very few incorrect rules? The most common reasons presented for rejecting grammatically correct rule 6 statements related to the permissibility of the word in the final position: for example, a number of learners maintained that "FAC" (an F class word) could not be used at the end of a sentence. (Two of the correct sentences paired with those violating rule 6 ended in the word "FAC".) Rejecting these grammatical sentences meant that they accepted sentences ending in "FAC PEL" in which the "D" word "PEL" followed immediately after the "F" word "FAC" (rule 6 states that a D word cannot appear immediately after an E or F word). In order to correctly reject a rule 6 item, one must be aware that if a D word appears in final position, a C word must precede it. Learners must attend to the penultimate word in the sentence having checked the word in final position. Learners could also examine the sentence starting from mid-position and check what appears after the "E" or "F" word. By failing to attend to the words prior to that in final position or after that in mid-position, learners miss the key problem. In summary, on rule 6 it would appear that learners in the exposure and memorisation conditions might have failed to notice the features in the less salient positions and had instead induced simple but incorrect rules for classifying items, usually relating to the permissibility of the more salient final word.

In order to correctly reject rule 3, (there may be at most one C phrase at the end of a sentence) learners must again focus their attention on the words which precede the final word. However, in rule 3, if the rule is broken, two C type words or a CDC combination are present. Learners in the both the exposure and instructed conditions appeared to have noticed when this occurred, frequently referring in their reason statements to the impermissibility of the existence of "two triangles", "two red words" or "two C words" and that "KOR" (a "D" word) could not placed between two "triangles" (the CDC combination). Those in the memorisation condition appeared to have failed to notice the combination of C words or phrases. Learners in the exposure condition noticed this rule but not rule 6 possibly because it was slightly less complex overall and might be more salient: two words of the same class in combination might be easier to spot than the absence of a "C" word before a "D" word. Learners in the memorisation condition appear not to have noticed this more salient violation and had again relied on a simpler, but incorrect rule governing permissibility of the word in final position, to make their classification on rule 3. It might be concluded that type of input interacts with the extent to which less salient and more complex features are noticed. Noticing of less salient features in the input appears to be a factor in their acquisition. This point will be discussed in greater depth in the final chapter.

Results on the free production tests revealed that instructed learners produced significantly more complete grammatical sentences than those in the memorisation condition and more but not significantly more than those in the exposure condition. Learners in the memorisation condition broke rules 1, 2, 3, 7, 9 and 10 more frequently (but not significantly more frequently) than those in the other two input conditions and the exposure learners broke rule 6 more frequently than learners in the other two conditions. Rules 5 and 8 were broken most frequently by the exposure and memorisation learners. Rule 4 was broken by learners in all three conditions to a similar degree. These findings provide partial support for Lightbown *et al* (1980) who found a positive effect of instruction in carefully planned production. Learners in the instructed condition performed best on the free production task and violated the rules less frequently than those in the other two conditions. Learners in the exposure condition continued to struggle with rule 6 of the language in both free production and rules test.

Whilst those in the memorisation condition did not outperform those in the other conditions on the more complex rules, it is possible that the learners in the memorisation condition had not learned implicitly despite the effort to induce implicit learning in this condition. If this were the case then these findings could not be used as evidence against Reber and Krashen's claims that complex rules are best acquired unconsciously. It was necessary, therefore, to determine whether learners in the memorisation condition had learned implicitly. The main source of evidence for this was the reasons' data. According to Reber, knowledge acquired implicitly "is always ahead of its possessor to explicate it" (Reber, 1989, p.229). It appears that Reber meant by this that one cannot verbalise all that one knows implicitly. According to Reber, most of implicit knowledge is unavailable for verbal report and is thus "ahead" (in Reber's words) of what can be described or "explicated" by the person who has this knowledge. Examination of the reasons data showed that learners in all three conditions were unable to explicate *all* the rules underlying their correct responses. It could therefore be argued that learners in all three conditions had learned at least some aspects of the system implicitly. However, was there more evidence of implicit learning in learners in the memorisation condition than in learners in the other two conditions? In order to discern whether or not this were the case, two lines of enquiry were followed. Firstly, did learners in the memorisation condition adopt a non-intentional approach to learning whereas those in the other conditions adopted an intentional approach? Reber argued that a non-intentional approach was more likely to induce implicit learning. Secondly, were learners in the memorisation condition less able to verbalise the reasons for their judgements than those in the other two conditions? These two questions will be addressed in turn. Firstly, the information provided in mid-form 1 might serve to shed some light on the extent to which learners in the memorisation condition adopted a non-intentional rather than an intentional approach to learning and these results are examined below. Results from the reasons data will be reviewed later to address the second question.

In mid-form 1, presented after the input stage and before testing, learners were asked to write the strategies they had used to either learn the rules, search for the rules or memorise the syllable sets. It was found that those in the instructed condition tended to write less on their forms than learners in the other two conditions. Just under half the instructed learners referred to strategies they had used to memorise permissible word orders using the class letters, for example, one learner wrote: "CDF go together to replace E cos go together in alphabet". The instruction on the mid-form required learners to describe their *strategies* for learning rather than the rules they had learned. Only four learners wrote down any rules possibly because they could not see any reason for repeating the rules they had just been taught or possibly because they simply followed the instruction to write down strategies rather than rules.

In contrast, the majority of learners (twelve out of fifteen) in the exposure condition referred to *rules* rather than the strategies they had used to find the rules. Learners in this condition might have ignored the request to write down the strategies they had used because, having been actively engaged in looking for rules, they wanted to present those they had found. It might have made more sense to them to write the rules than write the strategies they had used to look for them or they might simply have found it easier to write the rules than describe the strategies they had used. The important point is that the majority of learners wrote detailed descriptions of rules they had found. This might serve as an indication that learners in the exposure condition had followed the instruction which asked them to search for rules and it could be argued that such learners had therefore adopted an intentional approach to learning.

Finally, the majority of learners (twelve out of fifteen) in the memorisation condition referred to *strategies* they had employed to memorise the sentences. Only a small minority of learners described any rules: two by referring to the syllable orders and three through reference to the shapes or colour orders. It would appear that, given the emphasis on reporting of strategies for memorisation, the majority of learners in this condition had followed the instruction given in the input stage to memorise the strings and therefore, it could be claimed, had adopted a non-intentional approach to learning..

Whilst learners in the memorisation condition might have made active attempts to memorise the strings, the results from mid-form 2 indicated that some learners in this condition had also become aware that a rule system existed: when asked the extent to which they felt there was an organised system which governed the order of the words in the sentences, just over half the learners in the memorisation condition indicated that they thought there was such a system. In the exposure condition about half the learners indicated that they thought there was a system and about half indicated that there was not or that they were unsure. Surprisingly, six learners in the instructed condition also indicated that they thought there was not a system or that they were uncertain of whether a system existed. It is difficult to account for why learners in the instructed condition felt there was not a system given the fact that they were told at the outset that there was a set of rules and that they were then systematically taught the rules. Perhaps these learners misunderstood the term "system" or thought that there was an element of deception involved in which the rules they had been given did not actually account for the word orders. It is also possible that they had found it difficult to remember the word orders or had experienced difficulty following the instructions which were intended to teach them the rules. They might have used the mid-form to express the extent to which they felt they had learned the system rather than the extent to which they thought a system existed. In future studies it might be advisable for learners to be individually interviewed at this stage in the study in order to clarify the position.

Whilst the responses on mid-form 2 were unexpected, the main conclusions that might be drawn are that a number of learners in the memorisation condition had spotted a system or guessed that one existed. Whether such a discovery reduced the likelihood of learners adopting an implicit approach to learning is impossible to say. Schmidt (1990, reviewed in Chapter One) argued that whilst learners must consciously notice features in the input in order for them to be acquired. He also claimed that whilst there was evidence of a facilitative effect of conscious learning (where the rules were understood during the learning process) he acknowledged that there was also evidence for implicit learning. It appears from this that Schmidt would agree that although learners must first notice a system exists, they might still learn the system implicitly.

In summary, it appears that the majority of learners in the memorisation condition followed the instruction to memorise and as such might not have engaged in a conscious search for rules. As stated above, such conditions are, according to Reber, more conducive to implicit learning than an intentional approach. The fact that a number of memorisation learners felt an underlying system existed does not exclude the possibility that learning in this condition was largely implicit. Further examination of the reasons data is necessary to discern whether there was more evidence of implicit learning in the memorisation condition than in the instructed and exposure conditions.

A comparison was made of the extent to which learners were able to verbalise reasons for their classifications across the three input conditions. It was found that learners in each of the three conditions failed to provide reasons for just over a quarter of the correctly rejected items: learners in the instructed condition failed to provide a reason on 27% of the correctly judged items, those in the exposure and memorisation conditions failed to provide reasons on 26% of the correctly judged items. No significant differences were found between the conditions. If absence of a reason on a correctly judged item is taken as evidence of implicit processing (as argued by Reber) then there appears to be no evidence to suggest that learners in the memorisation condition adopted a more implicit approach than those in the other two conditions: as stated above it would seem it could be argued that learners in all three conditions used implicit judgements on some items.

For the remaining correctly judged items, learners provided a wide range of reasons for justifying their classification decisions. The reasons were categorised according to six different criteria. Two (categories "A" and "B") related to reasons which would always lead to a correct classification: category "A" reasons were most similar to those used in the original descriptions of the eight rules and category "B" related to reasons which if applied would always lead to a correct classification but did not map directly onto the eight rules. Category "C" reasons would, if applied, only produce a correct classification on the item being examined but would lead to incorrect classifications if used to judge all items.

When analysis was performed only on category "A" reasons, a main effect of input condition was found. Further analysis on each of the eight rules of the language separately revealed that learners in the memorisation condition produced significantly fewer category "A" reasons than those in the instructed condition and fewer, but not significantly fewer, than those in the exposure condition on rules 1 and 2 only. Learners in all three input conditions provided significantly fewer type "A" reasons on the remaining more complex rules than on rules 1 and 2. These results might be interpreted by Reber and Lewis as providing evidence firstly, that learners in the memorisation condition adopted a more implicit approach to learning than those in the instructed condition on the two simple rules, evidenced by their failure to provide an "adequate" reason. Furthermore it might be argued that learners in all three input conditions adopted a more implicit approach on the more complex rules than on the simple rules.

However, when category "B" reasons were included in the analysis, the significant difference between learners in the memorisation condition and those in the instructed condition on rules 1 and 2 was no longer evident. By including reasons which "work" but do not map directly onto the original rules, the difference in ability to explicate what learners know of the rules disappeared. Learners in the memorisation condition knew more about items testing rules 1 and 2 than it first appeared and were able to verbalise what they knew in terms which did not map directly onto the eight originally described rules but nevertheless indicated that they were able to justify their choices on items which tested these two rules. These findings indicate that learners in the memorisation condition might not have adopted a more implicit approach to learning than their instructed and exposure counterparts on rules 1 and 2.

When type "C" reasons (i.e. those which were incorrect but led on this occasion to a correct judgement) were examined separately, again no differences were found between learners in the three input conditions. This finding indicated that learners in all three conditions produced the same proportion of incorrect justifications for their decisions. Learners in all three conditions created rules which were not representative of the underlying grammatical structure.

No statistical analyses were performed on the remaining reasons data, but a higher percentage of items were assigned type "E" reasons (those which were impossible to judge) by learners in the memorisation conditions than those in the other two input conditions; more learners in the memorisation condition produced type "F" reasons (describing judgements based on feel) than those in the other conditions and only learners in the memorisation condition provided type "G" reasons (describing judgements based on familiarity). Altogether, 11% of the reasons provided by learners in the memorisation condition were of type E, F or G compared with only 1% in the other two conditions. Seven percent of items classified by learners in the memorisation were judged on the basis of feel or familiarity. None of the learners in the instructed or exposure conditions reported this kind of reason. On the basis of the last finding one could again argue that learners in the memorisation condition adopted a more implicit approach than those in the other conditions on some items.

In the above description, it was noted that learners in the memorisation and instructed conditions differed on the proportion of category "A" reasons they had produced but on rules 1 and 2 only. If the boundaries on what constitutes an acceptable reason are widened then the difference, although still evident, is no longer significant. Reber and Lewis (1977) expressed some doubt about the relevance of some of the reasons provided by their participants. They noted, as I have, that some of the rules described are less representative of the underlying system than others: "non representative elaborations become quite common; subjects develop rules which are not systematically reflected in the structure of the language" (Reber and Lewis, 1977, p.348.). Examples of such rules have been categorised in the present study as category "B" and "C" reasons. Reber and Lewis reported that for a "sizeable minority of instances" learners provided reasons for correctly rejected items that were "irrelevant" and provided an example of such a reason: a string of letters was correctly rejected but for a reason which "somehow misses the point" (Reber and Lewis, 1977, p.352). The string was "VSSXXVV", the learner provided the following reason for rejecting the string "two S's cannot follow a V". Reber and Lewis acknowledged that the reason "was certainly correct" but noted that the learner had not identified the "source of nongrammaticality": the problem apparently lay with the initial "V". Reber and Lewis stated that "these issues are extremely complex and given the structure of the grammar it is extremely difficult to draw firm conclusions about what subjects know either implicitly or explicitly." (Reber and Lewis, p. 352). Despite this, the "irrelevant" reasons in conjunction with the "absence of reasons" were later used to support Reber and Lewis' argument that learners were engaging in implicit learning. They seemed to conclude that because learners were either unable to provide a formal rationale or provided an irrelevant one then the learners had learned implicitly.

I would argue that if any reason other than those based on feel or familiarity is provided, then the learner has made a judgement with some conscious knowledge of the rule they have created. It does not matter if the rule fails to map directly onto the original rules created by the experimenter. The rule is still consciously verbalisable and it works. With this argument one could conclude that there was no more evidence of implicit learning on rules 1 and 2 in the memorisation condition than in the instructed or exposure conditions once the "irrelevant" (as claimed by Reber) category "B" and "C" reasons were included.

In the current study it is also difficult to draw firm conclusions about what the learners know either implicitly or explicitly. It would appear, perhaps unsurprisingly, that learners in all the input conditions were unable or chose not to provide reasons for *every* correct classification: this was evidenced in the examination of category "D" responses where no reasons were supplied. Reber and Lewis might argue that this constitutes strong evidence of implicit learning in all three conditions, learners have made those judgements on the basis of their implicit knowledge which they have experienced difficulty verbalising. However, there are alternative possibilities as to why learners did not provide a reason for those items. They might have simply chosen not to give a reason on those occasions perhaps due to fatigue or boredom, they might have been uncertain as to whether their reason was correct so decided not to provide one or they might have been simply guessing on some items and did not want to admit doing so.

Learners in the memorisation condition produced significantly fewer category "A" reasons than those in the other two conditions and this could be taken as evidence that learners in this condition had relied more on their implicitly acquired knowledge to make their judgements than those in the other conditions. However, closer analysis revealed a difference between the conditions only on the simple rules and once category "B" reasons were included the difference was no longer significant. On the basis of this evidence, one might conclude that there is no evidence that learners in the memorisation system relied more on implicitly acquired knowledge than those in the other conditions. However, it should be noted that learners in the memorisation condition produced fewer overall category "A" "B" and "C" reasons than those in the other two conditions (57% of the total number of correctly rejected items compared to 70% and 72% for the instructed and exposure conditions respectively). They also produced more category "E" "F" and "G" reasons. Only memorisation learners reported basing judgements on "feel" or "familiarity" (category F and G reasons): of the total number of items correctly rejected by those in this condition, 10% were based on feel or familiarity. It could be argued in view of these differences and the fact that learners in the memorisation condition reported some intuitive decision making that these learners had adopted a more implicit approach to learning.

In conclusion, as stated above, it is impossible to determine accurately the extent to which learners in the memorisation condition learned implicitly. It is possible that learners in this condition did rely more on implicit knowledge than those in the other two conditions but equally it could be argued that no clear differences were evident. It is also possible that learners in all three conditions based some judgements on implicit knowledge, equally it could be argued that in fact all the decisions were based on clear, consciously held rules but that learners simply chose not to verbalise them. Even Reber and Lewis came to the conclusion that it was difficult to judge what their subjects knew either implicitly or explicitly and I have reached a similar conclusion. It would appear that even when conditions are set up artificially to induce implicit learning, the technique of asking learners to provide reasons for their decisions does little to reveal conclusively whether the resulting knowledge is implicit or explicit. There is a need to devise more effective methods for eliciting that which is consciously known and suggestions for this are examined in the final discussion chapter.

Whilst it is clear that learners in the memorisation condition failed to outperform those in the instructed and exposure conditions on the more complex rules, it is impossible to say whether learners in the memorisation condition had learned implicitly or that Reber and Krashen are wrong in suggesting that complex rules are best acquired unconsciously. As no clear conclusions can be drawn at this stage regarding the implicit learning issue, attention will now focus on the patterns of performance of learners in the three conditions.

The main aim of the current study was to improve performance on the complex rules. In Chapter Four of this research, rules 1 to 8 were categorised according to their relative complexity. The chart showing how rule complexity was calculated is reproduced below (see Table 6.4). In order to obtain a simple order of complexity for the eight rules, each rule can be given assigned one point for each feature which is thought to contribute towards its complexity. Rules 1 and 2 score none or one point and are regarded as the least complex, rules 4 and 5 are of medium complexity scoring two and four points respectively, and finally rules 3, 6, 7 and 8 score between five and a maximum seven points and are considered the most complex.

In examining the findings of the current study it is interesting to note that the instructed learners scored above chance on all rules except rule 8; those in the exposure condition scored above chance on all rules except rules 6 and 7 and those in the memorisation condition scored above chance on all rules except 3, 6, 7 and 8. It would appear there is a relationship between the amount of information one is given regarding the rules and the degree to which learners reach above chance performance on the more complex rules. No such relationship exists for the simple and medium complexity rules.

Table 6.4 Factors contributing towards complexity on each rule.

Rule No.	Description	Conditional (involving co-occurence of features)	Contains a negative	Contains a disjunctive	Beneficial to have knowledge of phrasal structure?	Visual salience of feature determined by position in sentence	Frequency of rule in the input	Extent to which the rule related to single lexical items
1	every sentence must have at least one A word	no	no	no	no	high	all	single
2	no sentence can contain more than one A word.	no	yes	no	no	high	all	single
3	there may be at most one C phrase at the end of a sentence	yes	yes	no	yes	low	half	general
4	every sentence must have at least one E or F word	no	no	yes	no	low	all	single
5	no sentence may contain more than one E or F word	yes	yes	yes	no	low	all	single
6	a D word cannot appear after an E or F word	yes	yes	yes	yes	low	half	general
7	a C phrasecannot occur before an E word	yes	yes	no	yes	low	half	general
8	a C phrase must occur before an F word	yes	no	no	yes	low	half	general

Whilst no statistical comparisons can be made between the results of the current study and that of Study Three, some interesting observations can be made. In Study Three, where learners completed two grammaticality judgement tasks and were not asked to provide reasons for their decisions, the pattern in the findings was as follows: the instructed learners performed significantly better on rules 1 and 2 than on all the other rules and the exposure learners performed significantly better on rules 1 and 2 than on all the other rules except rule 5. In Study Three performance on the more difficult rules was significantly poorer than on the simple ones. In the current study, learners in the instructed condition performed significantly better on rule 1 compared to rule 8 only and those in the exposure condition performed significantly better on rule 1 than on rules 6, 7 and 8 only. It would appear that for the instructed learners performance on rules 3 - 7 was of an overall higher standard in the current study than in Study Three. In the exposure condition performance on rules 3 and 4 was no longer significantly poorer than rules 1 and 2. Whilst, as stated above, it is not possible to make statistical comparisons across the two studies, it is interesting to note that performance on the complex rules was overall higher in the current study than in Study Three, relative to performance on the simple rules.

The mission in the current study was to attempt to improve performance on the more complex rules - it appears that inadvertently this has occurred. It is a possibility that the process of eliciting reasons from learners improved their performance on the more complex rules. Krashen might argue that this improvement was due to learners monitoring the output of their acquired system. Others might argue that learners simply put more effort into recalling the consciously held knowledge they had about the rules. Further studies are necessary to examine this issue more closely and possible suggestions will be presented in the final chapter of this thesis.

The questions posed in the introduction to this study were as follows: "Are complex rules best acquired under implicit conditions?", "Can it be established whether or not implicit learning has actually taken place?" and "Is implicit learning best induced under conditions to memorise?". There is insufficient evidence to answer question one due to the difficulty of establishing whether implicit conditions have been established. Implicit learning might be induced under conditions to memorise but it is by no means clear if this is the best method to adopt.

Chapter Seven

Discussion.

7. 1 Introduction

The following discussion is divided into five main sections. The first reviews the main goals of the research. The second examines each of the studies in turn, reviewing the questions each study addressed, the main findings and the links between the studies. The third section re-examines the main findings in relation to the previous literature, discusses the theoretical and practical implications of those findings and presents ideas for further research. The fourth section critically evaluates the use of artificial language systems as tools for modelling second language and the final section presents overall conclusions.

7. 2 The goals of the research

The main goal of the research was to discover which conditions of input and type of instruction best facilitate the acquisition of syntax in adult learners. An artificial miniature language was used as a model of real second language in a bid to control the language input and the conditions of exposure to that input. Performance of learners under four different input conditions was compared: under type "a" conditions, learners were referred to as "instructed" learners and were systematically taught the rules of the language. Type "b" or "exposure" learners were shown example sentences and were asked to search for the rules. Type "c" learners were shown the same sentences as those presented to the exposure learners but were not told to search for rules, instead they were asked to memorise the sentences and were referred to as "memorisation" learners. Finally, type "d" learners or "cued" learners received input which contained cues to the language's underlying phrasal structure.

Performances of learners under the differing input conditions were compared on both grammaticality judgement and (in the final three studies) free production tasks. Each of the input conditions was modelled on conditions experienced by adult second language learners and parallels were drawn between studies in the second language literature and the findings of the current research.

7. 3 A review of the five studies.

In Study One a comparison was made between learners whose input incorporated cues to phrasal structure (type "d" input) with those whose input contained no such cue (type "b" input). The study was a replication of Morgan *et al*'s (1989) research in which it had been hypothesised that natural language input contains such cues to phrasal structure which they claimed facilitate the learning of syntax by child learners. Study One was performed with two goals in mind: firstly to assess the language as a tool for testing, under controlled conditions, hypotheses concerning second language acquisition and secondly, to see what effect the cues had on the acquisition of the syntax. The key question addressed was "does exposure to cross-sentential cues to phrasal structure facilitate syntax acquisition compared to exposure without such cues?".

Morgan *et al* reported that their cued learners performed significantly better than non-cued learners on both simple and complex rules. In Study One, virtually the opposite finding occurred: non-cued learners outperformed the cued learners on the simple rules and performed better but not significantly better on the complex rules. It was suggested that the type of instruction used to accompany the input might have been different in the two studies and might have differentially affected the learning outcomes.

It was noted that the instructions given to learners in the Morgan *et al* study might have encouraged a more explicit approach to learning whereas those given to learners in Study One might have encouraged a mixture of an explicit and implicit approach. Reber *et al* (1980) had reported that the type of instruction accompanying input interacts with the salience of the underlying system: they had found that if the underlying system was rendered more salient, then more explicit instruction resulted in better performance; where the underlying system was less salient then a more implicit approach was more successful. It was hypothesised that in Study One the input which contained the cues might have made the underlying system more salient and that the more explicit approach, possibly adopted by learners in the Morgan *et al* study, might have facilitated the cued learners over the non-cued.

In Study Two the Morgan *et al* study was replicated once more but the instructional set accompanying the input was manipulated: learners received either the same instructions as given in Study One or more explicit instruction designed to raise their awareness of the existence of the rules and to focus their attention on the second "cue-containing" sentence. It was found that learners in the cued conditions continued to perform more poorly than those in the non-cued condition even under the more explicit instructional set. There was no evidence to support the claim that cross-sentential cues to phrasal structure facilitated the acquisition of syntax. Nor was there any evidence that learners in the cued conditions had acquired more knowledge of phrasal structure: results on the two tests of phrasal structure did not reveal a positive effect of cued input on performance compared to non-cued input.

It had been suggested at the end of Chapter Two that the addition of cues to phrasal structure in the input might have rendered the underlying system more salient. In Chapter Three it was suggested that whilst the cues might theoretically increase the salience of the system, only where learners were able to notice or attend to the cues would such enhancement occur. In view of the fact that learners in the cued conditions had three tasks to perform concurrently compared with only two in the uncued condition and that the cued learners' input was more complex than that of the non-cued learners, it is possible that the cued learners were simply unable to devote the attentional resources required to attend to and profit from the cues. Suggestions for further research on this issue are presented in the next section.

Whilst learners in the more explicit instruction condition did not perform significantly better than those given the original instructions, a trend in the data was evident: under the more explicitly oriented instructions learners in all three conditions performed better (though not significantly better) than their originally instructed counterparts. If more explicit instruction focusing on the existence of the rules helped to a degree, would direct teaching of the rules help more? Would learners who are systematically shown the rules be more likely to "consciously notice" the features in the input, a prerequisite for acquisition according to Schmidt (1990).

At this point it was decided to leave the issue of cross-sentential cueing behind and to focus on the primary question of the role of formal instruction in syntax acquisition. The miniature language was judged to be an effective tool for modelling second language acquisition in adult learners and a decision was made to employ the language in the remaining studies in the research.

In Study Three a comparison was made between "instructed" learners who were systematically taught the rules of the language (type "a" input) and learners given the same input and instruction as those in the non-cued condition in the previous study (type"b" input). The comparison was roughly analogous to that between formally instructed second language learners and naturalistic learners who search for rules in the input. Previous research in the field indicated a general consensus that instruction facilitates the success and rate of acquisition but not the process. However, a number of these studies were confounded due to difficulties in maintaining control over the kind of input learners received. More controlled, experimental studies pointed either towards a positive effect of instruction over rule search or to no differences in performance. Two key questions were posed in Study Three: "Is there a difference in learning outcome when learners have been encouraged to deduce the rules for themselves compared to the learning outcome of those who have been formally taught the rules?" and "Is formal instruction only effective for simple rules or can complex rules also be taught?"

Krashen (1984) and Reber (1994) argued that complex rules or systems could not be taught explicitly and that only simple rules of thumb could be consciously learned. Similarly, Pica (1985) reported a positive effect of instruction but for simple rules only. Finally, Lightbown (1983) reported positive effects of instruction which disappeared over time. Findings from Study Three indicated no main effect of instruction over exposure: only on rule 6 did learners in the instruction condition outperform those in the exposure condition. The findings offered partial support to those who had reported a positive effect of instruction but also offered partial support to those who had reported no effects. It did not support Pica's (1985), Krashen's (1984) or Reber's (1994) claims that only simple rules could be taught as rule 6 was one of the more complex rules. The positive effect of instruction disappeared after the nine week break providing some support for Lightbown (1983).

The superior performance of learners in the instructed condition on rule 6 was examined closely. It was found that learners in the exposure condition performed significantly worse on rule 6 compared to their performance on most of the other conditional rules whereas the instructed learners' performance on this rule was not different from their performance on the other conditional rules. Further inspection of a number of factors which were considered to contribute towards rule complexity revealed that rule 6 included all the contributing factors and was judged the most complex of the rules. A number of possible reasons for the difficulty experienced by the exposure learners on rule 6 were presented in Chapter Four and will be re-examined in the next section along with suggestions for further research.

Further analyses of the data indicated that the classification of the eight rules into the original unconditional/conditional groupings required review. All the rules were examined and the number of factors considered to contribute towards each rule's complexity was summed. The following order of complexity was obtained (from the most simple to the most complex): rule 1, 2, 4, 5, 8, 3, 7 and finally rule 6, (rules 3 and 7 were of equal complexity). Learners in both input conditions experienced more difficulty with the more complex rules 3 - 8 than the simpler rules 1 and 2 and the original unconditional/ conditional categories were abandoned. Suggestions for further research relating to the issue of rule complexity will be presented in the next section.

Although the instructed learners had outperformed those in the exposure condition on the most complex rule, their performance on the remaining complex rules was not significantly better than that of the exposure learners. At this point, two avenues of research were pursued in a bid to improve performance on the complex rules. In Study Four a group of Hungarian English Teachers was tested under identical conditions to those in Study Three. Following a study by Robinson (1996) it was predicted that these more "grammatically sensitive" learners might perform better on the complex rules under instructed rather than exposure conditions. The prediction was not borne out. Learners in both conditions experienced more difficulty with the more complex rules compared to rule 1 and no overall effect of input condition was found. Learners in the instructed condition outperformed those in the exposure condition on rule 6 only. No other differences were found on any of the remaining rules. The findings were similar to those of Study Three and it was tentatively concluded, in the absence of a controlled comparison, that those who are more grammatically sensitive perform no differently on simple and complex rule learning than those of mixed language learning experience. Suggestions for further research on this point will be presented in the next section.

Finally, in Study Five, a third condition was incorporated. The conditions of input were modelled on those of a naturalistic learner who is exposed to language but makes no efforts to search for rules. The conditions of input were similar to those claimed by Krashen and Reber to induce implicit or unconscious learning. Both Krashen and Reber argued that more complex rules could only be acquired unconsciously or learned implicitly. Efforts were therefore made to try and induce such conditions in a bid to improve performance on the more complex rules: learners were presented with the same input given to the exposure learners but were not told a rule system existed. They were asked to memorise the strings of nonsense syllables and were referred to as "memorisation" learners receiving "type c" input.

It had been predicted that the learners in this condition would perform better than those in the instructed and exposure conditions - who had hypothetically adopted a non-implicit approach to learning- on the more complex rules. The following key questions were presented: "Are complex rules best acquired under conditions designed to induce implicit learning?" "Can it be established whether unconscious or implicit learning has actually taken place?" "Is implicit learning best induced under conditions to memorise?"

In answer to the first question above, the answer was no: learners in the memorisation condition, the condition set up to induce implicit learning, did not outperform those in the instructed and exposure conditions on the more complex rules. Those in the latter two conditions actually performed better than those in the memorisation condition on rule 3, considered to be one of the more complex rules. In answer to question two: "Can it be established whether unconscious or implicit learning has actually taken place?" and question three: "Is implicit learning best induced under conditions to memorise?" there were no conclusive answers. Learners in all three conditions failed on an equivalent number of occasions to provide reasons for correctly judged items. It was reasoned that this might indicate that learners in all three conditions had learned implicitly. However, it was also argued that the failure to provide a reason might not necessarily indicate that the knowledge used to make the judgement was implicit.

On the remaining items, where reasons were provided, some differences between input conditions were evident: learners in the memorisation condition provided fewer category "a" "b" and "c" reasons (i.e. those which described a rule which "worked") overall than those in the instructed and exposure conditions and were the only learners to refer to judgements based on "feel" or "familiarity". It was argued that this might be used as evidence that memorisation learners had adopted a more implicit approach. It was concluded that there was insufficient evidence to discern, using the "reasons" methodology, whether or not implicit learning had occurred or whether memorisation learners had adopted a more implicit approach to learning. Further discussion of these issues will be presented in the final section of this discussion.

Finally, it was noted in Chapter Six that performance on the complex rules appeared to have improved in Study Five relative to performance in Studies Three and Four. It was tentatively suggested that the act of supplying a reason might have improved performance on the more complex rules. Suggestions for future research on this issue will also be presented in the next and final section.

In summary, in each of the five studies of the current research, different conditions of input and accompanying instruction were manipulated. Only subtle differences were found in performance when comparing learners from each of the four conditions. In the following section the main findings will be re-examined and compared to those of previous studies, the theoretical and practical implications of those findings will be presented along with ideas for further research. In the fourth section the use of artificial language systems as tools for modelling second language will be critically evaluated and in the final section overall conclusions will be presented.

7.4 A review of the main findings, their relation to previous literature and the theoretical and practical implications.

Four main findings emerged from the research. Firstly, instructed, exposure and memorisation learners performed similarly on the majority of rules but subtle differences appeared on the more complex rules. Secondly, learners who were grammatically sensitive tended to produce patterns of learning similar to those of learners with mixed language experience. Thirdly, cross-sentential cueing of phrasal structure did not facilitate performance but fourthly, asking learners to provide reasons for their choices on grammaticality judgement tasks did appear to improve performance on the complex rules.

Any theory of second language acquisition would need to explain these results, in particular those relating to the differing effects of input on acquisition. (Those relating to the type of learner and the provision of reasons require further replication and will be discussed later in this section.) In the discussion which follows, comparisons will be made between the findings obtained in the current research and those of previous studies, the implications for theories of second language acquisition will then be considered. Finally, the implications for second language teaching practice will be examined.

The central finding that only subtle differences between learners in the three conditions were apparent is perhaps the most important of all the findings. It appeared that exposure and instruction were equally effective on the majority of rules. In Chapters One and Four of this thesis, a review was made of the literature which compared learners under differing conditions of input was reviewed. The main conclusion drawn was that formal instruction has a positive effect on the rate and success of acquisition but not on the process of acquisition. Long's (1983) review of twelve studies has been regularly cited as providing evidence that instruction is effective in improving the success and rate of acquisition. Long himself concluded that there was "considerable evidence" that second language instruction makes a difference but he also indicated that this was a tentative conclusion. A closer inspection of the twelve studies reveals that in only three of the studies was a positive effect of instruction actually reported. Long had argued that many of the studies which had reported finding no differences between instruction and exposure had shown a "hint" of an advantage of instruction and some were methodologically flawed. Of the five studies which had examined correlations between performance and years of exposure and years of instruction, only one had reported finding a positive correlation between years of instruction and performance alone. Three of the five had found that both instruction and exposure positively correlated with performance. In summary, of the twelve studies Long reviewed, eight reported finding no difference between exposure and instruction and one found a positive effect of exposure. It was noted in Chapter One that Long had perhaps been rather overgenerous in his conclusions in favour of instruction and that lack of adequate control over crucial variables meant that no definite conclusions could be drawn. Long completed his review by repeating the same questions that the research had set out to address, for example: does second language instruction make a difference? It appears that even he felt the question had not yet been answered.

In the later studies reviewed in Chapters One and Four, whilst there was clearer evidence of a positive effect of instruction, the majority of these studies indicated that instruction was only effective under specific conditions or with particular types of language input. Lightbown (1983) reported positive effects of instruction early on which "wore off" over time. Others found positive effects of instruction but only in carefully planned production (Lightbown *et al,* 1980). Pica (1985) concluded that instruction was effective only for simple structures whilst Robinson (1996) reported finding positive effects of instruction for both complex and simple rules.

In summary, of the twenty five studies reviewed in total, eight reported no difference between instructed and exposure learners, one a positive effect of exposure and the remainder a positive effect of instruction. Of those that reported positive effects of instruction, all but three included a restriction on the conditions under which instruction was effective or on the kind of features that could be taught. One might conclude from this that both instruction and exposure are valuable kinds of input. Learners appear to be able to profit from both types of input but only under certain conditions and with certain kinds of language input can instruction improve performance beyond that attained through exposure. Exposure, on the other hand, only rarely leads to better performance than attained under instructed conditions.

Such a pattern of findings was observed in the current research. Performance appeared to depend on an interaction between the type of input provided and the complexity of the feature to be learned. No overall superiority in performance was found for any of the input conditions and only when each rule of the language was examined individually did differences emerge. These differences were obtained on the more complex rules and did not appear to support the predictions made by Krashen and Reber that more complex features could not be taught explicitly and that such features were best acquired unconsciously or learned implicitly. In view of the fact that the theories of both Krashen and Reber were not supported, possible alternative hypotheses regarding the acquisition of both complex and simple features were sought.

Any alternative hypothesis would need to explain the pattern of findings obtained in the current study: it would need to explain the differences which occurred on rules 6 and 3 and why these differences were relatively short lived. It would also need to explain why cued input failed to facilitate the acquisition of even the simple rules of the language. Such an alternative hypothesis is presented here. In Chapter Six it was proposed that learners in the instructed condition performed better on rule 6 than those in the exposure condition because exposure learners had failed to notice the features relating to rule 6 due to their less salient position in the sentence. Exposure and memorisation learners had instead induced simpler but incorrect rules for judging rule 6 sentences which related to the more salient features in final position. A similar pattern was observed on rule 3 where those in the memorisation condition appeared to have failed to notice the features relating to the rule and had also induced simple but incorrect rules. Those in the instructed condition had noticed the features relating to both rules. It was hypothesised that noticing of more complex, less salient rules, increases in relation to the extent to which learners are made aware of the existence of the underlying system and/or in relation to the amount of effort exerted in attempts to learn or search for rules: learners in the instructed condition performed at above chance on all the rules (except rule 8 in Study 5), those in the exposure condition failed to perform above chance on rules 6 and 7 and those in the memorisation condition failed to perform above chance on rules 3, 6 and 7. It appears that as the rules become more complex and less salient, the performance of learners in conditions where no instruction is received gradually deteriorates.

The findings and hypotheses presented above stand in direct contrast to those presented by Krashen and Reber who claimed that less salient, more complex rules do not benefit from explicit instruction. However, the current findings and hypotheses do support those of others (R. Ellis, 1990, 1993; Long, 1988, 1991; Schmidt, 1990) who have argued that formal instruction "works" by increasing the salience of target features in the input so that they are more likely to be noticed by the learner. Schmidt (1990) claimed that *conscious* noticing of features is required for acquisition of those features to occur. Others (e.g. Seliger, 1979) argued that pedagogical rules act as "acquisition facilitators" focusing the learners attention on the critical attributes of the language. Sharwood Smith (1994) proposed that simply making features salient in the input could be beneficial to language learning and that teaching of rules might not be necessary. Finally, both Reber and Krashen acknowledged that learners must attend to the input for acquisition to take place.

The emphasis in all the above accounts appears to be upon the importance of attending to input and noticing features within that input. The probability of a feature being noticed appears to relate to the extent to which the feature is salient or is *made* salient. I would argue that the extent to which a feature is made salient is related to the kind of input the learner receives and what the learner does with that input. Not only is formal instruction effective in raising the chances of a feature being noticed but other kinds of input can also be successful. The only advantage instruction appears to have is in raising salience of the "most difficult to spot" features and this would account for the superior performance of the instructed learners on the most complex rules only. I would further argue that whilst any kind of input can provide opportunities for noticing to take place the learner must have the attentional resources available to focus on the input. In Studies One and Two of the current research it appeared that the cued learners, who were asked to attend to three tasks simultaneously, encountered difficulties acquiring even the most simple rules. This provides possible evidence that input can only be acquired if one pays sufficient attention to it. Van Patten (1990) and Hulstijn (1988) found that learners experienced difficulty attending to both form and meaning in their input, tending to focus more on one at the expense of the other. Further research is required to determine the extent to which different language learning activities vary according to the level of attention they demand, for example, learners might be asked to perform distracter tasks whilst engaging in rule search and the effect on performance examined.

In summary, the subtle differences observed between the performances of learners in the instructed, exposure and memorisation conditions could be due to the degree to which learners in the different conditions had noticed the relevant features relating to the more complex and less salient rules. The poor performance by those in the cued conditions might have been due to their inability to notice the features in the input because of a failure to attend to those features.

The main hypothesis arising from the current research is the "noticing hypothesis". If acquisition can be found to be directly related to noticing and the different input conditions adopted here are also found to relate to noticing then an explanation of the patterns of results obtained in the current study might be obtained. In order to test the noticing hypothesis, a methodology is required to determine precisely which features in the input learners have noticed. It is generally accepted that in order to notice something one must first either pay attention to it or have one's attention drawn to it. Schmidt (1988) defined noticing as "availability for verbal report" with the proviso that the reports were elicited concurrently or immediately after the experience. Whilst the validity of *retrospective* reports has been widely criticised, there is more support for "verbal protocol analysis" in which learners are asked to report their thoughts concurrently. It is argued that such reports give an indication of the learner's locus of attention (Evans, 1996). In future studies learners could be asked to describe their thoughts during the input session and the features they describe could be recorded. In addition, exposure and memorisation learners could be monitored using the tracking of eye movements across the input sentences to determine the extent to which they attend to features in the less salient positions. The adoption of this latter method to determine the features instructed learners notice in their input might be more difficult as their input involves reading written notes presented on screen describing the rules. It might not be possible to make comparisons of eye-movements across all three conditions, but the verbal protocol analysis could be adopted in all three cases.

In the testing stage, eye-movements could be charted to determine which features learners in all three conditions are examining during the decision making process. Single grammatical and ungrammatical sentences could be presented in the testing stage rather than pairs of sentences to ensure that learners are not directed towards any particular features in the sentences. A comparison could be made across the three input conditions to see firstly, if there is any difference in the extent to which the features relating to the individual rules of the language have been noticed in the input and secondly, if there is any difference in their focus of attention during the classification of the sentences. Furthermore, the relationship between features that are noticed or mentioned in input and performance on those features could be ascertained to see if a positive relationship exists. Schmidt and Frota (1986) predicted such a relationship claiming that they had found strong evidence between noticing of specific features in input and emergence in production. However, as mentioned in Chapter Four, their data were based upon input obtained from one case study, the "case" in question being one of the researchers. The study tended to lack experimental control and as such the results should be interpreted with caution.

The above suggestions for possible research relate to attempts to find empirical evidence for a relationship between noticing and performance. It has also been suggested that highlighting of features in the input increases the possibility of learners noticing those features. However, how does the issue of noticing relate to the implicit/explicit learning distinction and the debate surrounding it? If Schmidt is correct that learners must *consciously notice* features in the input, does this imply that learners cannot learn complex features implicitly? In the current study it was found that explicit instruction related positively to ability to notice less salient features. Does this rule out the possibility that learners go on to learn the features implicitly? Is it possible to notice a feature consciously then acquire it implicitly? The reasons provided by learners in the instructed condition indicated that learners were not able to verbalise all the reasons for their correct responses and it was argued that this might indicate that instructed learners had actually learned some of the rules implicitly. If this were the case then Reber and Krashen's claims that complex features can only be acquired implicitly could still be true. Whilst Schmidt argued that conscious noticing was necessary for learning to take place, he also acknowledged that implicit learning was possible. It appears then from Schmidt's account that in theory learners can consciously notice a feature but learn the feature implicitly. Reber and Krashen also argued that attention to the input is necessary for acquisition to take place and it is assumed that learners must be aware that they are attending to input. The issue of attention and noticing does not then necessarily shed light on the extent to which the features are subsequently consciously learned or unconsciously acquired although it has been implied in the literature that noticing relates to an explicit learning approach.

In order to determine whether Krashen and Reber are correct in their claim that complex features can only be acquired implicitly, it must be shown whether or not learners in any of the three input conditions had learned implicitly and secondly, whether the rules under scrutiny were actually complex rules.

The issue of implicit learning is still widely debated. Berry (1994) reviewed the evidence for implicit learning and argued as I have, that one of the main problems in the area is the confusion in the literature over the use of the terms implicit and explicit learning and knowledge. In the current study and the majority of previous studies, researchers have attempted to determine the extent to which learners can verbalise the "knowledge" they have obtained. If learners experience difficulty verbalising the reasons for making the classification judgements then it is assumed that the knowledge they have is implicit and has resulted from implicit learning. Much debate has revolved around this precise issue, researchers disagreeing over the extent to which the knowledge obtained is implicitly or explicitly represented. Some (e.g. Reber, 1994) have argued that learning of artificial grammars takes place through unconscious abstraction of the underlying system and that the knowledge which derives from this process is largely unavailable for conscious report. Others (Perruchet and Pacteau, 1990, 1991) have argued that learning of artificial grammars involves only the learning of letter pairings or bigrams and not the abstraction of the underlying system. They have argued that the knowledge of the bigram pairings was "explicit" because learners could recognise at above chance levels those bigrams they had seen in the input. Dulany *et al* (1984) have argued that knowledge can only be referred to as unconscious if it can *never* be revealed using verbal report.

Berry (1994) has countered that less emphasis should be placed on the extent to which the knowledge is verbalisable and the "thorny issue of consciousness" (Berry, 1994, p. 771) and that more emphasis should be placed on the methods of acquiring knowledge and the conditions under which dissociations between knowledge and performance arise.

Berry and Dienes (1991, 1993) presented four "working characterizations" which they believed to be associated with implicit learning: firstly that the amount of knowledge which is accessible for verbal report is "transfer specific": under free recall conditions it is virtually inaccessible (Dienes, Broadbent and Berry, 1991); with forced choice tests (like those used in the current research) there is limited accessibility (Dulany, Carlson and Dewey, 1984). Secondly, it is more associated with incidental learning conditions (similar to that of the memorisation condition) rather than deliberate hypothesis testing (Reber, 1976, Berry and Broadbent, 1988). Thirdly, it "gives rise to a phenomenal sense of intuition" (Reber, 1976; Berry and Broadbent, 1988) and fourthly, remains relatively robust, over time (Allen and Reber, 1980), in psychological disorders (Abrams and Reber, 1989) and in secondary tasks (Cohen, Ivry and Keels, 1990).

Whilst such characterisations might be useful in pinpointing the kinds of conditions associated with implicit learning, they still fail to address the question of how to determine whether or not implicit learning itself has taken place. All these characterisations have been linked to conditions under which the emergence of dissociations between verbalisability and performance have been evidenced. Again, the central issue appears to be whether such dissociations have taken place. In the current study, learners in all three conditions were unable to verbalise reasons for correct decisions on roughly the same number of items. Whether this inability was due to the fact that they were using their implicit knowledge derived from implicit learning to make their decision is still unproven. Those in the memorisation condition claimed to have made more judgements based on feel that those in the other conditions but is this really sufficient evidence that learners in this condition learned implicitly? It is impossible to tell. It is therefore impossible to state conclusively whether or not complex rules are best acquired under implicit conditions. It is possible that implicit learning conditions had not been induced or it is possible that all learners acquired some aspects implicitly and others explicitly. Even in Reber's research in which he focused much attention on the issue of verbalisation, Reber found it difficult to determine what learners really did consciously know about the system. He freely admitted this: "it is extremely difficult to draw firm conclusions about what subjects know either implicitly or explicitly" (Reber and Lewis, 1977, p. 352).

The main obstacle for research on implicit learning lies in finding a valid methodology for proving its existence. There seems to be a consensus that implicit learning does exist but researchers have struggled to provide conclusive evidence. Both Berry (1994) and Carr and Curran (1994) have noted that research in the field of neuropsychology provides some of the best evidence of learning in the absence of conscious awareness. For example, Knowlton, Ramus and Squire (1992) presented artificial grammar strings to retrograde amnesiacs. These patients had suffered brain damage making them unable to form new memories of experiences that would normally be consciously retrievable. Knowlton *et al* (1992) reported that correct classification of strings was made without intact explicit memory and concluded that the classification had been made using implicitly acquired information. In future studies, comparisons could be made between similar amnesiac patients and controls using the miniature language adopted in the current study. If the amnesiacs outperform the controls on the more complex rules of the language one might conclude that Reber and Krashen's claims that complex rules are best acquired unconsciously have been supported. Currently, given the findings of the present search using the method of supplying reasons, there is insufficient evidence to make a judgement.

The second issue of importance relates to rule complexity. Both Reber and Krashen stated that simple rules of thumb can be taught explicitly but that complex rules must be acquired implicitly. But what actually constitutes a simple rule of thumb and what constitutes a complex rule? In the absence of any clear set of criteria defining rule complexity researchers have used a variety of methods to classify rules. Robinson (1996) used "expert judgements" - his experts being a group of ESL teachers. N. Ellis (1993) simply described the rule system of "soft mutations" of Welsh as "complicated" and illustrated this by describing various phonological changes and contexts in which the changes occurred in the soft mutation rule. Morgan *et al* 's (1989) more complex rules related to those which involved co-occurrence restrictions among the word classes. Finally, in the current study a range of factors were presented which were hypothesised to contribute towards rule complexity. Some of these factors were taken from research in second language, others from reasoning research. In order to determine whether Krashen and Reber are correct in their claim that complex rules are best acquired unconsciously, it is essential that a consensus is arrived at regarding the features which contribute towards rule complexity so that the above claim can be properly tested. Currently researchers appear to be creating their own criteria and these will no doubt vary from study to study.

Once a set of criteria is established it will not only make it possible to make more valid comparisons across studies but it will also enable comparisons to be made amongst the individual rules. In the current research the rules were placed in an order depending on the number of "complexity factors" they were thought to contain. Each factor was awarded one point, the implication being that each factor contributed an equivalent degree of complexity. This was a useful and relatively simple system to adopt and the patterns of findings obtained pointed towards some interesting conclusions regarding the interaction between conditions of input and type and complexity of rule. However, a number of questions were raised in Study Five regarding possible differences in the level of complexity contributed by individual factors. For example, it was hypothesised that the presence of a negative might contribute less towards complexity than the presence of a conditional or a disjunctive. Future studies might attempt to manipulate these features individually to determine their relative contribution to complexity.

In summary, it would seem virtually impossible to determine conclusively whether or not learners in any of the three input conditions had actually learned the rules implicitly, explicitly or both. Furthermore, until more research on the complexity issue is performed it is difficult to determine whether Reber and Krashen's interpretation of complexity falls in line with the interpretations made in the current research. Perhaps, as Berry (1994) has argued, less emphasis should be placed on the extent to which the knowledge is verbalisable and more emphasis should be placed on the methods of acquiring knowledge.

This has been the focus of the current research. In this research there is a trend indicating that the more information one receives about the actual rules the more likely one is to notice features relating to the more complex and less salient rules. However, other types of input conditions might also lead to successful acquisition. In N. Ellis' (1993) study, reviewed in Chapter Four, participants were required to work out the rules governing soft mutations in Welsh. These rules determined which letter should be placed in word initial position in certain Welsh words. Ellis did not teach the rules explicitly but presented the first letters in isolation in otherwise meaningful sentences. In this way he highlighted the feature in the input. He reported that those learners who had received input which highlighted the feature and which contained real instances of soft mutations performed better than those who had been presented with highlighted features but no real instances and better than those whose input was not highlighted in any way. It would seem that the best type of input on this occasion involved highlighting accompanied by a contextualised example. Further research might compare performance of learners under varying conditions of input in which features are highlighted differently. For example, learners who are taught the rules could be compared with those who receive input in which the features are highlighted but not taught.

I would suggest that theories of second language acquisition should focus on the issue of raising salience and methods for highlighting less salient features such as those presented above. I would further suggest that whilst it is possible that some learning does take place explicitly and some implicitly, there is at present insufficient evidence to determine whether the different types of learning lead to differential performance. The problem is that it is extremely difficult to determine which type of learning has actually occurred and therefore how performance has been differentially affected. However, I would argue that for any feature to be acquired either implicitly or explicitly, the feature must first be noticed. Once noticed it can then be learned. Even noticing, commonly equated with the conscious perception of something, might not necessarily occur consciously. Perhaps noticing can take place subliminally and the term should be changed from "noticing" to "perceiving". However, my central claim is that input needs to reach a certain level of salience for noticing or perception to take place, for the brain to register the input and for learning of the feature to occur. Efforts in research might concentrate on determining the best kinds of input for this to occur.

In the current study it could be argued that instruction was the "best" kind of input but research in the second language field has indicated that the use of instruction to highlight features can be problematic. Lightbown (1985) proposed that the process of acquisition might be similar in any context. However, she pointed out that input acquired in formal settings might actually be distorted because some features are over-highlighted whilst others are excluded. As a results learners overuse the highlighted features early on only to abandon them when a new feature is introduced. This might account for the finding in Pica's (1985) study in which her instructed learners overused certain morphemes. As a consequence Pica concluded that only simple rules should be taught. It would appear that the choice concerning which features in the input are highlighted and for how long they are highlighted requires careful consideration. For example, teaching the "present simple" aspect for two weeks exclusively might be more likely to be detrimental than useful. Focusing on the present simple for short periods when the learner is "developmentally ready" might serve to make the learner more aware of its existence and help learners notice and acquire the feature. Such an argument was presented by Meisel, Clahsen and Pienemann (1981) who claimed that developmental features were acquired in a natural order but that if a feature was taught at the right time, when the learner was developmentally ready, then it could speed the acquisition process. I would further (somewhat tentatively) suggest that the natural order itself might be related to salience. More salient features from any kind of input, be it formal instruction or naturalistic exposure, are acquired first. Further research on the order of accuracy of acquisition focusing on the effect of salience might shed light on this proposal.

Whilst the main aim of the current research was to determine the conditions of input which best facilitate acquisition of syntax, and, in particular, of the more complex rules, a manipulation was included in the research to determine whether more "grammatically sensitive" learners would profit more from formal instruction on the more complex rules than from simple exposure. This was found not to be the case. However, no statistical comparison was made between grammatically sensitive and mixed ability learners. Further research is required to determine whether any interaction between type of learner and input condition exists. If no interaction were found it might be hypothesised that the effects of instruction and other kinds of input are similar regardless of individual differences. It is possible that more grammatically sensitive learners might perform overall better than mixed ability learners but that the pattern of learning is similar. The Hungarian learners who participated in the current study actually performed slightly worse than those in the mixed ability group (although this difference was not tested). This might have been because the instructions for the task were in English and not Hungarian. However, the pattern in their performance was very similar to that of the mixed ability learners and it might be tentatively suggested that individual differences do not have much impact on the way in which salience affects performance.

Whilst none of the above manipulations improved overall performance on the complex rules, an unexpected trend did occur when comparing the findings from Study Five with those of Study Three. Unfortunately no statistical comparisons could be made but it appeared that the learners in both instructed and exposure conditions in Study Five had improved on some of the more complex rules relative to their counterparts in Study Three. In Study Three the instructed learners performed significantly better on rules 1 and 2 than on all the other rules whereas those in Study Five performed better on rule 1 than on rule 8 only. Performance on rules 3-7 was no longer poorer than on the simpler rules 1 or 2. In Study Three the exposure learners performed significantly better on rules 1 and 2 than on all the other rules except rule 5. In Study Five, they performed significantly better on rule 1 than on rules 6, 7 and 8. Performance on rules 3 - 8 was no longer poorer than rule 2 and rules 3 and 4 were not poorer than on rule 1.

This improvement on the complex rules relative to the simpler rules in both conditions had not been predicted. The main difference between Studies Three and Five was that in the latter learners were only given one rules test and were asked to provide a reason for the rejection of the sentence they considered to be incorrect. It is possible that the act of supplying a reason encouraged the learners to think more carefully about their responses and it might have encouraged them to make more use of the knowledge they had formulated about the rules. In Krashen's theory of second language acquisition it was stated that if learners were to use the "monitor" (the product of the explicitly learned system) learners had to have "time to think", must "focus on form" and must "know the rule". It is possible that the encouragement to formulate a reason induced the use of the monitor and so might have led to improved performance. However, this is purely conjecture. Some would argue that the reasons provided might have been simple justifications for implicitly made judgements. This might or might not be the case but further research is required to make a direct comparison between learners who are asked to provide reasons for their judgements and those that are not, to determine whether the process does lead to significantly improved performance on the more complex rules. If it does then Krashen's claim that the monitor is only useful for simple rules would be questioned.

In summary, the main findings of the current research can be explained in terms of the noticing hypothesis. Many of the findings in the literature and those of the current research can be explained by this hypothesis. Whilst it might be true that some features are learned with less awareness on the part of the learner than other features, efforts to determine if this is the case have frequently been thwarted by the difficulty of determining precisely that which has been learned consciously and that which has been acquired consciously. Krashen argued that complex rules were acquired unconsciously, but we have yet to see firm evidence to support his position. Some evidence has been presented in the current research that learners who were explicitly taught the rules acquired more of the complex features than those receiving exposure only. Many might conclude that this is evidence of explicit learning. I would suggest that even under such conditions one cannot be sure whether the learner adopted an implicit or explicit approach to learning. Equating a particular type of learning with a particular type of input is perhaps of little practical value as it does not serve to inform the language learner or teacher about the most useful kind of input for improving acquisition. Determining precisely how input works to improve performance might be a more fruitful line of enquiry. A review of the practical implications of this research for the field of second language learning and teaching will be presented in the final section.

7. 5 The use of the miniature artificial language methodology as a tool for modelling second language.

In Chapter One of this thesis studies which had used miniature artificial languages or MALs to model first and second language were reviewed. The majority of the studies had been performed to shed light on first language acquisition but the use of adult learners in these studies was widely criticised. Some had argued that the conditions of learning and the adoption of adult participants were more analogous to conditions of second language learning than first language learning and McLaughlin (1980) went as far as to claim that "MAL learning is L2 learning writ small".

It was also noted in Chapter One that in studies on the acquisition of natural second languages researchers had frequently reported difficulties controlling for confounding variables. These included the failure to control for the overall amount of instruction and exposure received, the fact that learners were not randomly allocated to the different conditions of input, problems with producing accurate measurements of the amount of instruction or exposure received and failure to control for the precise type of instruction and exposure received.

In the current study the decision was made to adopt an artificial methodology so that all these features could be adequately controlled. The miniature language system adopted was one of the few to contain both a reference field and constituent structure. It was sufficiently complex that none of the adult participants reached ceiling levels on the complex rules and it contained both simple and complex rules so that theories relating to complexity issues could be examined. On a more practical note, it could be taught in under three hours and a number of participants could be trained and observed at one time. The pattern of findings obtained bears a strong resemblance to those of studies which have been performed on real second language learners under both natural and experimental conditions. One of the only possible problems, but one that is true of all the methodologies was the extent to which the complex rules were of similar complexity to the complex rules of other studies and whether the simple rules were of similar complexity to the simple rules of other studies. It should be noted that in Robinson (1996), the conditions of input were very similar to those adopted in Study Five. However, Robinson found a positive effect of instruction on both simple and complex rules. Only an effect on complex rules was found in the current study. It is possible that Robinson's simple rules were actually more complex than those used here. It is acknowledged that in the current study rules 1 and 2 were extremely simple. As stated above, the issue of complexity is one which requires further attention.

One additional criticism with the use of the MAL was that, although it contained a reference field, the language did not have any meaning in the traditional sense. It could be argued that the introduction of meaning in some form can only be advantageous. A number of researchers have begun to use partially artificial input which has meaning (Hulstijn, 1988) and input which is completely artificial but has meaning and a complex morphological structure (De Keyser, 1995). However, it could also be argued that reducing meaning to the form of a symbol to represent the part of speech removes any confound of meaning on syntax acquisition. Furthermore, the overall pattern of results from the current research showing positive effects of instruction subject to specific conditions was similar to that found in the large number of studies reviewed in Chapter One which have used natural language input. It could therefore be argued that the use of the language as a model of natural language is justified. Furthermore, whilst it is acknowledged that learners could not use the language for natural communication and that this is a limitation of this kind of methodology, studies on natural language in which communicative ability can be measured can be somewhat restrictive in that only a very small part of the system is normally examined and manipulated. Using the MAL adopted in the current study allowed the learning of an entire system to take place.

In summary, I would suggest that the use of the MAL was justified and that its main advantage over research in the field was in the element of control that could be exerted over the variables manipulated. Precise control of the type of input and type of instruction accompanying that input was maintained. All learners in each condition received exactly the same input and learners in all three input conditions were presented with the language for the same period of time. If such control could be exercised in the field then no doubt this would be the preferred methodology but until this can be achieved the use of artificial methodologies such as the one used in the current research should be considered a very useful tool for modelling the acquisition of a second language.

Before turning to the final conclusions of this research, brief mention will be made of the research and findings of Morgan *et al* (1989) whose study was replicated in Studies One and Two of the current research. Morgan *et al* claimed that the cross-sentential cues constitute a "necessary component of language input" (Morgan *et al,* 1989, p.360). They argued that the such cues could be found in maternal self-repetitions which had been reported as being related positively to measures of language growth (Newport, Gleitman and Gleitman, 1977). Morgan *et al* argued that the use of expansions and re-orderings in maternal speech served to cue the phrasal structure of the original utterance. Whilst it is quite possible that expansions and re-ordering of sentences are related to language growth, it does not necessarily follow that this growth results from cross-sentential cueing of phrasal structure. There are alternative possibilities for the effect on language growth that should also be considered and these are related to the issue of attention and noticing that has been raised in this discussion. It may be that it is the provision of input in a context of "joint attention" which facilitates development. For example, the expansions and re-ordering described by Morgan *et al* might occur during dialogues in which the caregiver is attempting to focus the child's attention on something the caregiver is attending to. The example provided by Morgan *et al* might serve to do this: "There it is. There's your foot". Positive effects of joint attention are known to occur in child language development (Harris, 1992).

Whilst Morgan *et al* considered cueing of language input to be important, it would appear cross-sentential cueing is not effective. However, the issue that they raised is important and is again related to the concepts of attention and noticing. They clearly felt that language input, if cued or highlighted in some way, might be easier to acquire. This I would support. The failure of cross-sentential cueing might simply have been due to the burden on the learners' attentional resources. Two further criticisms might be levelled at Morgan *et al*'s research: firstly, the use of adult participants to model child language acquisition has been questioned. Secondly, the fact that two attempts to replicate Morgan *et al*'s findings have failed calls into question the reliability of their results. One might predict that learners with a higher load on their attentional resources and more complex input would struggle compared with those who have less to attend to and less complex input and, as stated above, further research is required to establish whether this is the case.

7. 6 Final thoughts and implications for the field of second language learning.

The current research was motivated by a desire to determine the extent to which formal classroom instruction actually works. Whilst the instructed learners throughout Studies Three, Four and Five tended to have a slight advantage over those in the other two conditions, no differences were found on the majority of the rules. This is probably the most interesting finding: that the learners performed so similarly despite the differences in their input. Regardless of the type of input learners receive, they reach very similar levels of acquisition overall but subtle differences do emerge. It was argued that these differences might have been due to the extent to which more complex and less salient features were noticed.

Classroom practitioners and learners of second language might take some comfort from knowing that, despite the quite considerable differences in the form the input took in the current research, the performance of learners was so surprisingly similar. One might advise teachers and learners that all kinds of input can be valuable but that if formal instruction is used, that certain conditions might be attached. Firstly, that it might help learners with the less salient features but that other kinds of input might be equally effective for the more salient input, secondly, that overemphasis of any one particular feature can lead to over use, thirdly, that one should consider when it is most appropriate to teach a feature: some would argue that the learner must be developmentally ready but the basis for deciding when the learner is "ready" is still relatively poorly researched. Finally, that any positive effects of instruction might be short lived. Some might be concerned that the positive effects of instruction might not last but, as De Keyser (1994) pointed out, no classroom studies have found long term effects of implicit learning either. Perhaps learners require some updating and revision of previously taught items on a regular basis for long term storage to occur.

In conclusion, the manipulation of input on syntax acquisition results in only subtle differences in learning outcome. It would appear that humans will try to make sense of any kind of input and will produce a variety of hypotheses regarding the structure of that input. However, regardless of the approach to learning or type of input, only subtle differences appear in performance. Such subtle differences should not be ignored as it might be precisely these subtleties on which future research should focus. These differences might be related to the extent to which input is attended to and subsequently noticed by the learner. The rather contentious issue of consciousness is still being debated. Some would prefer to avoid the term consciousness altogether. One of the major problems has been in defining the terminologies used and in finding empirical evidence to support the theories. Explicit instruction has been confounded with explicit learning and no one really knows how to induce implicit learning nor of how to determine whether or not it has taken place. Researchers frequently relate a particular type of input to a particular type of learning and then make assumptions about the knowledge that results. Whilst theories have suggested that implicit learning is best for the acquisition of complex features, research has still to produce the evidence to support this contention.

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Appendices Contents

Appendix A

Language items, instruction, testing materials and questionnaire.

Appendix B

Anova Summary Tables

Appendix A1.1

Base Language Sentences

Sentence Type:	Sentence:
AE	1. HES VOT
	2. HES JAX
	3. MIK VOT
	4. RUD VOT
	5. BIF JAX
AEC	1. RUD JAX CAV
	2. HES JAX NEB
	3. RUD VOT SOG
	4. HES VOT CAV
	5. BIF VOT CAV
ACF	1. BIF CAV FAC
	2. RUD NEB DUP
	3. MIK LUM FAC
ADE	1. MIK TIZ VOT
	2. BIF KOR JAX
	3. HES KOR JAX
AECD	1. HES JAX NEB TIZ
	2. HES JAX CAV PEL
	3. BIF JAX SOG KOR
ACFC	1. HES SOG DUB NEB
	2. MIK NEB DUP SOG

ADEC	1. RUD PEL VOT SOG
	2. MIK KOR VOT NEB
ACDF	1. RUD LUM PEL FAC
	2. BIF NEB PEL FAC
	3. BIF SOG KOR DUP
ADCF	1. HES KOR SOG FAC
	2. RUD PEL CAV DUP
	3. MIK TIZ LUM FAC
ACFCD	1. RUD CAV DUP LUM KOR
	2. HES NEB FAC SOG PEL
ADECD	1. MIK PEL VOT LUM TIZ
	2. RUD TIZ JAX LUM PEL
ACDFC	1. MIK NEB TIZ DUP SOG
	2. BIF LUM TIZ FAC CAV
ADCFC	1. BIF KOR NEB DUP LUM
	2. MIK PEL LUM FAC SOG
ADCDF	1. MIK KOR CAV TIZ DUP
	2. RUD TIZ LUM PEL FAC
	3. BIF TIZ CAV KOR DUP

Appendix A1.2

Proform Sentences

Sentence Type:	Sentences: (*lower sentence includes proform)
AE	HES VOT IB VOT*
	HES JAX IB JAX
	MIK VOT IB VOT
	RUD VOT IB VOT
	BIF JAX IB JAX
AEC	RUD JAX CAV RUD JAX ET
	HES JAX NEB IB JAX NEB
	RUD VOT SOG RUD VOT ET
	HES VOT CAV IB VOT CAV
	BIF VOT CAV BIF VOT ET
ACF	BIF CAV FAC IB CAV FAC
	RUD NEB DUP RUD ET DUP
	MIK LUM FAC MIK ET FAC
ADE	MIK TIZ VOT IB VOT
	BIF KOR JAX IB JAX
AED	HES KOR JAX IB JAX

HES JAX NEB TIZ
HES JAX ET

AECD HES JAX CAV PEL
IB JAX CAV PEL

BIF JAX SOG KOR
BIF JAX ET

ACFC HES SOG DUP NEB
HES SOG DUP ET

MIK NEB DUP SOG
MIK ET DUP SOG

ADEC RUD PEL VOT SOG
RUD PEL VOT ET

MIK KOR VOT NEB
IB VOT NEB

ACDF RUD LUM PEL FAC
IB LUM PEL FAC

BIF NEB PEL FAC
BIF ET FAC

BIF SOG KOR DUP
BIF ET DUP

ADCF HES KOR SOG FAC
HES KOR ET FAC

RUD PEL CAV DUP
IB CAV DUP

MIK TIZ LUM FAC
MIK TIZ ET FAC

ACFCD RUD CAV DUP LUM KOR
IB CAV DUP LUM KOR

HES NEB FAC SOG PEL
HES NEB FAC ET

ADECD MIK PEL VOT ET
MIK PEL VOT LUM TIZ

RUD TIZ JAX LUM PEL
IB JAX LUM PEL

ACDFC MIK NEB TIZ DUP SOG
IB NEB TIZ DUP SOG

BIF LUM TIZ FAC CAV
BIF ET FAC CAV

ADCFC	BIF KOR NEB DUP LUM BIF KOR NEB DUP ET
	MIK PEL LUM FAC SOG IB LUM FAC SOG
ADCDF	MIK KOR CAV TIZ DUP IB CAV TIZ DUP
	RUD TIZ LUM PEL FAC RUD TIZ ET FAC
	BIF TIZ CAV KOR DUP BIF TIZ ET DUP

Appendix A1.3

Permutation Sentences

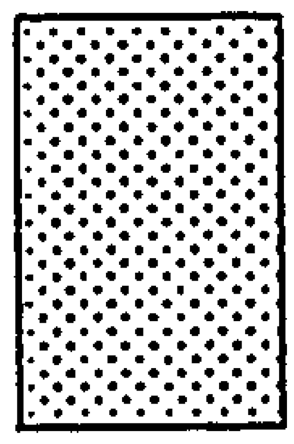
Original	Permuted	Sentence (*lower sentence is permuted)
AE	EA	HES VOT VOT HES*
		HES JAX JAX HES
		MIK VOT VOT MIK
		RUD VOT VOT RUD
		BIF JAX JAX BIF
AEC	EAC	RUD JAX CAV JAX RUD CAV
		HES JAX NEB JAX HES NEB
		RUD VOT SOG VOT RUD SOG
		HES VOT CAV VOT HES CAV
		BIF VOT CAV VOT BIF CAV
ACF	CFA	BIF CAV FAC CAV FAC BIF
		RUD NEB DUP NEB DUP RUD
		MIK LUM FAC LUM FAC MIK
ADE	EAD	MIK TIZ VOT VOT MIK TIZ
		BIF KOR JAX JAX BIF KOR
		HES KOR JAX JAX HES KOR

		HES JAX NEB TIZ JAX HES NEB TIZ
AECD	EACD	HES JAX CAV PEL JAX HES CAV PEL
		BIF JAX SOG KOR JAX BIF SOG KOR
ACFC	CFAC	HES SOG DUP NEB SOG DUP HES NEB
		MIK NEB DUP SOG NEB DUP MIK SOG
ADEC	EADC	RUD PEL VOT SOG VOT RUD PEL SOG
		MIK KOR VOT NEB VOT MIK KOR NEB
ACDF	CDFA	RUD LUM PEL FAC LUM PEL FAC RUD
		BIF NEB PEL FAC NEB PEL FAC BIF
		BIF SOG KOR DUP SOG KOR DUP BIF
		HES KOR SOG FAC SOG FAC HES KOR
ADCF	CFAD	RUD PEL CAV DUP CAV DUP RUD PEL
		MIK TIZ LUM FAC LUM FAC MIK TIZ
ACFCD	CFACD	RUD CAV DUP LUM KOR CAV DUP RUD LUM KOR
		HES NEB FAC SOG PEL NEB FAC HES SOG PEL
ADECD	EADCD	MIK PEL VOT LUM TIZ VOT MIK PEL LUM TIZ
		RUD TIZ JAX LUM PEL JAX RUD TIZ LUM PEL
ACDFC	CDFAC	MIK NEB TIZ DUP SOG NEB TIZ DUP MIK SOG
		BIF LUM TIZ FAC CAV LUM TIZ FAC BIF CAV
ADCFC	CFADC	BIF KOR NEB DUP LUM

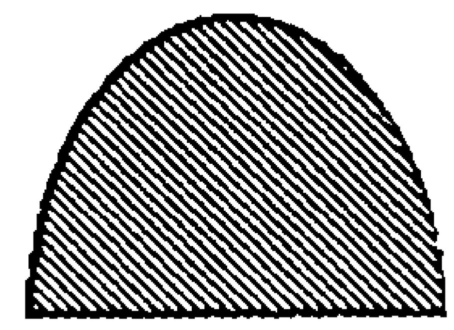
		NEB DUP BIF KOR LUM
		MIK PEL LUM FAC SOG LUM FAC MIK PEL SOG
ADCDF	CDFAD	MIK KOR CAV TIZ DUP CAV TIZ DUP MIK KOR
		RUD TIZ LUM PEL FAC LUM PEL FAC RUD TIZ
		BIF TIZ CAV KOR DUP CAV KOR DUP BIF TIZ

Appendix A1.4

Vocabulary Test Example.



1. NEB 2. KOR 3. CAV 4. BIF



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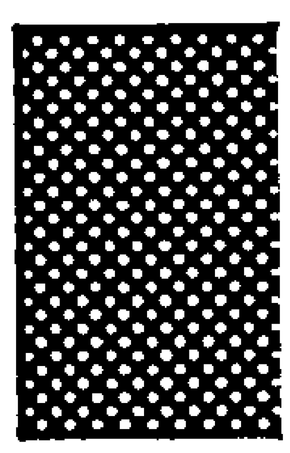
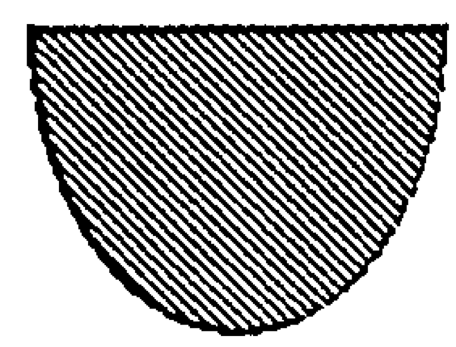
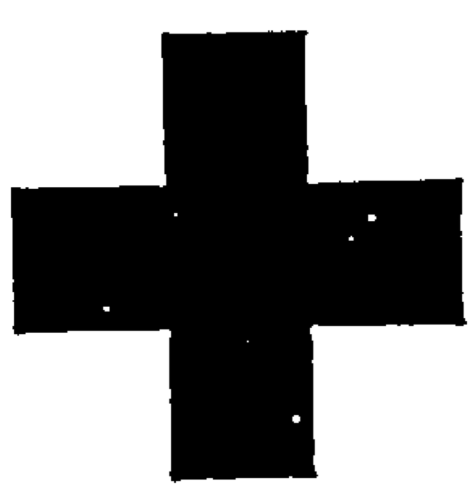


1. NEB 2. TIZ 3. HES 4. DUP



1. LUM 2. KOR 3. FAC 4. MIK



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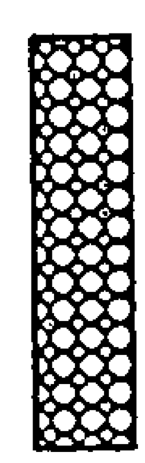
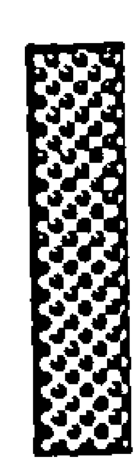
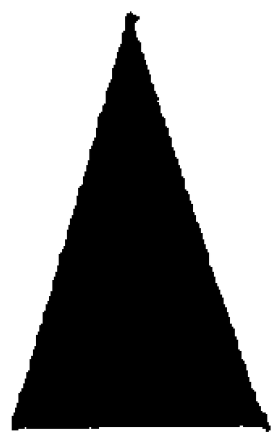


1. LUM 2. SOG 3. PEL 4. JAX

1. PEL 2. TIZ 3. VOT 4. BIF

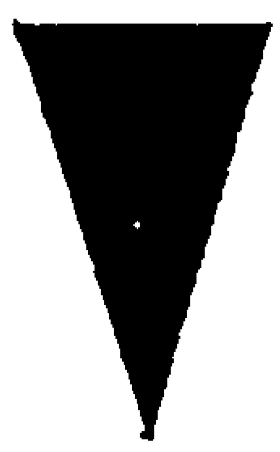


1. DUP 2. KOR 3. MIK 4. CAV



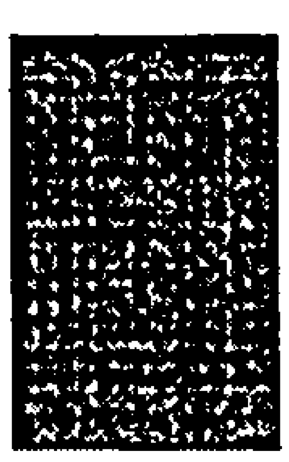
1. PEL 2. HES 3. JAX 4. NEB

1. DUP 2. CAV 3. MIK 4. KOR

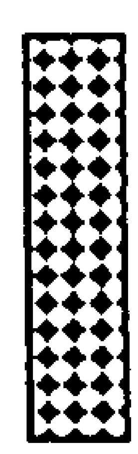


1. SOG 2. RUD 3. VOT 4. FAC

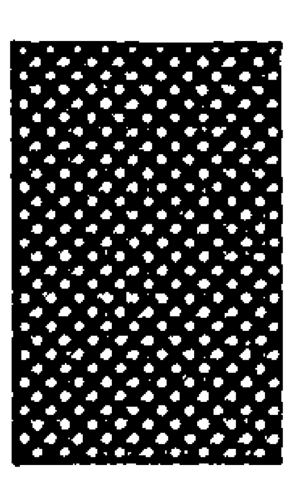
1. TIZ 2. BIF 3. LUM 4. FAC



1. MIK 2. LUM 3. VOT 4. JAX



1. TIZ 2. VOT 3. BIF 4. NEB



1. PEL 2. FAC 3. SOG 4. RUD

Appendix A1.5

Fragment Constituent Test Items

(Note: the top fragment in each pair is correct, the bottom fragment is incorrect because it violates the relevant phrase.)

A Phrase

Brackets = unviolated fragment.	Brackets = violated fragment.		
(AD)E	A(DE)	MIK TIZ TIZ JAX	HES VOT TIZ VOT
[(AD)EC	A(DE)C	BIF PEL PEL VOT	MIK PEL PEL JAX
(AD)CF	A(DC)F	RUD TIZ TIZ SOG	HES KOR KOR NEB
(AD)ECD	A(DE)CD	BIF TIZ TIZ JAX	BIF KOR KOR JAX
(AD)CFC	A(DC)FC	MIK KOR KOR CAV	RUD KOR KOR SOG
(AD)CDF	A(DC)DF	HES PEL PEL SOG	MIK KOR KOR PEL
(AD)CFC	A(DC)FC	MIK TIZ TIZ LUM	MIK PEL PEL SOG
(AD)E	A(DE)	BIF KOR KOR VOT	BIF PEL PEL JAX

B Phrase

A(CF)	(AC)F	CAV DUP HES CAV	NEB DUP MIK NEB
A(CF)C	AC(FC)	LUM DUP DUP SOG	NEB FAC FAC LUM

A(CDF)	(ACD)F	SOG PEL DUP MIK SOG PEL	LUM KOR DUP HES LUM KOR
AD(CF)	A(DC)F	NEB DUP KOR NEB	CAV DUP KOR CAV
A(CF)CD	(AC)FCD	LUM DUP MIK LUM	SOG DUP DUP LUM
A(CDF)C	AC(DFC)	NEB TIZ FAC TIZ FAC CAV	CAV PEL DUP RUD CAV PEL
AD(CF)C	AD(CF)C	LUM DUP KOR LUM	SOG DUP DUP CAV
AD(CDF)	A(DCD)F	CAV TIZ DUP KOR CAV TIZ	SOG TIZ FAC PEL SOG TIZ

C Phrase

AE(CD)	A(EC)D	CAV TIZ JAX CAV	CAV KOR VOT CAV
ACF(CD)	AC(FC)D	LUM KOR DUP LUM	NEB TIZ FAC NEB
ADE(CD)	AD(EC)D	SOG PEL JAX SOG	LUM KOR JAX LUM
AE(CD)	A(EC)D	LUM PEL JAX LUM	NEB PEL VOT NEB
ACF(CD)	AC(FC)D	NEB PEL FAC NEB	CAV KOR DUP CAV
ADE(CD)	AD(EC)D	CAV TIZ VOT CAV	NEB KOR JAX NEB
ADE(CD)	AD(EC)D	NEB KOR VOT NEB	CAV PEL VOT CAV
ACF(CD)	AC(FC)D	LUM TIZ DUP LUM	SOG PEL FAC SOG

Appendix A1.6

Transformational Constituent Test Items

A Phrase

Original Sentence	Non-violating sentence	Violating sentence
RUD KOR VOT	VOT RUD KOR	KOR VOT RUD
RUD PEL VOT	VOT RUD PEL	PEL VOT RUD
MIK PEL VOT NEB	VOT MIK PEL NEB	PEL VOT MIK NEB
MIK TIZ VOT LUM	VOT MIK TIZ LUM	MIK LUM TIZ VOT
BIF PEL CAV DUP LUM	CAV DUP BIF PEL LUM	PEL CAV BIF DUP LUM
MIK KOR CAV FAC	CAV FAC MIK KOR	KOR CAV MIK FAC
BIF TIZ NEB DUP	NEB DUP BIF TIZ	BIF DUP TIZ NEB
BIF PEL LUM FAC NEB	BIF PEL NEB LUM FAC	BIF FAC PEL LUM NEB

B Phrase

BIF NEB DUP CAV	BIF DUP CAV NEB	BIF CAV NEB DUP
RUD SOG FAC CAV	RUD FAC CAV SOG	RUD CAV SOG FAC
MIK NEB PEL DUP	NEB PEL DUP MIK	PEL DUP MIK NEB
BIF LUM TIZ FAC	LUM TIZ FAC BIF	TIZ FAC BIF LUM
MIK CAV KOR DUP NEB	MIK NEB CAV KOR DUP	MIK DUP NEB CAV KOR
BIF CAV PEL DUP NEB	BIF NEB CAV PEL DUP	BIF DUP NEB CAV PEL
MIK KOR LUM FAC NEB	MIK KOR NEB LUM FAC	MIK KOR FAC NEB LUM
HES KOR NEB DUP LUM	HES KOR LUM NEB DUP	HES KOR DUP LUM NEB

C Phrase

HES VOT LUM TIZ	HES LUM TIZ VOT	VOT LUM HES TIZ
HES VOT SOG PEL	HES SOG PEL VOT	VOT SOG HES PEL
RUD CAV FAC LUM PEL	RUD LUM PEL CAV FAC	RUD FAC LUM CAV PEL
HES CAV DUP LUM TIZ	HES LUM TIZ CAV DUP	HES DUP LUM CAV TIZ
BIF KOR VOT SOG PEL	BIF KOR SOG PEL VOT	BIF KOR PEL VOT SOG
HES TIZ JAX LUM KOR	HES TIZ LUM KOR JAX	HES TIZ KOR JAX LUM
RUD JAX NEB TIZ	RUD NEB TIZ JAX	JAX NEB RUD TIZ
RUD TIZ VOT CAV PEL	RUD TIZ CAV PEL VOT	VOT CAV RUD TIZ PEL

Follow up Questionnaire Study One

Follow up Questionnaire
Miniature Language Study.

Subject No. 38 Condition No. 01 .

Thank you for taking part in this study on the acquisition of a miniature language.

Before I give you any feedback on the rationale behind the experiment I would be grateful if you could complete the following questionnaire relating to your experiences during the experiment.

(You are under no obligation whatsoever to complete the form, please tell the experimenter if you do not wish to do so and she will give you feedback immediately.)

Please answer in as much detail as possible and feel free to continue any section on a separate sheet of paper. All information will be confidential.

Please read through the questionnaire once before attempting to answer any questions.

1.How did you attempt to "discover the word - shape pairings" and the "patterns in the language"? Word-shape pairings came easily early on for some shapes. I learnt them in pairs initially by attaching them to word pictures or longer words. Thus I learnt NEB (looks like a nib) & SOG (soggy) the LUM (lumber-falling over) and CAV (caving in) then DUP (down & ~~over~~ up) & FAC (happy face). These happened after about 20-30 minutes. After that I learnt the large rectangles in pairs (BIF, MIK, RUD & H....) and the crosses JAK & VOL. I learnt the thin rectangles last (KOR TIZ PEL) As you will note, the ones I learnt last I've forgotten soonest.* I'VE SET WHAT FOLLOWS OUT MORE CLEARLY IN SECTION 3.

I realized that the large rectangles always came first. I mentally pigeon holed them as the subject. Their position never varied. I then noted that the semicircles came after the large rectangles (I called them objects) unless there was a cross (which I thought of as imperatives - a negative imperative & a positive imperative)

I then realized that the thin rectangles, if they were present, came

2. During the exercises or tests when you were required to choose between two or more options, on what basis or bases did you make your decisions ?

(You might think of any strategies you used or whether you based your decision on simple 'feel' etc.)

There were four different types of tests, please state your answers according to the type of test.

a) Tests matching words with geometrical shapes.

Learnt them steadily largely by linking shapes to words other than the ones shown e.g. ▨ ((funny) <u>face</u>).
FAC

b) Tests showing two full sentences requiring judgement of correctness according to the patterns you saw.

In the initial half of the experiment I could see nothing in the way of a pattern at all. I have quite a lot of experience in using intuition pro-actively but this was not a suitable subject & after frustration set in I was reacting more or less at random.

In the later stages there was no problem once I had learnt most of the <u>shapes</u> by rote. The best give away was the position of □ & ▽ △.

c) Tests showing parts taken from sentences in which you were required to judge which formed a better "group or unit".

Didn't like this bit. One's involving □ were quite straightforward & the relation of ▯ to □ & △ ▽ was OK. I found the extracts containing ✚ , ✕ ~~particularly~~ more difficult because I didn't feel I'd fully assimilated the rules pertaining to them. As far as the triangular shapes were concerned I hadn't perceived a coherent pattern & was quite unsure of them.

I was dogged by the fact that I was certain that in some cases neither option was correct under the rules I thought I'd seen.

d) Tests in which the order of the words had been changed and you were asked to judge which new arrangement was preferable.

Again the basic rules particularly concerning □ & ▽ △ & to a lesser extent ✚, ✕ & ▯ were reasonably coherent & it was easy(ish) to decide which was preferable but the triangular shapes were more difficult.

I did make some decisions in the latter stages based on intuition where the triangular shapes were concerned. I believe they did obey rules & I think (!) that given more time under test conditions (if I'd maintained my sanity) I might have worked out what they were.

3. Can you describe any patterns or regularities in the language you saw?

(subject) - came first in all sentences. BIF & HIK were opposite patterns as were RUD & HES. Whether the patterns on the rectangles had any significance I don't know.

(object) - always appeared after the subject unless the sentence contained an imperative.

(negative ~~(positive)~~) (imperatives) (positive) - followed the subject in imperative sentences. These sentences could be as short as subject & imperative

(adjectives) - I can remember three of these but I think there may have been four. They were linked to the subject or object. They followed the subject when used & preceded the object. They could also stand alone after an imperative whether or not the subject was qualified by an adjective. They had different patterns on them which, again, may have had significance

(comparators) - If I was to guess I'd say these compared in the sense of 'greater than' or 'less than'. They qualified the subject in relation to the object or modified the imperative.

(directors) - I think these showed signs of vectors. I had difficulty discerning pattern in the placing of all the triangular shapes.

4. Did you find any aspect of the experiment particularly easy or difficult?

I was doubtful about the purpose of some of the early stages of the experiment & found them frustrating rather than difficult. Learning the correlation of shapes to words was relatively easy once I started pairing them & attaching them to mnemonics. Comparing parts of sentences was, I think, the most difficult. The last triad was taxing because although I felt fairly sure of the rules my attention was beginning to ~~set~~ wander & fatigue set in in a big way.

5. Have you any guesses as to what the study sought to discover?

How we learn a basic vocabulary & then go on to use the words grammatically. I imagine that some of the early parts of the test were to check out any personal predilection to certain word formations or the numbers 1 & 2.

6. Have you any further comments you would like to make regarding the study?

I think you should get a medal & a long holiday for staying the course let alone rendering down the results. Interestingly I was able to remember the word/shape correlation better the morning after the experiment although, be it said, when I filled in the questionnaire on the evening of the experiment I had drunk half a bottle of wine & was very tired.

7. Do you speak any languages other than your native language? If so, to what level?

Conversational french. Limited spanish & latin.

8. Combined Honours Students only.
Are any of your other subjects language based?

Thank you for completing the questionnaire. Please could you place it in Penny Fowler's Pigeonhole in the Office. If you wish there are recycled envelopes in the office into which it can be placed. Penny will then contact you to arrange a full (but short!) debriefing.

Appendix A2.1

Longer Sentences added in Study Three
Sentences up to seven words in length.

Sentence Type:	Example:
ADCDFCD	BIF KOR LUM TIZ FAC CAV PEL HES PEL SOG TIZ DUP NEB KOR
ACDFCD	MIK SOG PEL DUP LUM KOR RUD CAV PEL FAC NEB TIZ
ADCDFC	BIF TIZ LUM KOR DUP NEB HES PEL CAV TIZ FAC SOG
ADCFCD	MIK KOR CAV DUP SOG PEL RUD TIZ LUM FAC NEB KOR

Appendix A2.2

Nosmoish Language Practice Booklet

Page One

Now make up 8 sentences of your own and write them below. You do not need to include the shapes, just write the words. Use any combination of words you think conform to Nosmoian word order rules:

1. MIK SOG Rud
2. BIF KOR
3. RUD JAX PEL
4. DUP SEL
5. NEB BIF RUD
6. CAV SEL KAC
7. HES KOR DUB
8. SOG MIC PEL

Page Two

Now make up 5 sentences of your own and write them below. Thi time, make sure the number of words in each sentence correspond to the number shown in brackets.
For example: sentence 1 below should be three words in length.
Use any combination of words you think conform to Nosmoia: word order rules:

1. (3) MIC KOR RUD
2. (4) PEL SEG RUD FAC
3. (5) LUM SEL BIF NEB TIZ
4. (2) CAV PEL
5. (5) RUD JAX CAV PEL DUB

Page Three

Now make up 8 sentences of your own and write them below. You do not need to include the shapes, just write the words. Use any combination of words and any length sentence you think conform to Nosmoian word order rules.

1. RUD JAX
2. CAV PEL LUM
3. RUD SOG BIF CAV
4. TIZ BIF PEL
5. MIK NEB JAX
6. CAV PEL
7. KOR RUD PEL
8. DUP RUD CAV LUM

Page Four

Now see if you can complete the following sentences using an: combination of words you think conform to Nosmoian word orde rules.
If you think a sentence is already complete, you can choose to leav it as it is.

1. BIF CAV ~~[illegible]~~ DUP
2. MIK KOR CAV
3. HES CAV VOT
4. RUD JAX PEL
5. BIF PEL LUM CAV
6. MIK TIZ VOT
7. HES NEB PEL DUP
8. RUD SOG FAC DUP PEL
9. BIF PEL LUM KOR CAV
10. MIK KOR CAV DUP LUM

Appendix A2.3

Nosmoish Language Study Booklet

Page 1

Make up four sentences with the following word order pattern: ADEC
example: BIF KOR JAX CAV

1. MIK TIZ VOT SOG

2. HES KOR JAX CAV

3. BIF PEL VOT NEB

4. RUD KOR JAX LUM

Now return to the Computer Screen for further information.
(Do not turn over this page until instructed to do so.)

Page Two

Make up four sentences with the following word order pattern: ADE
example: BIF KOR JAX

1. HES TIZ JAX CAV

2. MIK PEL VOT NEB

3. BIF PEL VOT CAV

4. RUD KOR JAX LUM

Now return to the Computer Screen for further information.
(Do not turn over this page until instructed to do so.)

Page Three

Make up two sentences for each of the word order patterns shown below: (try to avoid using the same words from each class each time so as to give you plenty of practice.)

ADEC:
1. HES PEL VOT LUM
2. MIK TIZ JAX SOG

ADE
1. HES KOR VOT
2. RUD PEL JAX

AE
1. MIK JAX
2. BIF VOT

AEC
1. RUD VOT SOG
2. HES JAX CAV

Now return to the Computer Screen for further information.
(Do not turn over this page until instructed to do so.)

Page Four

Make up a sentence for each of the following word order patterns: (try to avoid using the same words from each class each time so as to give you plenty of practice.)

1. ADCDFC
a) BIF TIZ SOG PEL FAC LUM

ADEC
b) BIF TIZ VOT LUM

1. ADCDF
a) HES PEL SOG TIZ FAC

ADE
b) HES PEL JAX

1. ACDF
a) MIK LUM KOR DUP

AE
b) MIK JAX

1. ACDFC
a) RUD CAV PEL FAC SOG

AEC
b) RUD JAX SOG

Now return to the Computer Screen for further information.
(Do not turn over this page until instructed to do so.)

Page Five

In this section, try to identify the word class patterns of the following sentences. Try to do this without looking at the vocab sheet. Write the appropriate word class letters in the space provided, one sentence at a time and then check with the vocab sheet to see if you are correct.

1. RUD PEL VOT SOG ADEC
2. RUD PEL VOT ADE
3. RUD VOT AE
4. RUD VOT SOG AEC
5. RUD PEL LUM KOR FAC SOG ADCDFC
6. RUD PEL LUM KOR FAC ADCDF
7. RUD LUM KOR FAC ACDF
8. RUD LUM KOR FAC SOG ACDFC

Now return to the Computer Screen for further information.

(Do not turn over this page until instructed to do so.)

Page Six

Now make up one sentence based on each of the following word class patterns:(try to avoid using the same words from each class each time so as to give you plenty of practice.)

1. ADCFC
   MIK TIZ SOG DUP NEB TIZ

1. ADCF
   BIF PEL NEB DUP SOG KOR

1. ACF
   RUB NEB FAC LUM PEL

1. ACFC
   RUD NEB FAC SOG TIZ

Now turn back to the instructions on the Computer screen.

When you have read the instructions, add a C word to the end of any sentence that does not already have a C at the end.

When you have finished this, add a D word to the end of all the sentences.

Amend the patterns accordingly.

Page Seven

Now read the following statements carefully and decide if they are True or False. Write T or F on the line provided next to each statement.

1. Every sentence must have at least *one* A word. T
2. Sentences may contain *more* than one A word. F
3. Every sentence must contain at least one E or one F word. T
4. Sentences can contain more than one E word. F

4a. Sentences can contain more than one F word. F

5. A D word cannot appear immediately after an E or F word. T

5a. A D word can appear immediately after an A or C word. T

5b. D words are compulsory after A and C words. F

6. A C word or a C + D word cannot appear before an E word. T
7. A C word or a C + D word must occur before an F word. T
8. There may be at most one C word or C + D word combination at the end of a sentence. T

8a. Every sentence must end in a C or C+D word. F

8b. Sentences may contain two C words or C+D word combinations, one in mid-position, the other at the end. F

Appendix A2.4

Nosmoish Language Test Booklet

Page 1

Make up four sentences with the following word order pattern: ADEC
example: BIF KOR JAX CAV

1. MIK TIZ VOT SOG

2. HES KOR JAX CAV

3. BIF PEL VOT NEB

4. RUD KOR JAX LUM

Now return to the Computer Screen for further information.

(Do not turn over this page until instructed to do so.)

Page Two

Make up four sentences with the following word order pattern: ADE
example: BIF KOR JAX

1. HES TIZ JAX CAV

2. MIK PEL VOT NEB

3. BIF PEL VOT CAV

4. RUD KOR JAX LUM

Now return to the Computer Screen for further information.

(Do not turn over this page until instructed to do so.)

Page Three

Make up two sentences for each of the word order patterns shown below: (try to avoid using the same words from each class each time so as to give you plenty of practice.)

ADEC:
1. HES PEL VOT LUM
2. MIK TIZ JAX SOG

ADE
1. HES KOR VOT
2. RUD PEL JAX

AE
1. MIK JAX
2. BIF VOT

AEC
1. RUD VOT SOG
2. HES JAX CAV

Now return to the Computer Screen for further information.

(Do not turn over this page until instructed to do so.)

Page Four

Make up a sentence for each of the following word order patterns: (try to avoid using the same words from each class each time so as to give you plenty of practice.)

1. ADCDFC
a) BIF TIZ SOG PEL FAC LUM

ADEC
b) BIF TIZ VOT LUM

1. ADCDF
a) HES PEL SOG TIZ FAC

ADE
b) HES PEL JAX

1. ACDF
a) MIK LUM KOR DUP

AE
b) MIK JAX

1. ACDFC
a) RUD CAV PEL FAC SOG

AEC
b) RUD JAX SUG

Now return to the Computer Screen for further information.

(Do not turn over this page until instructed to do so.)

Appendix A2.5

Nosmoish Language Memorisation Booklet

Page One

Write down five syllable sets that you have memorised in the spaces below. You do not need to include the shapes, just write the syllables.
You can choose from any of the sets you have just been presented.

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

Page Two

Write down five syllable sets that you have memorised in the spaces below. You do not need to include the shapes, just write the syllables.
You can choose from any of the sets you have just been presented.

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

Page Three

Write down five syllable sets that you have memorised in the spaces below. You do not need to include the shapes, just write the syllables.
You can choose from any of the sets you have just been presented.

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

Appendix A.2.6

Instructed Condition Instructions
Studies Three, Four and Five.

Note: the instructions were presented in 12 point, Geneva font with wider spacing between each section than shown below, see note below.

Thank you for agreeing to take part in this study.

You are free to withdraw from the study at any time should you wish to.

If you do not understand any instructions given or you have any queries, please let the experimenter know immediately.

When you are ready to begin, you can access further written instructions by scrolling further down the page. This is done by placing the mouse arrow on the downward arrow on the screen in the bottom right hand corner. Please call the experimenter if you are unsure how to do this.

When you have finished scroll down and read all further instructions carefully.

Space left here for scrolling in instructions which appeared on screen

Part One

The study involves some imagination on your part!

I would like you to imagine that you are visiting a country called Nosmo (pronounced "Nozmo"). In this country a special language is used which is usually written down rather than spoken. The language consists of just 15 words. Each word is paired with a special shape.

First you will be shown the shapes and their corresponding words one at a time. Try to remember which word is paired with which shape.

Call the experimenter when you reach this point.

Space left here for scrolling in instructions which appeared on screen

Part Two

Nosmoish, the written language used in Nosmo, is special in that it doesn't *mean* anything in the traditional sense. But the words can be placed in 'sentences'. The order of the words in the sentences is not random but is based on particular Nosmoian word order rules.

The shapes which are paired with the words help the Nosmoian people to remember this word order.

You want to learn the Nosmo language and the word order so that you can produce your own sentences in the language later on.

Unfortunately there aren't any trained teachers of the Nosmo language so you decide to enrol on a "Teach Yourself Nosmoish" Course.

Learning is carried out using a ready made computer package which is available from the Nosmoian Library.

Prior to your first lesson, you are required to learn the 15 words used in the language. Luckily you have already done this so you can now begin the first lesson.

The librarian will now provide you with the materials you require to get started.
Tell the librarian (Penny) you are ready to begin.

Stop here

Space left here for scrolling in instructions which appeared on screen

Part Three

Welcome to the Nosmoian Language Study Course.

You have already learnt the Vocabulary of the Nosmoian Language and the special shapes that help the Nosmoian people remember the correct word order.

You will now learn the secrets of the Nosmoian Word order rules!
Scroll down when you are ready to continue.

Space left here for scrolling in instructions which appeared on screen

Did you notice anything about the shapes? The shapes could be divided into different categories.
How many categories of shapes do you remember?

Part Four

Stop here
until you have made a guess at the problem above
then scroll down to find out if you are right.

Space left here for scrolling in instructions which appeared on screen

In fact there are **five** categories of shape: the five categories were rectangles, triangles, thin rectangles, crosses and
semi-circles.

As you know, each word was paired with a shape.

The **category** of shape determines the **class** the word belongs to.

For example, words paired with rectangles are Class **A** words.

Now look at **Sheet1.**

Note that *four* words are paired with a rectangle:
BIF HES MIK and RUD so these are Class **A** words.

Four words are paired with a triangle: **CAV LUM NEB SOG** these are Class **C** words;

three with a thin rectangle: **KOR PEL TIZ** these are Class **D** words;

two with a cross **JAX and VOT** these are Class **E** words;

and finally two with a semi-circle: **DUP and FAC** these are Class **F** words.

(For some odd reason there are no Class B words.)

Write down the **Class** to which the groups belong on **Sheet 1.**

Give yourself a couple of minutes to try to remember these.

Stop here
until you have finished the above task.

When you are ready, scroll down for the next instructions.

Space left here for scrolling in instructions which appeared on screen

Part Five

Now you will learn how this knowledge helps you to make sentences in Nosmo.

A possible sentence in Nosmoish is:

BIF KOR JAX CAV

How is this possible?

Because the word order rules allow an A word to come first, followed by a D word, then an E word and ending with a C word or:

ADEC

Look at the following sentence:

HES PEL JAX LUM

does this sentence correspond to the same rules? **use Sheet 1 to help you.**

Stop here
and try to answer the above question.
Then scroll down for next instructions.

Space left here for scrolling in instructions which appeared on screen

Part Six

You should have found that **HES PEL JAX LUM** also has the pattern **ADEC**

Now turn to **Page One** of
"The Nosmoish Language Study Booklet".

Try making up four sentences of your own of this pattern and write them on Page One of the Booklet. **Use Sheet 1 to help you.**

Stop
here until you have finished Page One,
then scroll down for the next instructions.

Space left here for scrolling in instructions which appeared on screen

If you remember, **BIF KOR JAX CAV** was the first example you were given. The grammatical pattern was **ADEC.**

BIF KOR JAX

is *also* a possible sentence in Nosmoish. Which class letter has been dropped?

Stop here
until you have guessed the letter.
Then scroll down for the answer.

Space left here for scrolling in instructions which appeared on screen

The Class C word has been dropped.
This is because the rules of the language state that the **C word at the end of a sentence is optional.** This results in another possible pattern: **ADE**

Further examples are:

HES KOR JAX
RUD PEL VOT

which also follow this ADE pattern.
See if you can make up 4 sentences with the pattern ADE and write them in your booklet on **Page 2.** Use Sheet 1 to help you.

Stop here
until you have finished Page 2
then scroll down for next instructions:

Space left here for scrolling in instructions which appeared on screen

Part Seven

Well done.
Now **go back to page two** and add an 'optional' C word to the end of your sentences to form **ADEC (use sheet 1 if you need to.)**

Stop here
until you have completed the above task.

When you have completed the task, please inform the librarian. It is now time for a break.

Space left here for scrolling in instructions which appeared on screen

Part Eight

So far you have learnt 2 possible grammatical word orders:

ADE and **ADEC**

The following sentence is also possible:

RUD JAX

Which pattern does this have? What do you think the rule is?

Stop here
until you have guessed the rule
then scroll down for the answer.

Space left here for scrolling in instructions which appeared on screen

You should find it has the pattern **AE.**
The rule is that a **D word after an A word is also optional.**

From this you now know 3 word orders:

ADEC
ADE
AE

To recap:
D after an A is optional.
Also C at the end of the sentence is optional.

Because C is optional at the end of a sentence, it can also be introduced after AE to produce:
AEC.

Turn to **Page Three** in your booklet and write two examples of each of these four word orders. Before you begin, read the instruction at the top of Page Three carefully. (Use sheet 1 to help you if you need to.)

Stop here
until you have completed Page 3.
When you have completed the task, please inform the librarian.

Space left here for scrolling in instructions which appeared on screen

Part Nine

As you may remember, the word order patterns you now know are:

ADEC
ADE
AE
AEC

To summarise the rules you know about so far:

1. In all sentences there is an **A** word at the **beginning** and there is only **one** A word in each sentence.
2. Sentences can end in a C word or an E word.
3. D words are optional after A words.
4. C words are optional at the end of a sentence.

From the above it also *appears* that there is *always* an E word.
However, the following patterns show this is *not* the case.
E can be **replaced** by something else, see below:

ADCDFC
ADCDF
ACDF
ACDFC

If you compare these patterns to those above (re-written below) you will notice that a sentence contains **either** an E word **or a CDF** group. **No sentence can include an E word as well as a CDF group in mid position but all sentences must contain either one or the other.**

So the following sentences patterns are possible:

ADCDFC or ADEC
ADCDF or ADE
ACDF or AE
ACDFC or AEC

This would produce the following possible sentences for the top two patterns:

ADCDFC: BIF KOR **CAV PEL DUP** LUM
or
ADEC: BIF KOR **JAX** LUM

Part Ten

Turn to Page Four in your booklet and make up a sentence for each of the 4 patterns ADCDFC, ADCDF,ACDF, ACDFC . Write each sentence next to Part a).

When you have finished, write next to (part b) the same sentence but replace the CDF words with an E word.

Stop here
until you have completed Page 4
then scroll down when you have finished.

Space left here for scrolling in instructions which appeared on screen

Now turn to **Page 5** in your booklet and try to identify the word classes to which the words in the sentences belong. Write them in the space provided in the booklet and then check you have got them correct by looking at Sheet 1.
Stop here
until you have completed Page 5
then scroll down when you are ready.

Space left here for scrolling in instructions which appeared on screen

Well done.

Part Eleven

Now you will learn some more information regarding permissible sentence patterns.

As you have seen on the screen above,
"BIF KOR **CAV PEL DUP** LUM" (ADCDFC) is correct.

However, BIF KOR **CAV DUP** LUM (ADCFC) is also correct as is BIF **CAV DUP** LUM (ACFC).

Notice that in the two shorter versions a word class letter has been dropped.

Which letter has been dropped and what is the rule for dropping this letter?

Stop here
until you have guessed the letter and the rule
then scroll down when you are ready.

Space left here for scrolling in instructions which appeared on screen

The word class letter that has been dropped is **D.**
The rule is that **after both A and C words the letter D can be optionally used.**

The following word class patterns are therefore grammatical:
ADCFC
ADCF
ACF
ACFC
The grouping **CDF** can drop the middle **D** to make CF, D is optional here in the same way as D is optional after A.
In **all** cases **D** words are **optional:** in other words, **KOR PEL** and **TIZ** are all optional but can only appear after an A word or a C word.

Now turn to **Page Six** in your booklet and see if you can make up a sentence for each of the new patterns. Try working without your sheet initially, use it to check your work afterwards.

Stop here
until you have completed the first part of Page 6
then scroll down when you are ready.

Space left here for scrolling in instructions which appeared on screen

Well done.

Part Twelve

You have now learnt almost all the rules of the Nosmoish language!

To complete your knowledge read on!

Notice that there is a C word at the end of two of the patterns shown on **Page Six.**
The C word at the end of a sentence (after a CDF grouping or an E) is optional.

Remember the first patterns you learnt were:

ADEC
ADE
AE

AEC

then you were introduced to an alternative to E in the form of CDF.

so the following possibilities were introduced:

ADCDFC
ADCDF
ACDF
ACDFC

You were then informed that D is optional after A and C (so that in the above sentences the D's could be removed.)

The final rule is a follow on from the above where a D is also optional after the **final C** (as well as the middle C and after A.)

This provides the final possible word orders (you will probably be very pleased to hear!)

These are:
ADCDFC**D**
ADCFC**D**
ADEC**D**
AEC**D**
ACDFC**D**
ACFC**D**
You should be able to recognise most of these orders ! (if you look at the patterns preceding the final CD).

Note that
1. they all begin with an A word.
2. They then have an optional D word.
3. The middle section consists of either a CDF or CF combination.
4. **or** the middle section consists of an E word.
5. The sentence is complete at this point **or** you can add a C word followed optionally by a D word.

Luckily, Nosmoians rarely if ever use sentences longer than 5 words long.

Now turn to Page Six in your booklet again and add a C word to the end of those sentences not already containing one, and then add a final D word.

Stop here
until you have completed Page 6
then scroll down for further instructions.

Space left here for scrolling in instructions which appeared on screen

Now see how many rules of the language you can remember.

Turn to Page Seven in the Booklet and read the statements very carefully.
Decide if the statement is true or false according to the Nosmoian Word Order Rules you have learnt and place a T or F in the space provided alongside each statement.

Stop here

until you have completed Page 7
then scroll down for more information.

Space left here for scrolling in instructions which appeared on screen

Well done

You have completed this session.

Please inform the Librarian.

Appendix A2.7

Instructions given to learners in Exposure Condition in Studies Three, Four and Five.

Note: the instructions were presented in 12 point, Geneva font with wider spacing between each section than shown below, see note below.

Thank you for agreeing to take part in this study.

You are free to withdraw from the study at any time should you wish to.

If you do not understand any instructions given or you have any queries, please let the experimenter know immediately.

When you are ready to begin, you can access further written instructions by scrolling further down the page. This is done by placing the mouse arrow on the downward arrow on the screen in the bottom right hand corner. Please call the experimenter if you are unsure how to do this.

When you have finished scroll down and read all further instructions carefully.

Space left here for scrolling in instructions which appeared on screen

Part One

The study involves some imagination on your part!

I would like you to imagine that you are visiting a country called Nosmo (pronounced "Nozmo").
In this country a special language is used which is usually written down rather than spoken.
The language consists of just 15 words. Each word is paired with a special shape.

First you will be shown the shapes and their corresponding words one at a time. Try to remember which word is paired with which shape.

Stop here and call the experimenter

Space left here for scrolling in instructions which appeared on screen

Part Two

Nosmoish, the written language used in Nosmo, is special in that it doesn't *mean* anything in the traditional sense. But the words can be placed in 'sentences'. The order of the words in the sentences is not random but is based on particular Nosmoish word order rules

The shapes which are paired with the words help the Nosmoian people to remember this word order.

You want to learn the Nosmo language and the word order so that you can produce your own sentences in the language later on.

Unfortunately there aren't any trained teachers of the Nosmo language. However, it is possible to get permission from the library in Nosmo to lend you a special computer disc containing possible sentences in Nosmoish.

Above each sentence are the shapes which correspond to the words in each sentence. (As I said earlier, the Nosmoian people use the shapes to help them with the word order.)

Prior to being given access to the disc containing possible sentences, you are required to learn the 15 words used in the language. Luckily you have already done this so you can now begin your first observation.

If you ask the librarian (Penny) she will set up a computer for you so that you can observe the Nosmoish sentences.
While you are observing the sentences you do *not* have to *do* anything or *write* anything but remember that later you will want to make up some of your *own*, *original* sentences.

See therefore, if you can work out for yourself what the Nosmoish word order rules are.

Stop here
check you have understood the task set above
then ask the librarian (Penny) for further instructions.

Space left here for scrolling in instructions which appeared on screen

Part Three

You have now seen some possible sentences in Nosmoish.

Now turn to your Nosmoish Language Practice Booklet.

Turn to Page One and complete the exercise as directed .

Stop here
until you have completed Page One
then call the librarian for further instructions

Space left here for scrolling in instructions which appeared on screen

Part Four

You have now had some more exposure to possible sentences in Nosmoish.

Now turn again to your Nosmoish Language Practice Booklet.

Turn to Page Two and complete the exercise as directed .

Stop here
until you have completed Page Two

now call the librarian

Space left here for scrolling in instructions which appeared on screen

Part Five

You have now had some more exposure to possible sentences in Nosmoish.

Now turn again to your Nosmoish Language Practice Booklet.

Turn to Page Three and complete the exercise as directed .

Stop here
until you have completed Page Three
then call the librarian for further instructions

Space left here for scrolling in instructions which appeared on screen

Well done.
You have now completed this section.
Please inform the librarian.

Appendix A2.8

Instructions given to learners in Memorisation Condition in Studies Three, Four and Five.

Note: the instructions were presented in 12 point, Geneva font with wider spacing between each section than shown below, see note below.

Thank you for agreeing to take part in this study.

You are free to withdraw from the study at any time should you wish to.

If you do not understand any instructions given or you have any queries, please let the experimenter know immediately.

When you are ready to begin, you can access further written instructions by scrolling further down the page. This is done by placing the mouse arrow on the downward arrow on the screen in the bottom right hand corner. Please call the experimenter if you are unsure how to do this.

When you have finished scroll down and read all further instructions carefully.

Space left here for scrolling in instructions which appeared on screen

Part One

This experiment involves the memorisation of sets of nonsense syllables.
Each nonsense syllable is paired with a distinct geometric shape (for example a rectangle, triangle etc).

First you will be shown the nonsense syllables and their individual shapes one at a time. Try to remember which syllable is paired with which shape.

Call the experimenter when you reach this point.

Space left here for scrolling in instructions which appeared on screen

Part Two

In this section you will be presented with sets of nonsense syllables. Above each syllable will be presented its corresponding geometric shape. You have already learned the individual syllable/shape pairings.

Your task is to try to memorise each set of syllables that you see.

Later you will be asked to try and write down sets that you have memorised.

Stop here
check that you have understood the task set above
then ask the experimenter (Penny) for further instructions

Space left here for scrolling in instructions which appeared on screen

Part Three

You have now seen the syllable sets.

Now turn to your Memorisation Booklet.

Turn to Page One and complete the exercise as directed .

Stop here
until you have completed Page One
then call the experimenter for further instructions

Space left here for scrolling in instructions which appeared on screen

Part Four

You have now seen the syllable sets for the second time.

Now turn again to your Memorisation Booklet.

Turn to Page Two and complete the exercise as directed .

Stop here
until you have completed Page Two
then call the experimenter for further instructions

Space left here for scrolling in instructions which appeared on screen
Part Five

You have now seen the syllable sets for the third time.

Now turn again to your Memorisation Booklet.

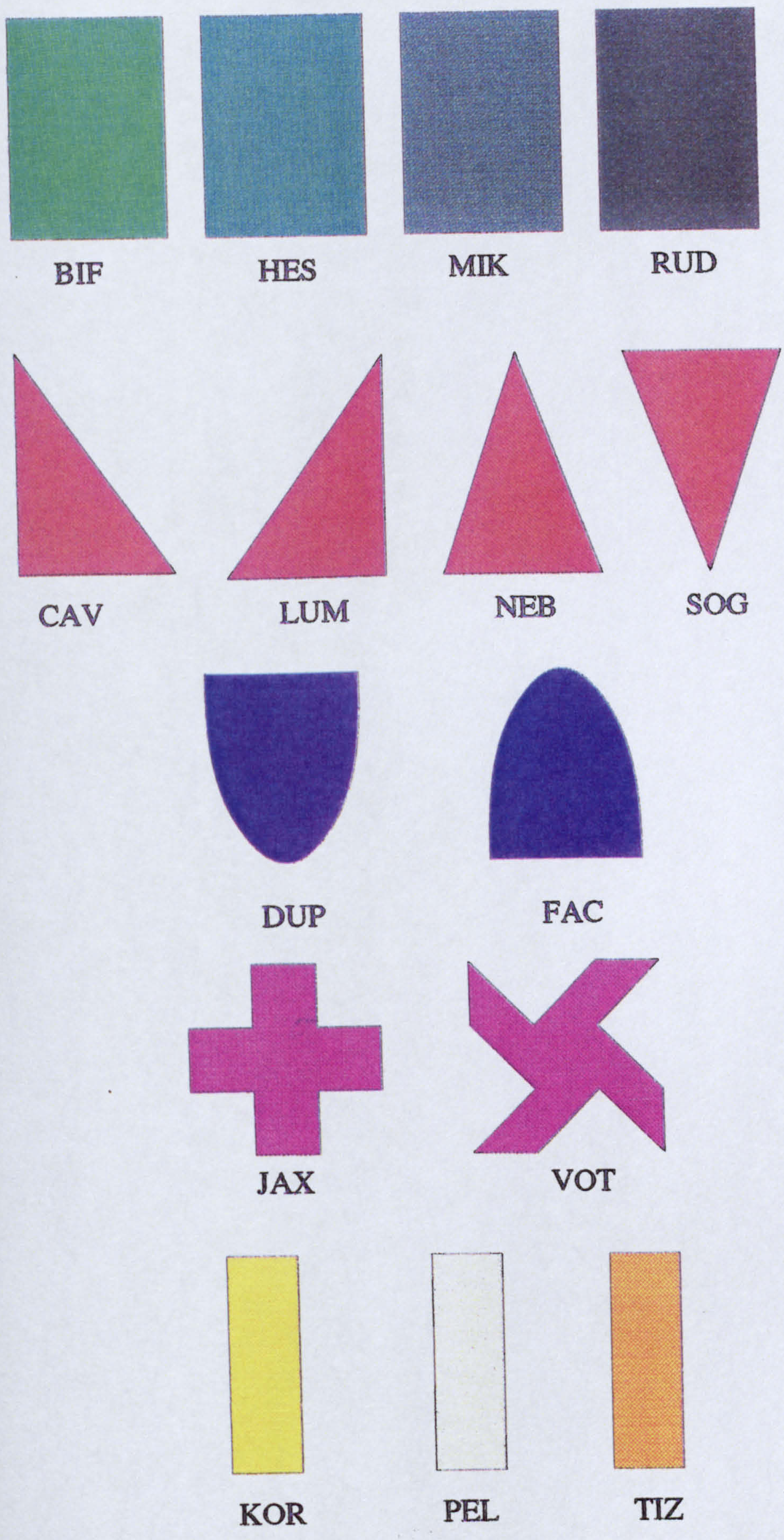
Turn to Page Three and complete the exercise as directed .

Stop here
until you have completed Page Three
then call the experimenter for further instructions

Space left here for scrolling in instructions which appeared on screen
Well done.
You have now completed this section.
Please inform the experimenter.

Appendix A2.9

Sheet One



Appendix A2.10

Examples of Grammaticality Judgement Tests used in Studies Three, Four and Five.

Look at the following sentence pairs.

One of the sentences follows the word order rules of the Nosmoish Language, the other breaks a rule of the Nosmoish language.

Put a tick against the sentence in each pair that you think has the **correct word order.**

MIK NEB FAC CAV SOG

MIK NEB FAC CAV

RUD NEB JAX SOG TIZ

RUD JAX SOG TIZ

MIK KOR NEB TIZ FAC SOG PEL

MIK KOR FAC SOG PEL

MIK VOT CAV KOR NEB

MIK VOT CAV KOR

HES BIF JAX NEB

BIF JAX NEB

MIK SOG DUP

MIK SOG DUP TIZ

MIK NEB DUP JAX

MIK NEB DUP

HES KOR CAV FAC LUM KOR

HES KOR CAV LUM KOR

TIZ LUM FAC SOG

RUD TIZ LUM FAC SOG

BIF KOR VOT

KOR VOT

MIK TIZ LUM DUP

MIK TIZ LUM

MIK KOR JAX NEB

MIK KOR NEB

BIF PEL CAV KOR DUP LUM TIZ

PEL CAV KOR DUP LUM TIZ

HES KOR CAV PEL

HES KOR CAV PEL DUP

BIF PEL SOG DUP

BIF PEL SOG DUP FAC

MIK RUD TIZ JAX

RUD TIZ JAX

BIF KOR VOT NEB

BIF KOR VOT JAX NEB

RUD NEB PEL DUP CAV TIZ

RUD MIK NEB PEL DUP CAV TIZ

HES TIZ JAX PEL SOG

HES TIS JAX SOG

HES PEL SOG TIZ FAC

HES PEL FAC

HES CAV FAC NEB TIZ

HES FAC NEB TIZ

BIF VOT LUM

BIF VOT KOR LUM

RUD PEL LUM DUP SOG TIZ

RUD PEL LUM DUP JAX SOG TIZ

HES PEL FAC

HES PEL LUM FAC

HES JAX LUM

HES CAV JAX LUM

RUD TIZ LUM KOR

RUD TIZ JAX LUM KOR

MIK DUP

MIK LUM DUP

HES SOG KOR FAC CAV PEL

HES SOG KOR FAC TIZ CAV PEL

HES PEL JAX NEB

HES PEL JAX NEB CAV

MIK KOR VOT

MIK KOR VOT LUM SOG

MIK RUD TIZ SOG DUP

RUD TIZ SOG DUP

RUD JAX FAC NEB

RUD JAX NEB

BIF TIZ NEB PEL DUP SOG

BIF TIZ NEB PEL DUP FAC SOG

MIK KOR CAV PEL JAX

MIK KOR JAX

SOG PEL DUP

MIK SOG PEL DUP

BIF RUD PEL NEB FAC

RUD PEL NEB FAC

MIK KOR SOG FAC TIZ

MIK KOR SOG FAC

MIK TIZ NEB KOR FAC LUM

MIK TIZ NEB KOR FAC LUM SOG

BIF TIZ JAX LUM

BIF TIZ NEB JAX LUM

KOR CAV DUP

HES KOR CAV DUP

Test 1(a) Subject no.

Read the following instructions carefully before starting this test:

You will be presented with sentence pairs, one sentence above the other. One of the sentences follows the word order rules, the other breaks a rule. Please carry out the following for each sentence pair: 1. **Put a tick** against the sentence in each pair that you think has the **correct word order.** 2. Try and indicate **why you rejected the incorrect** sentence by: a) underlining the part which is wrong b) explaining in your own words why it is wrong

Important note:

Don't spend too much time on each sentence pair. If you are unsure which sentence is correct make an intuitive guess.

If you have any idea at all about what is wrong with the sentence, write it down if you can. If you feel you can't say why a sentence is wrong, leave it and move on to the next sentence pair.

When you are ready to begin please turn to the next page.

1.

Tick the sentence which has the **correct word order.**

a) RUD VOT LUM

b) RUD VOT JAX LUM

Now put a line under the part in the incorrect sentence.
that you think is wrong.
In your own words why do you think the incorrect sentence is wrong?

____

____

2.

Tick the sentence which has the **correct word order.**

a) MIK PEL DUP

b) MIK PEL SOG DUP

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

3.

Tick the sentence which has the **correct word order.**

a) RUD KOR CAV VOT SOG

b) RUD KOR VOT SOG

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

4.

Tick the sentence which has the **correct word order.**

a) RUD JAX

b) RUD BIF JAX

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

5.

Tick the sentence which has the **correct word order.**

a) RUD CAV FAC

b) RUD CAV FAC TIZ

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

6.

Tick the sentence which has the **correct word order.**

a) BIF PEL JAX

b) BIF PEL JAX CAV LUM

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

7.

Tick the sentence which has the **correct word order.**

a) RUD CAV TIZ FAC PEL

b) RUD CAV TIZ FAC

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

8.

Tick the sentence which has the **correct word order.**

a) BIF KOR VOT PEL NEB

b) BIF KOR VOT NEB

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

9.

Tick the sentence which has the **correct word order.**

a) BIF NEB TIZ FAC CAV

b) BIF FAC CAV

Now put a line under the part in the incorrect sentence. that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

10.

Tick the sentence which has the **correct word order.**

a) HES JAX LUM KOR CAV

b) HES JAX LUM KOR

Now put a line under the part in the incorrect sentence. that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

11.

Tick the sentence which has the **correct word order.**

a) BIF NEB DUP

b) BIF NEB DUP FAC

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

12.

Tick the sentence which has the **correct word order.**

a) BIF VOT CAV TIZ

b) BIF LUM VOT CAV TIZ

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

13.

Tick the sentence which has the **correct word order.**

a) BIF KOR CAV KOR

b) BIF KOR JAX CAV KOR

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

14.

Tick the sentence which has the **correct word order.**

a) MIK VOT LUM

b) VOT LUM

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

15.

Tick the sentence which has the **correct word order.**

a) MIK JAX SOG TIZ

b) JAX SOG TIZ

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

16.

Tick the sentence which has the **correct word order.**

a) MIK SOG DUP CAV NEB

b) MIK SOG DUP CAV

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

17.

Tick the sentence which has the **correct word order.**

a) HES JAX CAV

b) HES RUD JAX CAV

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

18.

Tick the sentence which has the **correct word order.**

a) RUD JAX LUM

b) RUD LUM

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

19.

Tick the sentence which has the **correct word order.**

a) HES VOT NEB

b) VOT NEB

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

20.

Tick the sentence which has the **correct word order.**

a) RUD LUM NEB PEL

b) RUD LUM FAC NEB PEL

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

21.

Tick the sentence which has the **correct word order.**

a) LUM DUP CAV KOR

b) MIK LUM DUP CAV KOR

Now put a line under the part in the incorrect sentence. that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

22.

Tick the sentence which has the **correct word order.**

a) RUD SOG FAC

b) RUD SOG

Now put a line under the part in the incorrect sentence. that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

23.

Tick the sentence which has the **correct word order.**

a) RUD HES KOR NEB DUP

b) HES KOR NEB DUP

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

24.

Tick the sentence which has the **correct word order.**

a) BIF JAX CAV PEL

b) RUD BIF JAX CAV PEL

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

25.

Tick the sentence which has the **correct word order.**

a) BIF PEL VOT SOG

b) BIF PEL VOT SOG LUM

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

26.

Tick the sentence which has the **correct word order.**

a) HES TIZ SOG KOR DUP

b) HES TIZ DUP

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

27.

Tick the sentence which has the **correct word order.**

a) BIF SOG TIZ DUP JAX

b) BIF SOG TIZ DUP

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

28.

Tick the sentence which has the **correct word order.**

a) MIK JAX CAV

b) MIK LUM JAX CAV

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

29.

Tick the sentence which has the **correct word order.**

a) RUD TIZ CAV KOR VOT

b) RUD TIZ VOT

Now put a line under the part in the incorrect sentence. that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

30.

Tick the sentence which has the **correct word order.**

a) HES SOG DUP LUM

b) HES DUP LUM

Now put a line under the part in the incorrect sentence. that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

31.

Tick the sentence which has the **correct word order.**

a) MIK KOR JAX DUP LUM

b) MIK KOR JAX LUM

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

32.

Tick the sentence which has the **correct word order.**

a) RUD VOT NEB

b) RUD VOT KOR NEB

Now put a line under the part in the incorrect sentence.
that you think is wrong.

In your own words why do you think the incorrect sentence is wrong?

____

____

Working Memory Test
Instructions and Test

ALPHABET FORWARD AND BACKWARD

This is an exercise to see how quickly and accurately people carry out simple MEMORY tasks. To solve the problems you need to know the alphabet and the order of the letters in it.

The problem is to find WHAT LETTERS COME NEXT when you are told to move FORWARDS or BACKWARDS in the alphabet.

Look at these examples.

A + 1 = B.	This says that 1 step forward (+) from A is letter B. Check this out in your head.
B + 3 = E.	This says that 3 steps forward (+) from B is letter E. Is this right?
R - 1 = Q.	This says that 1 step backward (-) from R is letter Q. Check this one carefully.
Now try these:	F + 1 = ? Y - 1 = ? P - 2 = ?

Now try doing examples with more than one letter.

AD + 1 = BE.   One step forward from A is B and one step forward from D is E .... Answer BE.

What about working backwards?

BE - 1 =· AD.   One step backward from B is A and one step backward from E is D .... Answer AD.

Now try examples with two or three letters: KD + 3 = ? HLN + 1 = ?   NAF + 2 = ?

The first example below has been done for you to show how to mark the answers correctly. Now work out the answers for the other two examples by yourself.

1. GR + 2

E	D	I	S	F	G	[1]
D	R	I	F	S	H	[2]
T	E	I	F	R	S	[3]
E	T	H	G	D	X	[4]
S	I	G	H	Q	U	[5]

2. KDR - 1

J	I	C	B	S	R	[1]
Q	I	C	E	P	K	[2]
J	P	Q	E	H	F	[3]
Q	O	C	P	J	H	[4]
C	D	F	R	P	O	[5]

3. BMQ + 1

A	C	L	F	R	X	[1]
S	V	Q	R	P	N	[2]
P	F	N	T	V	C	[3]
M	L	F	N	B	R	[4]
N	O	C	X	A	R	[5]

ONLY ONE of the FIVE ROWS of letters has the correct letters in ANY ORDER. In the first example the answer has to have the letters I and T in it. Only one line has both of the correct letters. In the second example find the letters J C Q in one of the lines.

Ask now if you do not understand the test.

DO NOT TURN OVER THE PAGE UNTIL YOU ARE TOLD TO DO SO.

START HERE AND WORK FROM LEFT TO RIGHT ACROSS THE PAGE > > >

1\.

F L T + 2

C N F H K R [1]
V K N D H F [2]
B V X Q H J [3]
A W V H R P [4]
S H U N L T [5]

2\.

K U F - 2

I E F Q D L [1]
S L I Z J R [2]
S H I D W M [3]
I A L Q D T [4]
O S Z I Q R [5]

3\.

G O T + 3

R P F J Q Y [1]
S D U W J X [2]
W Q O J S F [3]
D J W P R A [4]
R Y J I C X [5]

4\.

W G P - 1

O B C V K N [1]
Q B O V S T [2]
V P T F L M [3]
O T F Z V S [4]
F D V R M L [5]

5\.

Y H N - 1

R G Z T X S [1
I G V X M P [2
R D X M K F [3
M D I W X A [4
X F D G A R [5

6\.

S C J + 2

S E B U D G [1]
S V B U L T [2]
U T P F E X [3]
P C U L D Z [4]
L U B E H W [5]

7\.

U E M - 1

U D J C B K [1]
H F T L I M [2]
P D U T L V [3]
H L T P J G [4]
U G D B T C [5]

8\.

Q L X - 1

W L S J P Q [1]
P W R F K V [2]
J H P F W D [3]
N A K V P C [4]
N S P Q K R [5]

9\.

U H N + 3

G D X Z K J [1]
W U Q X S H [2]
S X H Q P R [3]
G O X T K L [4]
K U B Q X C [5]

10\.

L C R + 2

E B M N Z H [
N T J X E C [
T L N J G C [
B X T N W K [
M E O J N G [

11\.

X K F - 2

N I Q G V W [1]
I J N V B C [2]
M D N V K A [3]
W E D L V T [4]
V T D U I M [5]

12\.

J C T + 2

E X K N L C [1]
S V R D L K [2]
O K L V G C [3]
V L M Z E Y [4]
E D J X L O [5]

13\.

Y T G - 1

S D X B F O [1]
S Q X M G L [2]
N R X F P J [3]
L F E Y X V [4]
I X E N S Z [5]

14\.

M W C + 2

Y G B O Z F [1]
E I A O J N [2]
O X E U Y M [3]
L E O P T Z [4]
Y S J O I Z [5]

15\.

P J U - 1

K U I R O V [
O T S N X F [
L P T A O S [
I L T N O K [
H R I V O M [

16\.

V J Q + 3

M E N L Y J [1]
Y B Q O M N [2]
V T C L Y F [3]
F C T Y V A [4]
M A Y D T P [5]

17\.

Q X K - 2

V X O E Q C [1]
Y I S Q O F [2]
V L O I D W [3]
I H E M O R [4]
F V Q O E H [5]

18\.

H C O + 2

P E O I J X [1]
C J Q U N F [2]
J S G W Q M [3]
A E X J Q V [4]
G J O U E L [5]

19\.

I C U + 2

W H K Y E C [1]
W K U Y J P [2]
K P X E Z Q [3]
R U W K P L [4]
K A M P E D [5]

20\.

X J P - 1

P O W G H V [
A F O N W P [
W F X A I N [
L I J D W U [
W O R I K N [

21\.

O T J + 3

G O M I R F [1]
W O M R L I [2]
W S F U R Y [3]
M C V R E D [4]
R X W H Z K [5]

22\.

G V M + 2

X K F O I N [1]
F O N A I T [2]
F L O I D Z [3]
I Z H X Q M [4]
K X D C I U [5]

23\.

G V N - 1

D A F Q U V [1]
M J I F R V [2]
U H J M F L [3]
F Y K M G C [4]
W F S U T J [5]

24\.

V F Q - 2

H V T Z O Q [1]
T C A U D P [2]
R W O T B N [3]
A T O Y D Z [4]
L R D K T N [5]

25\.

R F L - 1

Q K M Z E S [
K Y U Q C F [
E F T Q H N [
I O Q K F H [
Q C T E I V [

26\.

M H S + 3

V U G Q P T [1]
X K I P V B [2]
Z N K B P S [3]
P V M L Q Z [4]
K Q D J P A [5]

27\.

Y J R - 1

Q R X V A U [1]
X P H I U L [2]
I G Q E X P [3]
Q C X W D L [4]
J I T X H L [5]

28\.

P K E + 2

S R K M V H [1]
P E G L R U [2]
R H M X N I [3]
Z E P G R Q [4]
G R W X M T [5]

29\.

C H N + 2

J F P E T V [1]
N J G E F S [2]
P H U C E S [3]
P G D Y E H [4]
W J F E Y M [5]

30\.

M F X - 2

Z D M K V T
Y O G K V S
B I Q K V G
L D E I K Y
P B D Q K U

Appendix B

Tables of Statistical Analyses
Anova Summary Tables

Study One

i) Grammaticality Judgement Test Analyses.

Table 1.1 Trials 1-4, all rules, all participants.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	118.08	39	17.53	10.49	.0002
Trial	3	18.14	117	9.95	1.82	.146
Input * Trial	6	4.58	117	9.95	.46099	.8358

Table 1.2 Trials 1-4, unconditional versus conditional rules, all participants.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	.2947	39	.0326	8.97	.0006
Rule Type	1	.8496	39	.0258	32.89	.0000012
Trial	3	.0086	117	.0221	.392	.7587
Input * Rule Type	2	.0944	39	.0258	3.65	.0350
Input * Trial	6	.0091	117	.0221	.411	.8704
Rule Type * Trial	3	.0035	117	.0132	.266	.8497
Input * Rule Type *Trial	6	.0117	117	.0132	.886	.5071

Table 1.3 Trials 1-4, all rules, excluding participants not reaching criterion on final vocabulary test.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	112.05	28	19.59	5.71	.008
Trial	3	12.52	84	9.53	1.28	.284
Input * Trial	6	8.97	84	9.53	.941	.470

Table 1.4 Trials 1-4, unconditional versus conditional rules, excluding participants not reaching criterion on final vocabulary test.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	.189	28	.037	5.12	.012
Rule Type	1	.842	28	.019	28.32	.00001
Trial	3	.006	84	.029	.35	.787
Input * Rule Type	2	.046	28	.019	1.55	.228
Input * Trial	6	.022	84	.019	1.18	.322
Rule Type * Trial	3	.007	84	.011	.66	.576
Input * Rule Type *Trial	6	.012	84	.011	1.09	.374

Table 1.5 Trials 2-4 , all rules, all participants .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	497.16	39	55.79	8.91	.0006

Table 1.6 Trial 4 alone, all rules, all participants.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	46.45	39	13.05	.3.55	.03

Table 1.7 Trials 2-4, all rules, excluding participants not reaching criterion on final vocabulary test.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	327.21	28	62.35	5.24	.011

Table 1.8 Trials 4 alone, all rules only, excluding participants not reaching criterion on final vocabulary test .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	37.79	28	12.46	3.03	.064

Table 1.9 Trials 2-4 , unconditional versus conditional rules only, all participants .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	894.21	39	124.37	7.18	.002
Rule Type	1	2278.64	39	84.18	27.06	.000006
Input * Rule Type	2	313.86	39	84.18	3.72	.032

Table 1.10 Trial 4 alone, unconditional versus conditional rules, all participants .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	818.50	39	269.16	3.04	.059
Rule Type	1	2926.79	39	194.0009	15.08	.0003
Input * Rule Type	2	163.74	39	194.0009	.844	.437

Table 1.11 Trials 2-4, unconditional versus conditional rules only, excluding participants not reaching criterion on final vocabulary test, .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	607.571	28	135.06	4.49	.020
Rule Type	1	2471.69	28	95.28	25.93	.00002
Input * Rule Type	2	126.92	28	95.28	1.33	.280

Table 1.12 Trial 4 alone, unconditional versus conditional rules only, excluding participants not reaching criterion on final vocabulary test, .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	.067	28	.025	2.59	.092
Rule Type	1	.237	28	.022	10.63	.002
Input * Rule Type	2	.007	28	.022	.355	.703

ii) Fragment Constituent Test Analyses

Table 1.13 Fragment Constituent Test, all participants, Anova Summary Table.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	2.035	39	11.602	.175	.839
Trial	1	3.857	39	8.141	.473	.495
Input * Trial	2	13.821	39	8.141	1.697	.196

Table 1.14 Fragment Constituent Test, excluding participants not reaching criterion on final vocabulary test, Anova Summary Table.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	2.162	28	11.232	.192	.825
Trial	1	6.438	28	8.922	.721	.402
Input * Trial	2	8.927	28	8.922	1.0005	.380

iii) Transformational Constituent Test Analyses.

Table 1.15 Transformational Constituent Test, all participants, Anova Summary Table.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	5.166	39	5.386	.959	.392

Table 1.16 Transformational Constituent Test, excluding participants not reaching criterion on final vocabulary test, Anova Summary Table.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	3.438	28	5.832	.589	.561

Study Two

i) Grammaticality Judgement Test Analyses.

Table 2.1 Trials 1-4, all rules, all participants, .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	90.75	42	32.77	2.76	.103
Input	2	55.81	42	32.77	1.70	.194
Trial	3	21.95	126	9.51	2.30	.079
Instruction * Input	2	19.23	42	32.77	.586	.560
Instruction * Trial	3	6.95	126	9.51	.731	.535
Trial * Input	6	21.08	126	9.51	2.21	.045
Instruction *Input * Trial	6	1.71	126	9.51	.180	.981

Table 2.2 Trials 1-4, unconditional versus conditional rules, all participants, .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	.120	42	.049	2.42	.127
Input	2	.087	42	.049	1.75	.184
Rule Type	1	1.07	42	.021	50.49	.00000000
Trial	3	.016	126	.018	.892	.447
Instruction * Input	2	.037	42	.049	.760	.473
InstrucTion * Rule type	1	.038	42	.021	1.79	.187
Input * Rule Type	2	.001	42	.021	.073	.929
Instruction * Trial	3	.026	126	.018	1.43	.236
Input * Trial	6	.037	126	.018	2.03	.066
Rule Type *Trial	3	.049	126	.015	3.28	.023
Insruction *Input * Rule Type*	2	.001	42	.021	.089	.914
Instruction * Input *Trial	6	.002	126	.018	.131	.992

Instruction *Rule Type * Trial	3	.002	126	.015	.191	.901
Input * Rule Type * Trial	6	.003	126	.015	.237	.963
Instruction *Input * Rule Type * Trial	6	.012	126	.015	.891	.557

Table 2.3 Trials 1-4, all rules, excluding participants not reaching criterion on final vocabulary test, .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	4.58	30	30.49	.150	.700
Input	2	76.68	30	30.49	2.514	.097
Trial	3	28.04	90	10.24	2.738	.047
Instruction * Input	2	21.33	30	30.49	.699	.504
Instruction * trials	3	5.67	90	10.24	.553	.646
Input * Trial	6	22.55	90	10.24	2.202	.049
Instruction *Input * Trial	6	2.95	90	10.24	.288	.941

Table 2.4 Trials 1-4, unconditional versus conditional rules, excluding participants not reaching criterion on final vocabulary test, .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	.012	30	.052	.239	.628
Input	2	.119	30	.052	2.266	.121
Rule Type	1	1.097	30	.018	60.491	.00000000
Trial	3	.021	90	.020	1.046	.376
Instruction * Input	2	.035	30	.052	.675	.516
InstrucTion * Rule type	1	.012	30	.018	.696	.410
Input * Rule Type	2	.003	30	.018	.199	.820
Instruction * Trial	3	.017	90	.020	.864	.462
Input * Trial	6	.041	90	.020	2.043	.067
Rule Type *Trial	3	.037	90	.013	2.727	.048
Insruction *Input * Rule Type*	2	.021	30	.018	1.183	.320
Instruction * Input *Trial	6	.006	90	.020	.303	.933
Instruction *Rule Type * Trial	3	.002	90	.013	.163	.920
Input * Rule Type * Trial	6	.008	90	.013	.583	.742
Instruction *Input * Rule Type * Trial	6	.018	90	.013	1.347	.244

Table 2.5 Trials 2-4 , all rules, all participants, .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	270.75	42	102.19	2.64	.111
Input	2	313.00	42	102.19	3.06	.057
Instruction * Input	2	47.25	42	102.19	.46	.632

Table 2.6 Trial 4 alone, all rules, all participants, .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	11.02	42	23.08	.477	.493
Input	2	32.06	42	23.08	1.388	.260
Instruction * Input	2	6.52	42	23.08	.282	.755

Table 2.7 Trials 2-4, all rules, excluding participants not reaching criterion on final vocabulary test, .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	22.69	30	98.88	.229	.635
Input	2	390.58	30	98.88	3.949	.030
Instruction * Input	2	44.89	30	98.88	.454	.639

Table 2.8 Trials 4 alone, all rules only, excluding participants not reaching criterion on final vocabulary test.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	1.84	30	22.60	.081	.777
Input	2	56.07	30	22.60	2.480	.100
Instruction * Input	2	.72	30	22.60	.032	.968

Table 2.9 Trials 2-4 , unconditional versus conditional rules only, all participants .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	.043	42	.017	2.50	.121
Input	2	.054	42	.017	3.11	.054
Rule Type	1	.220	42	.006	33.44	.00000008
Instruction * Input	2	.010	42	.017	.579	.564
Instruction * Rule Type	1	.005	42	.006	.793	.378
Input * Rule Type	2	.001	42	.006	.163	.850

Instruction * Input * Rule Type	2	.001	42	.006	.280	.756

Table 2.10 Trial 4 alone, unconditional versus conditional rules, all participants .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	.001	42	.039	.041	.840
Input	2	.076	42	.039	1.93	.157
Rule Type	1	.381	42	.174	21.89	.00002
Instruction * Input	2	.004	42	.039	.120	.887
Instruction * Rule Type	1	.001	42	.017	.075	.785
Input * Rule Type	2	.0001	42	.017	.009	.990
Instruction * Input * Rule Type	2	.026	42	.017	1.54	.225

Table 2.11 Trials 2-4, unconditional versus conditional rules only, excluding participants not reaching criterion on final vocabulary test, .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	.008	30	.019	.415	.524
Input	2	.066	30	.019	3.45	.044
Rule Type	1	.249	30	.004	54.57	.00000000
Instruction * Input	2	.008	30	.019	.437	.649
Instruction * Rule Type	1	.001	30	.004	.341	.563
Input * Rule Type	2	.0001	30	.004	.022	.977
Instruction * Input * Rule Type	2	.017	30	.004	3.84	.032

Table 2.12 Trial 4 alone, unconditional versus conditional rules only, excluding participants not reaching criterion on final vocabulary test, .

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	.006	30	.044	.149	.701
Input	2	.097	30	.044	2.19	.129
Rule Type	1	.470	30	.012	36.82	.0000001
Instruction * Input	2	.0007	30	.044	.017	.982
Instruction * Rule Type	1	.0001	30	.012	.013	.980
Input * Rule Type	2	.005	30	.012	.442	.646
Instruction * Input * Rule Type	2	.048	30	.012	3.82	.033

ii) Fragment Constituent Test Analyses.

Table 2.13 Fragment Constituent Test, all participants, Anova Summary Table.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	2	55.69	42	16.30	3.41	.042
Input	1	15.84	42	16.30	.971	.329
Trial	1	17.51	42	6.75	2.59	.114
Instruction * Input	2	3.40	42	16.30	.208	.812
Instruction * Trial	2	6.13	42	6.75	.908	.410
Input * Trial	1	.01	42	6.75	.001	.968
Instruction * Input * Trial	2	7.51	42	6.75	1.11	.338

Table 2.14 Fragment Constituent Test, excluding participants not reaching criterion on final vocabulary test, Anova Summary Table.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	2	68.00	30	14.25	4.77	.015
Input	1	9.35	30	14.25	.656	.424
Trial	1	41.91	30	5.78	7.24	.011
Instruction * Input	2	15.39	30	14.25	1.07	.352
Instruction * Trial	2	12.45	30	5.78	2.15	.133
Input * Trial	1	7.68	30	5.78	1.32	.258
Instruction * Input * Trial	2	14.14	30	5.78	2.44	.103

iii) Transformational Constituent Test Analyses.

Table 2.15 Transformational Constituent Test, all participants, Anova Summary Table.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	44.08	42	9.79	4.49	.039
Input	2	21.02	42	9.79	2.14	.129
Instruction * Input	2	7.14	42	9.79	.729	.488

Table 2.16 Transformational Constituent Test, excluding participants not reaching criterion on final vocabulary test, Anova Summary Table.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Instruction	1	73.38	30	9.80	7.48	.010
Input	2	27.99	30	9.80	2.85	.073
Instruction * Input	2	13.45	30	9.80	1.37	.268

Study Three

Results obtained immediately after input (time one)

a) Grammaticality Judgement Tasks

Table 3. 1 Tests 1, 2 and 3, unconditional and conditional rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	5312.70	38	1186.765	4.476	.040
Test	2	385.48	76	132.563	2.907	.060
Rule Type	1	12760.42	38	255.079	50.025	.00000000
Input * Test	2	82.98	76	132.563	.625	.537
Input * Rule Type	1	1783.13	38	255.079	6.990	.011
Test * Rule Type	2	322.88	76	117.048	2.758	.069
Input * Test * Rule Type	2	40.40	76	117.048	.345	.709

Table 3. 2 Tests 1, 2 and 3, all eight rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	12398.44	38	4896.861	2.531	.119
Test	2	1326.17	76	476.734	2.781	.068
Rule Type	7	15123.51	266	717.037	21.091	.00000000
Input * Test	2	271.48	76	476.734	.569	.568
Input * Rule Type	7	2368.68	266	717.037	3.303	.002
Test * Rule Type	14	592.54	532	393.831	1.504	.104
Input * Test * Rule Type	14	286.37	532	393.831	.727	.747

Table 3. 3 Test 3 only (including longer items), unconditional and conditional rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	2475.312	38	392.381	6.308	.016
Rule Type	1	3021.701	38	105.890	28.536	.000004
Input * Rule Type	1	475.312	38	105.890	4.488	.040

Table 3. 4 Test 3 only (including longer items), all eight rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	4961.250	38	1482.303	3.346	.075
Rule Type	7	4521.250	266	396.889	11.391	.00000000
Input * Rule Type	7	1089.821	266	396.889	2.745	.009

b) Free Production Tests

Table 3. 5 Number of rule breakages.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	114.003	38	28.087	4.058	.051
Rule Type	7	127.592	266	10.127	12.599	.00000000
Input * Rule Type	7	31.953	266	10.127	3.155	.003

Results after nine week break (time two).

Grammaticality Judgement Tasks

Table 3.6 Tests 1 and 3, unconditional and conditional rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	204.420	35	271.540	.752	.391
Test	1	299.215	35	232.862	1.284	.262
Rule Type	1	2747.025	35	186.205	14.752	.004

Input * Test	1	168.068	35	232.862	.721	.401
Input * Rule Type	1	54.879	35	186.205	.294	.590
Test * Rule Type	1	155.815	35	312.088	.499	.484
Input * Test * Rule Type	1	173.880	35	312.088	.557	.460

Table 3.7 Tests 1 and 3, all eight rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	1931.458	35	1148.845	1.681	.203
Test	1	910.190	35	782.513	1.163	.288
Rule Type	7	6715.814	245	759.599	8.841	.0000000
Input * Test	1	200.73	35	782.513	.256	.615
Input * Rule Type	7	835.023	245	759.599	1.099	.364
Test * Rule Type	7	772.458	245	567.750	1.360	.222
Input * Test * Rule Type	7	598.713	245	567.750	1.054	.393

Results comparing performances at time one and time two.

Table 3.8 Tests 1 and 3, unconditional and conditional rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	1486.40	35	722.029	2.058	.160
Time	1	16343.42	35	297.355	54.962	.0000000
Test	1	748.40	35	187.162	3.998	.053
Rule Type	1	10959.35	35	284.782	38.483	.00004
Input * Time	1	3454.66	35	297.355	11.617	.001
Input * Test	1	20.16	35	187.162	.107	.744
Time * Tests	1	8.37	35	158.941	.052	.819
Input * Rule Type	1	345.81	35	284.782	1.214	.278
Time * Rule Type	1	934.19	35	155.195	6.019	.019
Test * Rule Type	1	446.20	35	183.322	2.433	.127
Input * Time * Test	1	191.59	35	158.941	1.205	.279
Input * Time * Rule Type	1	845.37	35	155.195	5.447	.025
Input * Test * Rule Type	1	124.74	35	183.322	.680	.415
Time * Test * Rule Type	1	12.05	35	214.904	.056	.814
Input * Time * Test * Rule Type	1	55.90	35	214.904	.260	.613

Table 3.9 Tests 1 and 3, all eight rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	1991.86	35	3104.317	.641	.428
Time	1	72593.41	35	1075.305	67.509	.00000000
Test	1	2520.95	35	661.654	3.810	.058
Rule Type	7	13367.04	245	808.149	16.540	.00000000
Input * Time	1	11402.53	35	1075.305	10.603	.002
Input * Test	1	12.50	35	661.654	.018	.891
Time * Tests	1	56.90	35	514.391	.110	.741
Input * Rule Type	7	1192.21	245	808.149	1.475	.176
Time * Rule Type	7	2608.45	245	609.487	4.279	.0001
Test * Rule Type	7	872.83	245	450.677	1.936	.064
Input * Time * Test	1	272.27	35	514.391	.529	.471
Input * Time * Rule Type	7	877.03	245	609.487	1.438	.190
Input * Test * Rule Type	7	531.37	245	450.677	1.179	.315
Time * Test * Rule Type	7	464.40	245	468.275	.991	.437
Input * Time * Test * Rule Type	7	423.98	245	468.275	.905	.502

Study Four

i) Grammaticality Judgement Tests.

Table 4. 1 Tests 1, 2 and 3, unconditional and conditional rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	95.15	11	567.31	.167	.689
Test	2	2.84	22	149.59	.019	.981
Rule Type	1	6273.23	11	111.41	56.30	.00001
Input * Test	2	208.84	22	149.59	1.39	.268
Input * Rule Type	1	.530	11	111.41	.004	.946
Test * Rule Type	2	239.32	22	176.54	1.35	.278
Input * Rule Type *Test	2	351.83	22	176.54	1.99	.160

Table 4. 2 Tests 1, 2 and 3, all eight rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	51.94	11	2601.63	.019	.890
Test	2	195.88	22	610.28	.320	.728
Rule Type	7	9903.62	77	733.97	13.49	.000
Input * Test	2	556.46	22	610.28	.911	.416
Input * Rule Type	7	2079.67	77	733.97	2.83	.011
Test * Rule Type	14	600.77	154	482.73	1.24	.248
Input * Rule Type *Test	14	764.46	154	482.73	1.58	.089

Table 4. 3 Test 3 only (including longer items), unconditional and conditional rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	152.68	11	191.01	.799	.390
Rule Type	1	2176.49	11	173.69	12.53	.004
Input * Rule Type	1	61.11	11	173.69	.351	.565

Table 4. 4 Test 3 only (including longer items), all eight rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	792.03	11	958.76	.826	.382
Rule Type	7	3014.95	77	417.02	7.22	.000001
Input * Rule Type	7	1063.30	77	417.02	2.54	.020

ii) Free Production Analyses.

Table 4. 5 Free Production test, all eight rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	1	7.41	11	4.33	1.71	.217
Rule Type	7	3.58	77	1.36	2.63	.017
Input * Rule Type	7	2.34	77	1.36	1.72	.116

Study 5

a) Grammaticality Judgement Test

Table 5. 1 Unconditional and Conditional rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	573.54	42	546.90	1.048	.359
Rule Type	1	7187.37	42	130.40	55.102	.00000000
Input * Rule Type	2	237.89	42	130.40	1.824	.173

Table 5. 2 All eight rules.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	2828.12	42	2225.44	1.270	.291
Rule Type	7	6003.96	294	424.99	14.127	.00000000
Input * Rule Type	14	974.95	294	424.99	2.294	.005

b) Reasons Analysis.

Table 5. 3 Analysis of Category A data.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	14827.74	42	2180.80	6.799	.002
Rule Type	7	14663.11	294	596.77	24.570	.00000000
Input * Rule Type	14	2079.94	294	596.77	3.485	.00002

Table 5. 4 Analysis of Category A and B data.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	2376.35	42	5318.50	.446	.642
Rule Type	7	15932.95	294	822.822	19.36	.00000000
Input * Rule Type	14	1074.32	294	822.822	1.30	.202

Table 5. 5 Analysis of Category C data.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	639.66	42	1376.40	.464	.631
Rule Type	7	1606.67	294	547.92	2.93	.005
Input * Rule Type	14	414.13	294	547.92	.755	.716

Table 5. 6 Analysis of Category D data.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	47.06	42	6050.81	.007	.992
Rule Type	7	5395.03	294	763.30	7.06	.0000001
Input * Rule Type	14	1111.22	294	763.30	1.45	.126

c) Free Production Test

Table 5. 7 Proportion of correctly produced sentences.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	113.857	41	34.02	3.34	.045

Table 5. 8 Number of rule breakages.

Effect	df	MS effect	df error	MS error	F ratio	p -level
Input	2	69.01	39	13.84	4.98	.011
Rule Type	8	21.06	312	5.26	3.99	.0001
Input * Rule Type	16	5.54	312	5.26	1.05	.401