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The effects of consonantal specificity, articulatory phonetics and prosody in young infants' lexical acquisition

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Abstract

The present study was designed to investigate the role of consonants within word-initial consonantal contrasts, articulatory phonetics (involving place of articulation and voicing features) and prosody in young infants' lexical acquisition. The participants were twenty-four 25-month-old infants, who were recruited from the Babylab database at The University of Plymouth. All children participated in a modified name-categorisation task and the actual experiment involved the use of eight disyllable paired pseudowords. The results found that this age group were unable to learn phonetically similar pseudowords that had a consonantal contrast and were unable to distinguish between word-initial contrasts that used articulatory phonetic features. However, the present study did find that this age group were sensitive to prosody changes when learning new words.

Ethical Statement

This project has complied with the ethical guidelines as stated by the School of Psychology within The University of Plymouth. In order to gain ethical clearance, an ethical proposal form was submitted to the School of Psychology's ethical committee. This ethical proposal form contained information regarding the aims and objectives of the project, a description of the required participants, how these participants would be recruited and how the participants would be involved in the project. Furthermore, the ethical proposal form highlighted various ethical issues (such as informed consent, right to withdraw and confidentiality), which required a description of how these issues would be considered and handled throughout the project. In addition to the above information, the projects information sheet, consent form and debrief were submitted as part of the ethical proposal form process. Additionally, I was personally required to undertake a Criminal Record Bureau (CRB) check, due to the project investigating how 25-month-old infants learn new words and this was also submitted with the ethical proposal form. With the ethical proposal form submitted, the School of Psychology's ethical committee reviewed the information and gave this project ethical approval.

In terms of the actual experiment, the parent of the child was given an information sheet to read prior to commencing the experiment, a consent form to sign if happy to proceed with the experiment and a debrief to read once the experiment was completed. The parent was also reminded that they had the right to withdraw at any point during and after the experiment. Two experimenters (Amy Luck and myself) were present at all times during the experiment, as well as the parent and their child. Video recording equipment was used, focusing only on the infant's hands, in order to record their response to the task, which would then be used at a later date to double check that the correct information had been recorded during the experiment.

All data relating to 25-month-old infants, where the word-initial consonant was changed, was gathered by Amy Luck and myself. This project report also discussed data relating to 20-month-old infants, where the word-initial consonant was changed, which was gathered by Alison De'Ath, Deborah Prior and Jenny Dewing. Furthermore, this project also discussed data relating to 23-month-old infants, where the word-medial consonant was changed, which was gathered by Siobhan Seward and Claire Denton.

Acknowledgements

I would like to take this opportunity to say thank you to Amy Luck, for all her assistance during the data gathering process. I would also like to say thank you to Caroline Floccia, for her help and guidance during the initial set up of this project, as well as her support throughout the project. In addition, I would like to say thank you to all the infants and their parents for attending the Babylab and participating in our experiment, in order to assist Amy and myself with our final year project.

Introduction

Research into phonetic specificity was carried out by Nespor, Pena and Mehler (2003, as cited in Nazzi & Bertoncini, 2009), who proposed that consonants may have a different role within language acquisition than vowels, suggesting that consonants may be more meaningful at a lexical level, whereas vowels may be more meaningful at a prosodic level. Further research was carried out by Nazzi, Floccia, Moquet and Butler (2009) who investigated whether 30-month-old infants would show any preference between consonantal features and vocalic features, when carrying out a task that required the infants to neglect one of these features. They found that 30-month-old infants showed a bias towards consonants (rather than vowels), suggesting a preference for using consonantal information when participating in a name-based categorisation task. Therefore, the present study will focus on the role of consonants when investigating the effects of word-initial consonantal contrasts, articulatory phonetics and prosody in young infants' lexical acquisition.

Research has been carried out into word-initial consonant contrasts, focusing on mispronunciation of familiar words (Jusczyk & Aslin, 1995; Mani & Plunkett, 2007), as well as consonantal contrasts in non-words (Nazzi, 2005).

Jusczyk and Aslin (1995) investigated the mispronunciations of words with infants aged 7½-months. In their study, they used four familiar words (cup, feet, bike and dog) and created mispronunciations of these words by changing their word-initial consonant (creating non-words tup, zeet, gike and bawg). The infants first took part in a familiarisation phase, where they heard isolated repetitions of two target non-words (out of four possible target non-words). This was followed by the test phase, which presented the infant with four six-sentence passages that contained a mix of familiar or unfamiliar target words. Using a modified head turn preference procedure, they found that infants did not listen longer to the passages that contained the previously familiarised target non-word that differed by a word-initial consonant, which suggested that the infants had difficulty recognising the mispronounced words and also suggested that the infants representations of familiar words were phonetically specified.

A further mispronunciation study was carried out by Mani and Plunkett (2007) who investigated consonant and vowel sensitivity in infants aged 15-months, 18-months and 24-months. In their study, familiar monosyllabic nouns were taken from the Oxford Communicative Developmental Inventory (Hamilton, Plunkett & Schafer, 2000). These nouns were verbally presented to the infant either correctly or incorrectly (using a mispronunciation of the word-initial consonant or the first vowel that appeared in the word). When analysing the looking behaviour, they found that all three age groups looked longer towards words with a correct pronunciation, rather than words with a mispronunciation. These results suggested that infants aged 15-months, 18-months and 24-months were all sensitive to both consonant and vowel mispronunciations.

The studies discussed above by Jusczyk and Aslin (1995) and Mani and Plunkett (2007) both found that infants had difficulty recognising mispronounced familiar words, suggesting that consonants and vowels were phonetically specified. However, these studies were carried out using familiar words and therefore the infants may have had a bias towards these words (Nazzi, 2005). This leads to the question, if infants were sensitive to word-initial mispronunciations in familiar words, would they be sensitive to word-initial consonantal contrasts in pseudowords?

Nazzi (2005) investigated the use of phonetic specificity in infants aged 20-months. In his study, the infants took part in a name-based categorisation task,

which involved the presentation of 6 triads of unfamiliar objects and three pairs of non-words (used twice to fulfil the 6 trials) that either focused on a consonantal contrasts in the word-initial position (e.g. pize/tize) or focused on a consonantal contrast in a non word-initial position (e.g. pide/pige). He found that 20-month-old infants could learn two phonetically similar words, when the consonantal contrast was in a word-initial position or a non word-initial position. This finding suggested that 20-month-old infants were sensitive to consonantal contrasts and do use phonetic specificity when learning new words.

Word-initial consonantal contrasts have been investigated further, with a particular focus on articulatory phonetics (Hallé & de Boysson-Bardies, 1996; Havy & Nazzi, 2009; Nazzi & New, 2007; Pater, Stager & Werker, 2004; Werker, Fennell, Corcoran & Stager, 2002). According to Barrett (2001) articulatory phonetics refers to the way in which the speaker produces a particular sound. For example, consonants can be bilabial (articulated with the lips, such as b/p), alveolar (articulated with the tongue near or touching the teeth, such as d/t) or velar (articulated with the tongue at the back of the mouth, such as g/k) (Carroll, 2008). According to Carroll (2008) these consonants can then be used to create differences in voice (e.g. using two bilabial consonants, one that is voiced and the other being voiceless) or place of articulation (e.g. using two types of consonant, such as a bilabial and a velar).

Hallé and de Boysson-Bardies (1996) investigated consonantal contrasts on the word-initial consonant, using voiced consonants with infants aged 11-months. In their study, they used a head turn preference procedure to investigate whether the infants preferred the familiar bisyllable words (e.g. balloon) over the altered word-initial familiar bisyllable words (e.g. palloon). They found that 11-month-old infants did not show any preference to either the familiar bisyllable or the altered word-initial familiar bisyllable word, which suggested that this age group was not sensitive to the word-initial voiced consonantal contrast, when listening to familiar words.

Werker et al. (2002) investigated whether 14-month-old, 17-month-old and 20-month-old infants could learn to pair phonetically similar words with two different objects. In their study, they used a modified habituation paradigm to investigate whether the infants would notice the word-initial consonantal contrast, which was switched by place of articulation (e.g. bih/dih). They found that 14-month-old infants failed to notice the switch, whereas 17-month-old and 20-month-old infants were able to notice the switch. This suggested that infants from the age of 17-months were able to learn new words through encoding fine phonetic details, whereas 14-month-old infants have not yet acquired this skill.

Pater et al. (2004) also investigated the role of articulatory phonetics in word learning, with infants aged 14-months. They carried out two experiments, where in the first experiment the word-initial consonant was switched by a place of articulation feature (e.g. bin/din) and in the second experiment the word-initial consonant was switched by a voicing feature (e.g. bin/pin). They used a modified habituation paradigm to investigate whether the infants would notice the switch that differed by place of articulation or voice. Both experiments found that 14-month-old infants failed to notice the articulation switch, which suggested that consonantal contrasts involving place of articulation and voicing features were not fully integrated into the phonological system of 14-month-old infants and offered further support to the previous research by Werker et al. (2002).

A further study was carried out by Nazzi and New (2007), who investigated whether 20-month-old infants were able to simultaneously learn new words that differed by a consonantal contrast. The infants took part in a name-based categorisation task, which involved the presentation of 6 triads of unfamiliar objects

and three pairs of non-words (used twice to fulfil the 6 trials) that differed on their word-initial consonant by place of articulation (using continuous non-plosive consonants). They found that 20-month-old infants were able to simultaneously learn new words, which used consonants that were phonetically similar by their place of articulation. This study therefore suggested that 20-month-old infants were sensitive to word-initial consonantal contrasts involving place of articulation when learning new words, which also supported previous work by Werker et al. (2002).

In addition, Havy and Nazzi (2009) carried out a study with 16-month-old infants, to investigate whether they used consonantal information when learning new words during a word learning task, as well as investigating whether articulation affected the infant's ability to learn new words. The infants took part in a modified version of the name-based categorisation task, which removed the categorisation component (asking the infant "which one goes with that?") and replaced it with the statement and question "look this is a (object name), I put this (object name) in the cup, can you put the other (object name) in the cup?" There were eight trials, which involved the presentation of eight triads and eight pairs of pseudowords that differed on their word-initial consonant. Four pairs of pseudowords differed by their word-initial consonant contrast with a voicing feature and four pairs of pseudowords differed by their word-initial consonant contrast with a place of articulation. Havy and Nazzi (2009) found that 16-month-old infants do use consonantal information when learning new words that are phonetically similar by one consonantal feature. In addition, Havy and Nazzi (2009) found that 16-month-old infants were equally sensitive to place of articulation and voicing features, although when investigating the looking time data, they found that place of articulation may be better processed than voice. These results suggested that consonants were used at a lexical level by 16-month-old infants and may play an important role in lexical acquisition.

From the previously discussed research, it was found that 14-month-old infants were insensitive to word-initial consonantal contrast that differed by both voice and place of articulation (Hallé & de Boysson-Bardies, 1996; Pater et al., 2004; Werker et al., 2002), yet by the age of 16-months onwards, these infants had become sensitive to these consonantal contrast features (Havy & Nazzi, 2009; Nazzi & New, 2007). This suggested that infants aged 16-months onwards had acquired the skill of been able to encode fine phonetic details, which may be important in the acquisition of new words.

According to Mattys (2000) word recognition studies have also investigated the role of prosody, focusing on the distinction between strong syllables (which contain a full vowel) and weak syllables (which contain a reduced vowel, also known as a schwa). It has been found that languages within different nationalities, such as English and French, use different accentual patterns (Vihman, Nakai, DePaolis & Hallé, 2004). The majority of words in the English language (estimated to be about 73%) are stressed on their initial syllable (i.e. trochaic or strong-weak words) (Cutler & Carter, 1987, as cited in Mattys, 2000), whereas the majority of words in the French language are iambic (i.e. weak-strong words) (Vihman et al., 2004).

Studies into prosody have been carried out by Jusczyk, Houston and Newsome (1999) and Vihman et al. (2004), which focused on English-learning infants. Jusczyk et al. (1999) investigated the use of strong-weak stress patterns and weak-strong stress patterns in English learning infants aged 7½- months, using a modified head turn preference procedure. In their first experiment, they used four strong-weak stress patterned bisyllable words (kingdom, hamlet, doctor and candle). The infants first took part in a familiarisation phase, where they heard isolated repetitions of the target words, followed by the test phase, which presented the

infants with four six-sentence passages that contained a mix of familiar or unfamiliar target words. They found that the infants listened longer to passages that contained the previously familiarised target word, which suggested that 7½-month-old infants were able to identify strong-weak stress patterned words from fluent speech. In a second experiment by Jusczyk et al. (1999), they used four weak-strong stress patterned bisyllable words (guitar, surprise, beret and device). Using the same procedure as previously described, they found that the 7½-month-old infants did not listen longer to the passages that contained the previously familiarised target word, suggesting that they were unable to identify weak-strong patterned words from fluent speech. Overall, the study by Jusczyk et al. (1999) suggested that 7½-month-old infants were sensitive to the prosody change, as they tended to respond better to strong-weak words, rather than weak-strong words.

Vihman et al. (2004) also carried out a study into prosody, where they investigated accentual patterns in 11-month-old English learning infants. In their study, the infants were presented with two lists of words (familiar words and mis-stressed familiar words) and used a head turn preference method to investigate whether these infants listened longer to normally-stressed familiar words (e.g. BAby) rather then mis-stressed familiar words (e.g. baBY). They found that 11-month-old infants showed no difference in listening time between stressed familiar words and mis-stressed familiar words, suggesting that this age group was insensitive to the stress changes, as they were still able to recognise familiar words that had an accentual shift.

Vihman et al.'s (2004) previous research led them to investigate the role of accentual patterns in word recognition, when the consonantal contrast was either in a word-initial position or a word-medial position. Using a head turn preference method, they found that 11-month-old English learning infants failed to recognise the familiar word when the onset consonant of the accented syllable was changed, yet did recognise the familiar word when the onset consonant of the unaccented syllable was changed. This went against Vihman et al.'s (2004) original hypothesis, that English-learning infants should be sensitive to strong-weak patterned words, as the English language used a majority of trochaic words. Therefore this study suggested that not only does the word-initial and word-medial consonant play an important role in the processing of lexical information, but also suggested the valuable role of the stressed syllable in infants' word representations.

From the research discussed above (Jusczyk et al., 1999; Vihman et al., 2004), there appeared to be a difference between age groups, with regards to prosody recognition. Jusczyk et al. (1999) found that 7½-month-old English learning infants were sensitive to prosody, whereas Vihman et al. (2004) found that 11-month-old English learning infants were insensitive to prosody. Therefore these studies were unclear in defining whether prosodical information was used to aid lexical acquisition and if prosody was part of lexical acquisition, these studies were unclear to what age this process occurred at. Furthermore, Vihman et al. (2004) found that 11-month-old infants had difficulty recognising familiar words when the onset consonant of the accented syllable was changed, which went against their original hypothesis and therefore suggested that word-initial and word-medial consonants played an important role in word recognition.

The present study was similar to the work carried out by Havy and Nazzi (2009), but also incorporated ideas from the prosody work carried out by Jusczyk et al. (1999) and Vihman et al. (2004). Firstly, the present study was similar to the work carried out by Havy and Nazzi (2009) as the present study was investigating whether infants used consonantal information when learning new words and was also

investigating whether articulatory phonetics affected the infants' ability to learn new words. In addition, the present study was using the modified version of the name-based categorisation task, as demonstrated in the study by Havy and Nazzi (2009). However, Havy and Nazzi's (2009) study focused on infants aged 16-months of age, whereas the present study focused on infants aged 25-months of age. The present study also incorporated ideas from the prosody work carried out by Jusczyk et al. (1999) and Vihman et al. (2004). Both Jusczyk et al. (1999) and Vihman et al. (2004) investigated prosody manipulations in familiar words, whereas the present study will continue to investigate prosody manipulations, but will focus on these manipulations in pseudowords, rather than familiar words.

The current study focused on three aspects: word-initial consonant contrasts; articulatory phonetics; and prosody. The purpose of investigating word-initial contrasts was due to previous research suggesting that 20-month-old infants used phonetic specificity when learning two phonetically similar words, which differed by a word-initial consonant (Nazzi, 2005) and therefore the present study investigated whether this was still the case for 25-month-old infants. The present study was then compared to work carried out by De'Ath, Prior and Dewing, who studied word-initial consonantal contrasts in 20-month-old infants, in order to investigate whether there was any change in phonetic specificity between the two age groups. In addition, the present study was also compared to work carried out by Seward and Denton, who studied word-medial consonantal contrasts in 23-month-old infants, in order to investigate whether infants learned new words better when the consonantal contrast was in a word-initial position or in a non word-initial position (similar to the work carried out by Nazzi, 2005).

The purpose of investigating articulatory phonetics was due to previous research suggesting that infants as young as 16-months of age were sensitive to word-initial consonantal contrasts involving place of articulation and voicing features (Havy & Nazzi, 2009; Nazzi & New, 2007; Werker et al., 2002) and therefore the present study investigated whether this was still the case for 25-month-old infants.

Lastly, the purpose of investigating prosody was due to previous research been unclear to whether English learning infants used prosodical information to aid lexical acquisition and if prosody was part of lexical acquisition, previous research was unclear to what age this occurred at. Therefore the present study investigated whether 25-month-old English speaking infants were sensitive to prosody, when learning new words (as found in previous research by Jusczyk et al., 1999). The present study was then compared to work carried out by De'Ath, Prior and Dewing, who studied word-initial consonantal contrasts in 20-month-old infants, in order to investigate whether there was any difference in prosody recognition between the two age groups. In addition, the present study was also compared to work carried out by Seward and Denton, who studied word-medial consonantal contrasts in 23-month-old infants, in order to investigate whether infants recognised different prosodies better when the consonantal contrast was in a word-initial position or in a word-medial position (similar to the work carried out by Vihman et al., 2004).

The present study used the 'Oxford Communicative Development Inventory' (OCDI; Hamilton et al., 2000). The OCDI was a questionnaire that was filled out by the parents of the participating infant, in order to assess the infants' receptive and productive vocabulary. The OCDI contained a total of 416 words and was used to investigate whether the infants' performance correlated with their vocabulary size.

The first hypothesis of the current study is that 25-month-old infants would be able to learn two phonetically similar pseudowords that differed by a word-initial consonant. The second hypothesis is that 25-month-old infants would perform better

when the word-initial consonantal contrast had a place of articulation feature, rather than a voicing feature. The third hypothesis is that 25-month-old infants would perform better when the phonetically similar pseudowords were stressed on the first syllable (strong-weak pseudowords) rather than on the second syllable (weak-strong pseudowords).

Method

Participants for 25-month-old infant word-initial consonant contrast experiment
A total of twenty-four 25-month-old infants (mean age = 24 months 26 days, range = 24 months 8 days to 25 months 20 days) participated in this study. These infants were recruited using the Babylab database at The University of Plymouth and were all from monolingual English speaking families. In terms of gender, an equal amount of males and females participated. An additional three infants also participated in this study, but this data was not included due to one infant failing to complete the experiment (as they were distracted by the new environment) and two infant systematically grabbing both test objects (as opposed to just one) throughout the eight trials.

Participants for 20-month-old infant word-initial consonant contrast experiment carried out by De'Ath, Prior and Dewing
A total of eighteen 20-month-old infants (mean age = 20 months 6 days, range = 19 months 16 days to 21 months 9 days) participated in the study by De'Ath, Prior and Dewing. These infants were recruited using the Babylab database at The University of Plymouth and were all from monolingual English speaking families. In terms of gender, an equal amount of males and females participated.

Participants for 23-month-old infant word-medial consonant contrast experiment carried out by Seward and Denton
A total of sixteen 23-month-old infants (mean age = 23 months 6 days, range = 22 months 13 days to 23 months 29 days) participated in the study by Seward and Denton. These infants were recruited using the Babylab database at The University of Plymouth and were all from monolingual English speaking families. In terms of gender, an equal amount of males and females participated.

Materials
The present study was carried out in the Babylab (a room dedicated to studies with infants aged zero to six years of age), which contained two child sized tables, two child sized chairs (one for the infant and one for Experimenter One), an adult sized chair (for Experimenter Two) and a comfortable seating area for the parent. A plan of the Babylab can be seen in appendix A.

Further equipment included 27 information sheets (see appendix B), 27 consent forms (see appendix C), 27 debriefs (see appendix D), 27 'Oxford University Communicative Development Inventory' questionnaires (Hamilton et al., 2000), 27 counterbalanced score sheets (see appendix E), 27 certificates (see appendix F), one A4 sheet of paper and a pen. In addition to the previously mentioned equipment, the practice trials required four small toys (a car, a pig, a cow and a dog), as well as two obscure objects, made of other material type (see appendix G for photograph of these object). The actual experiment required 24 obscure objects, which were grouped into eight triads, each containing a metal, plastic and other material object (see appendix H for photographs of these objects in their triads). Furthermore, the

infant's hands and their object selection were filmed using a Panasonic NV-GS25 video camera (with tripod) and five Sony recordable tapes.

Stimuli

The first practice trial included a triad of small familiar toys (a car, a pig and a cow) and these toys were named 'car' or 'animal'. The second practice trial included a familiar toy (a dog) and two obscure objects, these were named 'dog' (for the dog) and 'gik' (for the two obscure objects).

The actual experiment consisted of eight trials, each using a different triad, which included a metal, plastic and other material object (total of 24 obscure objects). These objects were selected due to being unfamiliar to the infant and would therefore not have a name associated to them. Each triad of obscure objects were then placed in small plastic bags and these plastic bags were labelled 1-8. The obscure objects in these eight triads remained together (in these numbered plastic bags) for the duration of the study. These triads were then counterbalanced by presenting the plastic bags in the labelled order of 1-8 for the first 16 participants, followed by 5-8 and 1-4 for the remaining 11 participants. Furthermore, the obscure objects in each triad was presented to the infant using a counterbalanced procedure, to ensure that the metal, plastic and other material object were used in every possible way during the experiment.

In terms of the disyllabic pseudowords, there were eight pairs, which all differed on their word-initial consonant, by using a consonantal contrast that were either voiced (articulated in the same area of the mouth, such as p/b) or placed (articulated in difference areas of the mouth, such as k/t). The four paired disyllabic voice pseudowords used were beelar/peelar, keepow/geepow, bonut/ponut and posar/bosar. The four paired disyllabic place pseudowords used were komess/tomess, gawjee/dawjee, tushow/pushow and goobey/doobey. All eight pairs of pseudowords were used once during the experiment and were counterbalanced in terms of word presentation (e.g. order of pseudowords), side of word presentation (e.g. beelar presented first, followed by peelar) and word match (e.g. the pseudoword to be identified could be either beelar or peelar), in order to prevent confounding issues, such as order effect. In addition, the above paired disyllabic pseudowords were stressed either on their first syllable (strong-weak pseudoword) or their second syllable (weak-strong pseudoword). Each experiment consisted of four strong-weak pseudowords and four weak-strong pseudowords, which were also counterbalanced to prevent confounding issues.

In order to double check that all aspects previously mentioned had been counterbalanced appropriately, scores sheets for each participant were created (see appendix E).

Design and Procedure

A within-subjects design was used, whereby the infant was exposed to all manipulated variables. There were three independent variables involved in this experiment. The first independent variable was a consonantal contrast on the word-initial consonant (e.g. p/b in the words peelar/beelar). The second independent variable concerned whether the word-initial consonant contrast was either voiced (e.g. articulated in the same area of the mouth, such as the bilabials p/b) or placed (e.g. articulated in difference areas of the mouth, such as the velar k and the alveolar t). The third independent variable was the stress pattern of the disyllabic pseudoword (e.g. strong-weak pseudoword or weak-strong pseudoword).

The dependent variable of this experiment was the object that the infant placed in the pot. This enabled analysis into the total amount of correct responses from out of the eight trials (which indicated the correct identification of the word-initial consonant), the total amount of correctly identified voice pseudowords and place pseudowords, as well as the total number of correctly identified strong-weak pseudowords and weak-strong pseudowords.

All infants with an age of 25 months (+/- 3 weeks) during a four month period were selected on the Babylab database at The University of Plymouth. The Babylab database contained contact details of parents and their infant(s), who joined the database through a convenience sampling method (e.g. advertisement for Babylab studies in local newspapers, leaflets, etc). The parents of these infants were contacted by telephone, in order to invite the parent and their child to participate in this study, at a convenient day and time. With verbal confirmation of a day and time, a confirmation letter (see appendix I), a map of the Babylab location, a Babylab leaflet and a copy of the 'Oxford University Communicative Development Inventory' questionnaire (Hamilton et al., 2000) were sent to the parents of the infant.

On the day of the experiment, the Babylab was set up by Experimenter One and Experimenter Two, using the same layout shown in appendix A. When the parent and their infant arrived, they were greeted by both Experimenter One and Experimenter Two, who then led the parent and infant through to the Babylab. Once in the Babylab, the parent and infant were offered a drink and given a few minutes to settle into the environment.

Experimenter One then encouraged the infant to sit down at the table with her, where they spent a few minutes interacting through a colouring activity or the reading of a book. This gave Experimenter One an opportunity to form a relationship with the infant. Meanwhile Experimenter Two spoke to the parent and gave the parent an information sheet to read, which explained the study that their child was about to take part in. The information sheet can be found under appendix B. Experimenter Two also asked the parent for the 'Oxford University Communicative Development Inventory' questionnaire (Hamilton et al., 2000), which had been previously sent to the parent for their completion, prior to the experimental date. The parent was then given an opportunity to ask Experimenter Two any questions that they may have had and once happy with all the information, the parent was asked to sign a consent form (see appendix C), confirming that they were happy for their child to participate in this study. With all the paper work complete, Experimenter Two gave the parent a set of headphones to put on, which was connected to music. The purpose of the headphones was to avoid the parent influencing the infant's decision during the experiment. Experimenter Two then sat next to the video camera and ensured that the video camera was only filming the infants' hands and the section of table where object selection would take place. The purpose of the video camera was to film the infants' responses, which could be used at a later date to double check that Experimenter Two had recorded the correct information on the score sheet, which was filled out during the experiment. Meanwhile, Experimenter One tidied away the colouring activity or the book and it was from this point that the experiment commenced.

Experimenter Two activated the recording facility on the video camera and signalled to Experimenter One that they were ready start. Experimenter One then stated the participant number to the video recorder and placed an A4 sheet of paper on the table.

Experimenter One commenced the two practice trials, which were used to introduce the infant to the task and to demonstrate the requirements of the infant

during the task. The first practice trial required three objects; a car, a pig and a cow. The first object (a car) was presented to the infant by Experimenter One, along with six scripted phrases (see appendix J). The reason for using the six scripted phrases was to ensure that Experimenter One only said the keyword (in this case 'car') six times. The six scripted phrases also corresponded with an action by Experimenter One. Therefore in the case of the car, Experimenter One said the following passage and carried out the following action:

> "Look at the **car**." (Experimenter One showed the infant the **car**). "This is a **car.**" (Experimenter One showed the infant the **car**). "Would you like to play with the **car**?" (Experiment One gave the infant the **car**). "I like the **car.**" (Experimenter One allowed the infant to explore the **car**). "Can I have the **car** back please?" (Experimenter One placed their hand out to receive the **car**). "I'm going to place the **car** right here on the table." (Experimenter One placed the **car** in a particular place on the table).

Once Experimenter One had said the six scripted phrases, Experimenter One placed the car on the right hand side of the A4 sheet of paper (viewed left hand side from the infants perspective, in order to minimise memory load), which had previously been placed on the table. Experimenter One then presented the infant with a second object (a cow) and repeated the six scripted phrases and corresponding action, replacing the word 'car' with the word 'animal'. Once Experimenter One had said the six scripted phrases, Experimenter One placed the cow on the left hand side of the A4 sheet of paper (viewed right hand side from the infants' perspective). Experimenter One then presented a final object (a pig) to the infant. This time Experimenter One did not use the previous six scripted phrases, but instead said:

> "Look, I have another **animal**. I'm going to put it in the pot. Can you put the other **animal** in the pot?"

Once Experimenter One had said this phrase, she positioned the pot in-between the two objects that had been previously placed on the A4 sheet of paper with one hand and with the other hand held the A4 sheet of paper. The reason for holding the A4 sheet of paper was to enable Experimenter One to pull the paper back toward themselves, if the infant showed signs of grabbing both objects at the same time. While the infant was making their selection, Experimenter One looked either straight ahead at the infant or at the pot. This was to ensure that Experimenter One gave no cues to the infant, regarding the correct answer to the trial. Once the infant had placed an object in the pot, Experimenter Two recorded the answer on a score sheet and Experimenter One praised the infant, regardless of whether the selection was correct or incorrect.

Experimenter One then moved on to the second practice trial, which used a different triad of objects (a dog and two obscure objects) and followed exactly the same procedure as above. This time the obscure object (called a 'gik') was presented first and placed on the A4 sheet of paper, followed by the dog. A final obscure object (also called a 'gik') was then presented to the infant and placed in the pot.

Once the first practice trial was correctly completed, the infant would move on to the second practice trial. However, if the infant was unsuccessful with their first attempt of the first practice trial, the practice trial was repeated up to a further two times (if necessary). This was also the case for the second trial. The reason for

allowing the infant up to three opportunities with each practice trials, was due to the practice trials being an opportunity for the infant to learn and gain understanding into the requirements of the task. Therefore, if the infant was unable to complete the task successfully, it suggested that the infant may not understand the task and by repeating the practice trial, the infant would be given another opportunity to gain understanding of what they were required to do. Once the infant had participated in both practice trials, the actual experiment commenced with all infants, even if they had failed the practice trial. However, if the infants did fail the practice trial, their responses were treated with caution when it came to analysing the data.

The actual experiment was then carried out using the same procedure demonstrated in the practice trials (using the six scripted phrases for the first two objects, followed by a different phrase when presenting the final object). The experiment finished once Experimenter One had carried out all eight trials with the infant. With the experiment completed, Experimenter Two stopped the video camera from filming and informed the parent that they could remove their headphones. The infant was praised by both experimenters for all their hard work during the experiment and given a personalised certificate (see appendix F) from Experimenter One to say thank you for participating. Experimenter Two then gave the parent a written debrief (see appendix D) and also verbally explained the purpose of the task. At this point, the parent was given another opportunity to ask any questions they may have had and was informed that the experimenters contact details were on the debrief, if they wished to ask any questions once they had left the Babylab. The parent and infant were then thanked again by the experimenters for giving up their time to attend the Babylab.

This procedure was repeated with a further 26 infants and their parents. Once all the infants had completed the experiment, the scores for each infant were inputted into an Excel spreadsheet (see CD-ROM in the appendix K), before been entered into SPSS for analysis.

Results

25-month-old infant word-initial consonant contrast experiment

The infants were given a score of 1 when they chose the correctly named object and a score of 0 when they chose the incorrectly named object. The total for each infant would range from 0 to 8 and these scores were then transformed into a percentage. The chance level of this experiment was 50%, as the infant had to choose between two objects. The infant chose the correctly named object 52.08% of the time, which was found not to be significantly more than chance when a One-Sample T Test was carried out, $t(23) = .7$, $p = .49$ (two-tailed). Table 1 below shows the distribution of the infants' correct results and the corresponding percentages.

Table 1: *Distribution of the infants correct responses and the corresponding percentages*.

Performance level	0	1	2	3	4	5	6	7	8
Number of infants	0	1	0	3	15	0	5	0	0
Percentage (%)	0	0.52	0	4.68	31.25	0	15.63	0	0

The 'Oxford University Communicative Development Inventory' (Hamilton et al., 2000) was carried out by each parent and showed that the infants had a mean of

275 words (SD = 132.19, range = 25 to 416, median = 322.5). A Pearson correlation revealed that there was very weak positive correlation between the number of correct responses given by the infant and their vocabulary size, r = +.48, p = .02 (two-tailed). Figure 1 illustrates this correlation.

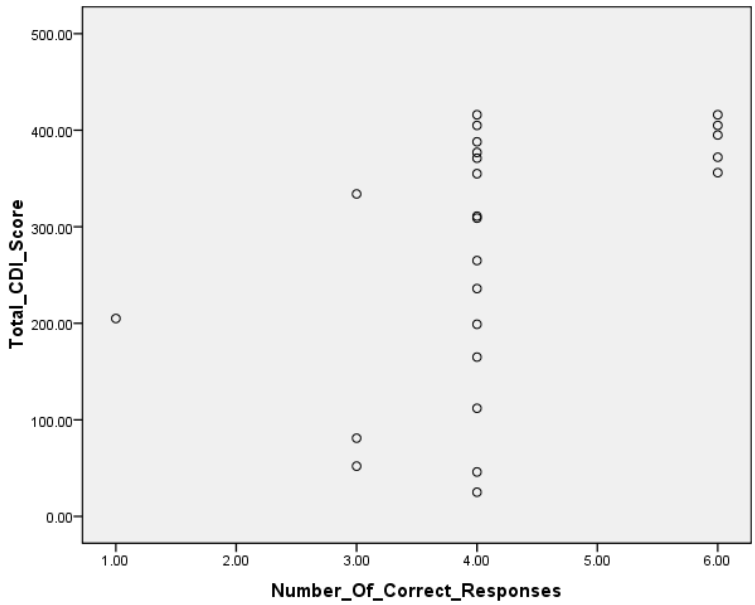

Figure 1. Scatterplot of the relationship between the number of correct responses given by the infant and their total 'Oxford University Communicative Development Inventory' (Hamilton et al., 2000) score.

Statistical analysis was carried out into whether the percentage of voice correct pseudowords and the percentage of place correct pseudowords were above the chance level of 50%. When comparing the voice correct pseudoword percentage at 45.83% with chance, a One-Sample T Test revealed that this was not significantly different, t(23) = -.81, p = .43(two tailed). When comparing the place correct pseudoword percentage at 58.33% with chance, a One-Sample T Test revealed that this was not significantly different, t(23) = 1.5, p = .15 (two-tailed). Table 2 shows the descriptive statistics for the number of correctly and incorrectly identified pseudowords in the voice condition and the place condition by each child.

In addition, a Paired Samples T Test was carried out, to investigate whether there was any significant difference between voice correct pseudoword percentages and place correct pseudoword percentages and found that there was no significant difference, t(23) = -1.4, p = .17 (two-tailed).

Table 2. *Descriptive statistics for the number of correctly and incorrectly identified pseudowords in each condition by each child (out of a maximum score of 4 for each condition)*.

	Voice condition		Place condition	
	Voice correct	Voice incorrect	Place correct	Place incorrect
N	24	24	24	24
Mean	1.83	2.17	2.33	1.67
SD	1.01	1.01	1.09	1.09

Statistical analysis was also carried out into whether the percentage of strong-weak correct pseudowords and the percentage of weak-strong correct pseudowords were

above the chance level of 50%. When comparing the strong-weak correct pseudoword percentage at 62.5% with chance, a One-Sample T Test revealed that there was a significant difference, t(23) = 2.4, p = .03 (two tailed). However, when comparing the weak-strong correct pseudoword percentage at 41.67% with chance, a One-Sample T Test revealed that this was not significantly different, t(23) = -1.78, p = .09 (two-tailed). Table 3 shows the descriptive statistics for the number of correctly and incorrectly identified pseudowords in the strong-weak condition and the weak-strong condition by each infant.

Table 3. *Descriptive statistics for the number of correctly and incorrectly identified pseudowords in each condition by each infant (out of a maximum score of 4 for each condition)*.

	Strong-weak condition		Weak-strong condition	
	Correct	Incorrect	Correct	Incorrect
N	24	24	24	24
Mean	2.5	1.5	1.67	2.25
SD	1.02	1.02	.92	.85

In addition, a Paired Samples T Test was carried out, to investigate whether there was any significant difference between the percentage of strong-weak correct pseudowords and the percentage of weak-strong correct pseudowords and found that there was a significant difference, t(23) = 2.63, p = .02 (two-tailed).

Comparing this study of 25-month-old infants' word-initial consonant contrast experiment with the previous study of 20-month-old infants' word-initial consonant contrast experiment carried out by De'Ath, Prior and Dewing.

The 20-month-old infant chose the correctly named object 55.56% of the time, which was found not to be significantly more then chance when a One-Sample T Test was carried out, t(17) = 1.22, p = .24 (two-tailed).

The 20-month-old infant data was compared to the 25-month-old infants' data. The 20-month-old infants chose the correctly name object 55.56% of the time, whereas the 25-month old infants chose the correctly named object 52.08% of the time. An Independent Samples T Test was carried out and revealed that there was no significant difference between the two age groups t(40) = .67, p = .51 (two-tailed).

In addition to the above analysis, statistical analysis was also carried out into whether the percentage of strong-weak correct pseudowords and the percentage of weak-strong correct pseudowords differed between the two age groups. When comparing the 20-month-old strong-weak correct pseudoword percentage at 58.33% with the 25-month-old strong-weak correct pseudoword percentage at 62.5%, an Independent Samples T Test revealed that there was no significant difference, t(40) = -.44, p = .66 (two tailed). When comparing the 20-month-old weak-strong correct pseudoword at 52.78% with the 25-month-old weak-strong correct pseudoword at 41.67%, an Independent Samples T Test revealed that there was no significant difference, t(40) = 1.57, p = .13 (two-tailed).

Comparing this study of 25-month-old infants word-initial consonant contrast experiment with the 23-month-old infants word-medial consonant contrast experiment carried out by Seward and Denton.

The 23-month-old infants in the word-medial consonant contrast experiment chose the correctly named object 49.22% of the time, which was found not to be significantly more then chance when a One-Sample T Test was carried out,

t(15) = -.29, p = .77 (two-tailed).

The 23-month-old infants' word-medial consonant contrast experiment data was compared to the 25-month-old infants' word-initial consonant contrast experiment data. The 23-month-old infant word-medial consonant contrast experiment chose the
correctly name object 49.22% of the time, whereas the 25-month-old infants word-initial consonant contrast experiment chose the correctly named object 52.08% of the time. An Independent Samples T Test was carried out and revealed that there was no significant difference between the two experiments t(38) = .67, p = .51 (two-tailed).

In addition to the above analysis, statistical analysis was also carried out into whether the percentage of strong-weak correct pseudowords and the percentage of weak-strong correct pseudowords differed between the two experiments. When comparing the 23-month-old infants word-medial consonant contrast experiment strong-weak correct pseudoword percentage at 43.75% with the 25-month-old infants word-initial consonant contrast experiment strong-weak correct pseudoword percentage at 62.5%, an Independent Samples T Test revealed that there was a significant difference, t(37.99) = -2.78, p = .01 (two tailed). However, please note that with this Independent Samples T Test, the Levene's Test for Equality of Variance was p = .02 and therefore equal variance could not be assumed. When comparing the 23-month-old infants word-medial consonant contrast experiment weak-strong correct pseudoword at 54.69% with the 25-month-old infants word-initial consonant contrast experiment weak-strong correct pseudoword at 41.67%, an Independent Samples T Test revealed that there was no significant difference, t(38) = 1.71, p = .1 (two-tailed).

Discussion

There were three aims to the present study. The first aim was to investigate whether 25-month-old infants would be able to learn two phonetically similar pseudowords that differed by a word-initial consonant. The second aim was to investigate whether 25-month-old infants would perform better when the word-initial consonant contrast had a place of articulation feature, rather than a voicing feature. The third aim was to investigate whether 25-month-old infants would perform better when the phonetically similar pseudowords were stressed on the first syllable (strong-weak pseudowords) rather than on the second syllable (weak-strong pseudowords).

The present study was similar to the study carried out by Havy and Nazzi (2009), which used a modified version of the name-based categorisation task that removed the categorisation component. There were eight trials, which involved the presentation of eight object triads and eight pairs of pseudowords that differed on their word-initial consonant. Four pairs of pseudowords differed by their word-initial consonant contrast with a place of articulation feature and four pairs of pseudowords differed by their word-initial consonant contrast with a voicing feature. In addition, the present study involved prosody manipulations (as demonstrated in the studies by Jusczyk at al., 1999 and Vihman et al., 2004), however these manipulations in the present study were with pseudowords, rather than familiar words. Therefore, four pairs of pseudowords were stressed by a strong-weak stress pattern and four pairs of pseudowords were stressed by a weak-strong stress pattern. All factors in the present study were counterbalanced to avoid confounding issues, such as order effect.

Analysis of the result found no evidence to support the first hypothesis. This was because the statistical analysis revealed that the infants performance score was

not significantly above chance, which suggested that the infants did not learn two phonetically similar pseudowords that differed by a word-initial consonant, further suggesting that 25-month-old infants were not sensitive to consonantal contrasts.

In addition, no evidence was found to support the second hypothesis. This was because the statistical analysis revealed that there was no significant difference between the word-initial consonantal contrast that had a place of articulation feature and the word-initial consonantal contrast that had a voicing feature. This result therefore suggested that 25-month-old infants were not sensitive to consonantal contrasts that involved articulatory phonetic features.

However, the quantitative results did appear to provide support for the third hypothesis. This was because the statistical analysis revealed that 25-month-old infants did perform better when the phonetically similar pseudowords were stressed on the first syllable (strong-weak pseudowords) rather than on the second syllable (weak-strong pseudowords), which suggested that this age group was sensitive to prosody changes when learning new words.

In addition, statistical analysis was carried out between the infants' performance during the experiment and the 'Oxford Communicative Developmental Inventory' questionnaire (Hamilton et al., 2000). The statistical analysis revealed that there was a very weak positive correlation between performance and vocabulary size, which suggested that the more words an infant knew, the better their performance would be during a task where the infant was required to learn two phonetically similar pseudowords.

Further statistical analysis was carried out between the present study and the previous 20-month-old infants word-initial consonant contrast study carried out by De'Ath, Prior and Dewing. When investigating whether these infants were able to learn two phonetically similar pseudowords that differed by a word-initial consonant, the statistical analysis revealed that there was no significant difference, which suggested that both age groups were performing at an equal level. When investigating prosody recognition, the statistical analysis revealed that there was no significant difference between the two age groups, which suggested that the age groups were performing at an equal level.

Statistical analysis was also carried out between the present 25-month-old infants word-initial consonant contrast study and a previous 23-month-old infants word-medial consonant contrast study carried out by Seward and Denton (however, this analysis was treated with caution as there was a two month age gap between the infants used in each study). When investigating whether these infants were able to learn two phonetically similar pseudowords, the statistical analysis revealed that there was no significant difference between the consonantal contrast being in a word-initial position or a word-medial position, which suggested that these infants performed at an equal level across both studies. When investigating weak-strong stress pattern recognition, the statistical analysis revealed that there was no significant difference between the two studies, which also suggested that these infants were performing at an equal level. However, when investigating strong-weak stress pattern recognition, the statistical analysis found that there was a significant difference between the two studies, which suggested that strong-weak pseudowords were better identified when the consonantal contrast was in the word-initial position, as opposed to a word-medial position.

The results from the present study did not appear to support the previous work by Jusczyk and Aslin (1995) and Mani and Plunkett (2007). Both Jusczyk and Aslin (1995) and Mani and Plunkett (2007) found that young infants were sensitive to word-initial mispronunciations in familiar words, which suggested that these infants

representations of familiar words were phonetically specified. This research led to the question, would infants be sensitive to consonantal contrasts in pseudowords? The present study found that 25-month-old infants could not learn two phonetically similar pseudowords that differed by a word-initial consonant, which suggested that this age group were not sensitive to consonantal contrasts and also suggested that this age group representations of pseudowords were not specified by consonants.

In addition, the results from the present study did not appear to support the previous work by Nazzi (2005). Nazzi (2005) found that 20-month-old infants could learn two phonetically similar words, which had a consonantal contrast that was either in a word-initial position or a word-medial position, suggesting that this age group did use phonetic specificity when learning new words. However, the present study found that 25-month-old infants were unable to learn two phonetically similar pseudowords, which had a consonantal contrast in a word-initial position. This was also the case in the study carried out by Seward and Denton, who found that 23-month-old infants could not learn two phonetically similar pseudowords, when the consonantal contrast was in a word-medial position. Therefore, the present study suggested that infants may not use consonantal specificity when learning new words.

Furthermore, the results from the present study did not appear to support the previous work by Havy and Nazzi (2009), Nazzi and New (2007) and Werker et al. (2002). In their research, they found that 16-month-old infants (Havy & Nazzi, 2009), 17-month –old infants (Werker et al., 2002) and 20-month-old infants (Nazzi & New, 2007; Werker et al., 2002) were all sensitive to consonantal contrasts that involved articulatory phonetics. However, the present study found that 25-month-old infants were not sensitive to a consonantal contrast that differed by a place of articulation feature or a voicing feature, which supported the previous work carried out by Hallé and de Boysson-Bardies (1996), Pater et al. (2004) and Werker et al. (2002). In their research, they found that 11-month-old infants (Hallé & de Boysson-Bardies, 1996) and 14-month-old infants (Pater et al., 2004; Werker et al., 2002) were not sensitive to articulatory phonetic features, which suggested that place of articulation features and voicing features were not fully integrated into their phonological system at this age. Therefore, the implications suggested by Hallé and de Boysson-Bardies (1996), Pater et al. (2004) and Werker et al. (2002) could be applied to the results found within the present study, leading to the suggestion that 25-month-old infants did not use articulatory phonetics features when learning new words, as this age group had not yet acquired the skills necessary to encode the fine phonetic details.

The results from the present study also did not appear to support the work carried out by Vihman et al. (2004). In their study, they found that 11-month-old infants were not sensitive to prosody changes, as the infants showed no difference in looking time between stressed familiar words and mis-stressed familiar words. However, the present study found that 25-month-old infants performed better when the phonetically similar pseudowords were stressed on the first syllable (strong-weak pseudowords), as opposed to the second syllable (weak-strong pseudowords). This result therefore suggested that 25-month-old infants were sensitive to prosody changes, which in fact supported the previous work carried out by Jusczyk et al. (1999). In Jusczyk et al.'s (1999) study they found that 7½-month-old infants were sensitive to prosody change, as their results suggested that this age group were able to respond better to strong-weak words, as opposed to weak-strong words.

Lastly, the results from the present study did not appear to support the second study carried out by Vihman et al. (2004). Vihman et al. (2004) found that 11-month-old English learning infants were unable to recognise the familiar word when the onset consonant of the accented syllable was changed, yet were able to recognise

the familiar word when the onset consonant of the unaccented syllable was changed. However, the present study found that 25-month-old infants were able to recognise strong-weak pseudowords, which had a word-initial consonant contrast. This result therefore supported the original hypothesis put forward by Vihman et al. (2004) that English learning infants should be sensitive to strong-weak patterned words, as the English language used a majority of trochaic words.

One criticism of this study was with regards to using a laboratory environment known as the Babylab. The Babylab is dedicated to studies investigating infants' language development and enables this research to be carried out under controlled conditions. However, in real life, infants do not learn words presented in isolation, but tend to learn words heard in fluent speech. Therefore, this may have lowered the external validity of the current study, as the results could not be fully generalised to a real-life situation. This problem could be overcome in future research by investigating whether infants could identify phonetically similar pseudowords in fluent speech, using a procedure similar to Jusczyk and Aslin (1995), who investigated the recognition of familiar and unfamiliar targets words in fluent speech.

Another criticism of the present study was that of the number of participants used. The Babylab database only had a limited number of 25-month-old infants available during the time period that the study was carried out in and even then, not all families were available to attend the Babylab, in order to participate in the present study. This led to the present study being carried out with only 27 participants, which lowered the external validity of the research, as it can not be said with certainty that the results gathered would generalise to the wider population. This problem could be overcome in future research by using a larger sample size, which would be more representative of the wider target population.

A further criticism of the current study was with regards to including data from the infants who failed the practice trials. The practice trials were an opportunity for the infants to learn and gain understanding into the requirements of the task. Therefore, if the infant was unable to complete the practice trial, it suggested that they did not fully understand the requirements of the task. Consequently, this reason could possibly explain why the present study did not support previous research (such as Havy & Nazzi, 2009; Nazzi, 2005; Nazzi & New, 2007; and Werker et al., 2002). Therefore, in future research, this problem could be overcome by only including data from infants who successfully completed the two practice trials.

Another criticism of the present study was with regards to the actual practice trials. Firstly, the idea of the practice trials was to use familiar objects, which the infants could recognise and easily differentiate between. However, the difficulty found in the present study was that these familiar objects were too familiar to the infant. Once the infant was given an opportunity to look at the familiar object, it took a great deal of persuasion by Experimenter One to obtain the familiar object back from the infant, in order to continue with the practice trial. This problem could be overcome in future by either using less stimulating familiar objects (e.g. wooden bricks, stickle bricks, plastic rings, shape sorter objects, etc) or by only showing the infant the object (as opposed to allowing the infant to hold the object). A second criticism with the practice trials was that both practice trials used animal objects (the first practice trial used a pig and a cow, whereas the second practice trial used a dog). Therefore the use of animals in both practice trials may have confused the infants, due to an animal object being the correct object to select in the first trial, which may have led the infants to think that the animal object (the dog) was the correct object to pick in the second trial. This problem could be overcome in future

by using objects that could not be classified into the same category (e.g. a wooden block and a plastic ring).

A further criticism of the current study was with regards to the type of pot, which was used for placing the selected objects inside. The pot that was used in the present study had a lid, which caused some infants to be distracted, as they were more interested in playing with the lid (e.g. shutting the lid) rather then focusing on the demands of the task. This problem could be overcome in future by using a container that had no additional distracting features, such as lids or handles.

A final criticism of the present study was with regards to including data from the infants who showed a bias towards selecting objects on one side only (a primacy or recency effect). One explanation of this bias could be that the infants genuinely thought these objects corresponded with the target object. Whereas another explanation could be that the infants did not fully understand the task, due to being praised for their object selection, regardless of whether the answer was correct or incorrect. Therefore, if the infants incorrectly chose an object, they were still praised, which led the infants to believe that they were correctly completing the task, as they were not educated to the contrary. Consequently, this may have caused a bias towards selecting objects on one side, as for example, if the infant selected an object on the right hand side during four consecutive trials and was positively praised for these four selections, they would be more likely to choose the right side object during the fifth trial. This problem could be overcome in future research by only including data from infants who rotated between both object selection sides.

In future, it would be useful to replicate the present study, but this time incorporating the ideas that have been put forward to resolve the limitations (such as gaining a larger sample size and using less stimulating familiar objects during the practice trials). This may enable psycholinguistic researchers to better investigate the role of consonants when studying the effects of word-initial consonant contrasts, articulatory phonetics and prosody in young infants' lexical acquisition and may produce findings similar to previous research (Havy & Nazzi, 2009; Nazzi, 2005; Nazzi & New, 2007; Vihman et al., 2004; Werker et al., 2002).

In addition, future research could also replicate the present study, but this time focusing on vowel contrasts (as opposed to consonantal contrast) within word-initial contrasts, articulatory phonetics (e.g. changing the vowels roundness or height) and prosody. This research on vowel contrasts could then be compared to the research on consonantal contrast, in order to investigate further whether vowels and consonants play different roles within language acquisition, as proposed by Nespor et al. (2003, as cited in Nazzi & Bertoncini, 2009).

In conclusion, the present study appeared to show that 25-month-old infants were unable to learn two phonetically similar pseudowords that differed by a consonantal feature, which suggested that this age group were insensitive to consonantal contrasts. In addition, the present study appeared to show that 25-month-old infants were unable to able to distinguish between word-initial contrasts that had a place of articulation feature or voicing feature, which suggested that this age group were not sensitive to consonantal contrasts involving articulatory phonetics. However, the present study did find that 25-month-old infants recognised a greater number of strong-weak pseudowords, in comparison to weak-strong pseudowords, which suggested that this age group was sensitive to prosody change when learning new words.

References

Barrett, M. (2001). *The Development of Language*. East Sussex: Psychology Press Ltd.

Carroll, D. (2008). *Psychology of Language*. London: Thomson Wadsworth.

Hallé, P., & de Boysson-Bardies, B. (1996). The Format of Representation of Recognized Words in Infants' Early Receptive Lexicon. *Infant Behavior and Development*, *19*, 463-481.

Hamilton, A., Plunkett, K., & Schafer, G. (2000). Infant Vocabulary development assessed with a British Communicative Development Inventory: Lower scores in the UK than the USA. *Journal of Child Language*, *27*, 689-705.

Havy, M., & Nazzi, T. (2009). Better processing of consonantal over vocalic information in word learning at 16 months of age. Retrieved 20/Mar/09 from: http://lpp.psycho.univ-paris5.fr/pdf/2464.pdf

Jusczyk, P., & Aslin, R. (1995). Infants Detection of the Sound Patterns of Words in Fluent Speech. *Cognitive Psychology*, *29*, 1-23.

Jusczyk, P., Houston, D., & Newsome, M. (1999). The Beginnings of Word Segmentation in English-Learning Infants. *Cognitive Psychology*, *39*, 159-207.

Mattys, S. (2000). The perception of primary and secondary stress in English. *Perception & Psychophysics*, *62 (2)*, 253-265.

Mani, N., & Plunkett, K. (2007). Phonological specificity of vowel and consonants in early lexical representations. *Journal of Memory and Language*, *57*, 252-272.

Nazzi, T. (2005). Use of phonetic specificity during the acquisition of new words: differences between consonants and vowels. *Cognition*, *98*, 13-30.

Nazzi, T., & Bertoncini, J. (2009). Consonant specificity in onset and coda positions in early lexical acquisition. Retrieved 20/Mar/09 from: http://lpp.psycho.univ-paris5.fr/pdf/2288.pdf

Nazzi, T., Floccia, C., Moquet, B., & Butler, J. (2009). Bias for consonantal over vocalic information in 30-month-olds: Cross-linguistic evidence from French and English. *Journal of Experimental Child Psychology*, *102*, 522-537.

Nazzi, T., & New, B. (2007). Beyond stop consonants: Consonantal specificity in early lexical acquisition. *Cognitive Development*, *22*, 271-279.

Pater, J., Stager, C., & Werker, J. (2004). The Perceptual Acquisition of Phonological Contrasts. *Language*, *80 (3)*, 384-402.

Vihman, M., Nakai, S., DePaolis, R., & Hallé, P. (2004). The role of accentual pattern in early lexical representation. *Journal of Memory and Language*, *50*, 336-353.

Werker, J., Fennell, C., Corcoran, K., & Stager, C. (2002). Infants' Ability to Learn Phonetically Similar Words: Effect of Age and Vocabulary Size. *Infancy*, *3 (1)*, 1-30.

Appendices for this work can be retrieved within the Supplementary Files folder which is located in the Reading Tools menu adjacent to this PDF window.