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An investigation into the relationship between an individual's level of hypnotic suggestibility and their ability to engage in ideomotor action

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Abstract

The relationship between hypnotic suggestibility and a propensity to engage in ideomotor action was investigated in 36 participants from the city of Plymouth, 24 of whom were psychology undergraduates from the University of Plymouth. Each participant carried out three hypnotic suggestibility tests before carrying out two computer-based ideomotor action tasks: a Brass finger-release task and an action-planning task. It was found that the higher a person's hypnotic suggestibility, the faster they completed ideomotor tasks such as compatible trials in the Brass task ($r = +.37$, $n = 27$, $p < .05$) and the inverse action planning trials ($r = +.35$, $n = 27$, $p < .05$). This suggests that the reason why some people are more susceptible to hypnotic suggestion than others is because they are able to engage more readily in ideomotor action.

Preface

This study was completed in keeping with ethical guidelines for psychological research involving human participants and received full ethical clearance. The researchers involved in this study followed the standard procedure for carrying out psychological research and made sure that: all participants were briefed, had signed a consent form, were informed of their right to withdraw at any point during or after the study, and that they were fully debriefed at the end of the experiment. The participants were also given contact details for the researchers as well as the principle investigator so that they would be able to raise any questions about the research or request their data be removed from the study at any stage after completing the experiment. All data were kept completely confidential and no information that could be used to identify individual participants was put into the write-up of the study. The signed consent forms were placed in a sealed envelope following completion of analysis.

Of the 36 total participants, I personally collected data from 20 and the remaining 16 were tested by my research partner Natasha Chatfield. Both researchers tested participants in the same way and results were compiled following completion of data collection.

Introduction

“We think the act and it is done...that is all that introspection tells us on the matter.” These words by James (1890) explain in simple terms, what is meant by the phrase ‘ideomotor action’; that is, the process by which a mental representation of an action produces a subsequent muscular reaction that requires little or no effort (Stock & Stock, 2004). Ideomotor action occurs when activation of a representation of a specific behaviour within the brain leads to a tendency to complete this behaviour without an individual necessarily being consciously aware of having done so (Forgas & Williams, 2001). Have you ever found that when carrying a full cup of tea you tend to spill it no matter how many times you tell yourself “don’t spill this, don’t spill this”? This is an example of ideomotor action that we might all be familiar with, whereby the dominant recurring thought of spilling the drink leads to the production of actions that in turn result in triggering the spill which was wished so desperately to be avoided (Wegner, Ansfield & Pilloff, 1998). You could liken this experience to that resulting from a hypnotic suggestion in which elicited behaviours are experienced as being outside of the executor’s control (Barnier, Dienes, & Mitchel, 2008).

The discovery of the ideomotor effect is attributed to Laycock (1845) who studied patients with Hydrophobia (Rabies). After discovering that the mere suggestion of having to drink was enough to induce behaviours consistent with those experienced when hydrophobic individuals are actually presented with a drink of water (“spasms of the respiratory muscles and gasping” (Laycock, 1845)), Laycock concluded that a simple thought could be enough to initiate reflexive responses (Laycock, 1845). However, as Laycock’s research was limited to work with hydrophobia patients, it is difficult to infer from this research alone, whether the theory of ideomotor action can be generalised to the human population as a whole or whether it is a phenomenon limited to those who suffer from Rabies. This limitation also led Laycock to fail to connect his theory to possible voluntary actions (such as instinctively reaching to

flick on a light switch after simply imagining the room becoming lighter) and instead he regarded the responses as purely cerebral reflex actions due to the fact that hydrophobic individuals have no control over any of their actions (Stock & Stock, 2004).

Laycock's original research was developed by Carpenter (1852) who did not study hydrophobic individuals, which provides some evidence for the ecological validity of Laycock's original theory. Carpenter's theory of ideomotor action was spawned from his research into the potential psychological explanations of the popular occult phenomena of his time, such as Table Turning and 'the Magical Pendulum' (Stock & Stock, 2004). Carpenter claimed that when an individual's mind is occupied with the ideas that have been suggested to them, their body is influenced by them to such an extent that their actions appear to be out of their control. He went on to state that, unlike what many enthusiasts and operators of these popular phenomena asserted to be true, the individuals' actions are not under the control of another being but that they are entirely directed by the ideas placed in their minds, without the individual even being aware of it (Carpenter, 1852). This led Carpenter to devise the term 'ideomotor' as the '*motor*' activity results from the incentive of dominant '*ideas*' (James, 1890).

Carpenter's theory about the underlying psychological causes of these paranormal phenomena were supported by Faraday (1853) who attempted to discover the cause of the table's movements within the phenomenon of 'table turning'. In order to discover whether the source of the movements was indeed the 'sitters' (the subjects who sat around the table and who were given the suggestions of how the table would move) as he supposed, Faraday attached five sheets of card to each other with a small amount of adhesive (that would still allow the sheets to slide over one another) and adhered these to the table top. Each sheet of card was slightly bigger than the one below which allowed a mark to be drawn across the underside of each sheet, marking its' original position. Faraday determined that if the table was the cause of the movements, it would move first and would drag the sheets of card with it from bottom to top resulting in the marked line sloping outwards in the opposite direction of the table's movements. However, if the "sitter" was the origin of the table's movements, the top sheet of card would move first, followed by the other sheets and then the table. This would be shown by the line on the underside of the sheets of card sloping in the same direction as the movements. As he expected, Faraday found that the cause of the table's movements were, in fact, the sitters' own actions of pushing the table with their fingers, in the anticipated direction (Hyman, 1999).

Faraday's findings show support for Carpenter's theory of ideomotor action as, despite the cause of the table's movements being found to be the sitters' own actions; they themselves were unaware that they had been pushing the table in the expected direction (Faraday, 1853). This suggests that a simple idea such as "the table will begin to move to the left" alone, is enough to cause an individual to unconsciously direct their actions towards achieving the desired outcome by pushing the table to the left. Despite the support of Faraday, Carpenter's theory is, like Laycock's, limited in the sense that it focuses solely on Occult phenomena, just as Laycock's original research was limited to Hydrophobia patients. These limitations could lead to ideomotor actions mistakenly being categorised as being unintentional

as neither Laycock or Carpenter have attempted to account for voluntary actions being triggered automatically from an idea.

The work of Carpenter does however provide some insight into the potential link between an experience of ideomotor action and the effects of hypnotic suggestion. This can be seen in the fact that he investigated occult phenomena such as the 'magical pendulum' which is a test used to detect a person's suggestibility. The pendulum illusion was developed by Chevreul (1833) who found that a simple pendulum suspended by from a person's finger tips would, when a person simply imagined it moving, begin to oscillate in the direction specified by the investigator. The individuals who carried out this task were unaware that the sole cause of the pendulum's movements were their own imperceptible muscular movements and instead believed that the pendulum acted of its own accord (Easton & Shor, 1975).

James (1890) was the first to develop a combined theory of ideomotor action which drew upon the ideas of Laycock and Carpenter, as well as the German theorists such as Herbart (1825). James adopted Carpenter's term 'ideomotor' for his theory as he agreed that it combined the elements of the theory "the driving force of the dominant idea and the resulting motor activity" (Spitz, 1997) effectively. He did not however agree with Carpenter on his idea that ideomotor theory can only be applied to situations where a person's free-will is limited, such as within occult settings. James (1890) made the connection between ideomotor theory and voluntary action, stating that all actions that we carry out every day should be considered as being ideomotor actions (James, 1890). An example of James' ideomotor theory of voluntary action could be the flicking on of a light switch when we enter a dimly lit room. We instinctively reach for the light switch without having to actively think about what we are doing, the idea of wanting the room to become lighter is, in itself, enough to trigger the necessary actions required to achieve this goal.

Evidence for James' theory of ideomotor action has been found in recent brain imaging studies which have shown that merely imagining an action can lead to activation of the areas of the motor cortex associated with action implementation. One such study was carried out by Wagner et al (2011) who found that smokers showed greater activity in left anterior intraparietal sulcus and inferior frontal gyrus, both of which are brain regions involved in the activation of contralateral hand gestures (e.g. raising a cigarette to your mouth), when they watch scenes of a person smoking (Wagner, Dal Cin, Sargent, Kelley & Heatherton, 2011). Further evidence for this theory has been found in a study by Jacobson (1929) who discovered evidence of 'action currents' in participants' arms when they were instructed to imagine they were bending it but told explicitly not to bend it. These currents remained for the duration that the participant imagined making the movement and terminated as soon as they stopped imagining the movement (Jacobson, 1929 as cited in Eysenck, 1943).

Brass et al also attempted to test this link between movement observation and movement execution through the use of a stimulus-response paradigm (Brass, Bekkering, Wohlschläger & Prinz, 2000). Their study was based on the premise set out by Greenwald (1970) that a mental response image is used to mediate action control in that when a perceived event is similar to a known response image, the perception of the event should alone, activate the response (Brass et al, 2000).

Brass et al (2000) found that when a stimulus had a high degree of ideomotor compatibility (that is, it relates well to a known response image) it profoundly decreased the participants' response times. However, this does not mean that they made fewer mistakes, Brass et al also found that when a stimulus was compatible with a response image (the stimulus displayed was the same as the expected response action) the correct response was activated, whereas when a stimulus was incompatible with the response image (the stimulus displayed was not the same as the expected response action), the participant's displayed an interference effect and the incorrect response was activated (Brass et al, 2000).

The above experimental evidence would therefore suggest that it is the idea of carrying out an action oneself and the action's learned sensory consequences that creates the action pattern needed to achieve our desired goals (Koch & Kunde, 2002). For this to occur, the outcomes of certain actions must have already been learned, if they have not previously been learned, the body cannot follow the mind's ideas of consequences to produce a habitual, unconscious action (Baars, 1992). An idea alone has no ability to generate an action unless there are substantial physiological connections between actions and outcomes formed "as a consequence of use" (Thorndike, 1912).

James' theory also attempted to explain why not all of our ideas of actions result in us actually carrying them out. James suggested that an action will follow "unhesitatingly and immediately" (James, 1890) from an idea of it in the mind, unless it meets with opposition from another conscious thought in which case the inhibitory ideas would prevent each other from being carried out (Baars, 1992, Stock & Stock, 2004). This could be also used to explain why some people are more susceptible to hypnosis than others, as many hypnosis techniques require ideomotor action in order for them to take effect. Using James' ideomotor theory (1890), it can be suggested that some individuals are more susceptible to hypnotic suggestions than others as they are unable to counter the ideomotor action effects with inhibitory ideas. On the other hand, those who are less susceptible to hypnotic suggestions are able to inhibit the suggested actions and thus reduce the ideomotor action effects. If an individual is not suggestible, they would likely inhibit the 'suggestion idea' with one of their own, such as "I don't want to do that" whereas, in a highly suggestible individual, this inhibitory idea would not be present and thus the ideomotor action effect is allowed to take place.

In order to test this hypothesis, the current study, investigated the relationship between hypnotic suggestibility and ideomotor action by using a series of hypnotic suggestibility tests and two ideomotor action tasks: a Brass finger-release task and a 'forward/inverse action-planning' task. It could be suggested that people who are highly susceptible to hypnotic suggestion will experience ideomotor action effects more often in their everyday lives than those with low susceptibility. This is likely to be due to the fact that both hypnotic suggestion and ideomotor action require a person to engage in behaviours simply by thinking about them. It is predicted that people who are more susceptible to hypnotic suggestion will complete the compatible Brass task trials and the inverse action planning (ideomotor) scenarios faster than those who are not as susceptible.

An individual's ability to engage in ideomotor action in the action-planning task was tested by asking the participants to respond to unambiguous everyday scenarios. These scenarios were either formed in a way that follows the same process as ideomotor action or in a way that is the opposite. The 'ideomotor scenarios' were known as inverse action planning: as the individual has to work backwards from a goal to an action, and determine whether the action would have achieved the desired goal. Whereas the non-ideomotor scenarios, known as forward action planning scenarios, required the individual to work forwards from an action and determine whether the outcome would follow from the action. It would follow therefore, that a person who often experiences ideomotor action in their everyday lives, would find it easier to answer the inverse action planning scenarios than someone who was not as accustomed to using ideomotor action in their lives and would therefore complete these scenarios much faster.

This study also tested an individual's ability to engage in ideomotor action using a stimulus-response task as outlined by Brass, Bekkering & Prinz (2001). In this measure, a key release action carried out by the participant was controlled by a visual representation of a movement (Brass et al, 2000). The stimuli used in this study were digitised images of a hand presented on a screen which were designed in such a way that they resembled the participants' hand as the participant would see it, as closely as was possible. It is predicted that participants who are utilising ideomotor action should respond much faster to stimuli that are compatible to a learned response than those that are incompatible. This prediction is based on the idea that when presented with an image of a pre-determined response, the ideomotor effect would create the necessary action required to complete this response almost immediately after having seen it without the individual having to be consciously aware of it. It is therefore predicted that those participants who are more susceptible to hypnotic suggestion will be less likely to inhibit ideomotor action effects, and will be faster at completing the ideomotor tasks than those participants who are less suggestible. This means that they should exhibit faster response times within the compatible Brass trials as well as the inverse action planning trials than those participants who are less susceptible to hypnotic suggestion.

Method

Participants

36 participants took part in this study, 24 of whom were undergraduate psychology students who participated as part of a course requirement and were recruited through voluntary sign-ups on the University of Plymouth Participant Pool. Those participants who were not undergraduates in psychology were known to the researchers and were recruited without being offered any sort of reward for completing the experiment. In total there were 15 males and 21 females.

Materials

The instructions for the HIP Eye-Roll test were given to each researcher on a printed sheet which consisted of the instructions to read to the participant and the scale which was to be used to measure their susceptibility in the Eye-Roll test (see appendix A). The personality questionnaire for the HIP was also provided on a printed sheet along with a response sheet for each of the participants (see appendix B).

The instructions for the other hypnosis tests (Head-Roll and Balloon vs. Bucket of Stones) were provided by a trained hypnotherapist in MP3 format which were then played to the participants through the program Windows Media Player (version 12). The scales used to measure participants' susceptibility to these tests were given to the researcher on printed sheets (see appendix C (Head-Roll) and appendix D (Balloon vs. Bucket of Stones))

The Brass Task and Action-Planning computer-based tasks were carried out on a HP Pavilion DV6-2114sa laptop computer or an Asus U35-JC laptop computer both running Windows 7. They were created and presented on a program called Presentation (version 15.0) (a stimulus delivery and experimental control program) that was downloaded from

http://www.neurobs.com/menu_presentation/menu_download/current. The stimuli used for these tasks are available in Appendix E (Brass Task) and Appendix F (Action Planning).

Procedure

This study employed a within-participants design in which all participants were exposed to the same measures, in the same order and in the same setting. Upon arrival at the experiment, participants were provided with a brief which explained the details of the research and informed them of their right to withdraw. Once they had read and agreed to the terms set out in the brief, they were asked to sign a consent form before the experiment commenced.

In the first stage of this experiment, participants were asked to complete a variety of hypnosis tests in order to measure their hypnotic suggestibility. The first of these tests was the Hypnotic Induction Profile (HIP) (Spiegel, 1974) which consisted of an Eye-Roll test and then a personality questionnaire. During this test the participant was asked by the researcher to sit with their head facing forward and, whilst holding their head in that position, to begin to look upwards towards their eyebrows and then to continue looking upwards, towards the top of their head (up-gaze). Once they had completed this they were asked to slowly close their eyes whilst continuing to look upwards (eye-roll). The participants' scores for this test were then measured on a five-point pictorial scale ranging from 0-4 (Spiegel, 1972) (see appendix A) by measuring (by eye) the amount of sclera (white of the eye) that was visible between the lower eyelid and the bottom of the iris.

Once the eye-roll stage of the HIP had been completed, the participants were read the Apollonian-Odyssean-Dionysian Personality Inventory (Spiegel, 1977) questionnaire by the researcher (see appendix B). Their personality was measured in terms of spatial awareness; perception of time; and myth-belief constellation. The participant's responses to the points on the questionnaire were scored as either Apollonian (A); Odyssean (O); or Dionysian (D) and were used to determine which of the three groups the participant belonged to: a highly hypnotizable individual falls within the Dionysian group and would have a high score (4-5) on the HIP whereas a person who does not respond well to hypnotic suggestion would likely belong to the Apollonian group and would show a low score on the HIP (1-2) people who were only mildly responsive to hypnotic suggestion were classified as Odyssean and would typically score around 3 on the HIP (mid-range).

Following this, the participants undertook a Head-Roll measure which was taken from the Harvard Group Test for Hypnotic Susceptibility (HGTHS) (Shor & Orne, 1962). The participant was asked to sit up straight with their head facing forward, and to close their eyes and relax. They were then given the suggestions that their head would begin to fall forwards until it hung limply on their neck. Once the participant had received the full suggestion, they were asked to sit up again and open their eyes. The participants' response to this test was measured during the test by comparing the angle at which their head dropped as a result of the suggestion techniques. Their scores for this part of the test were scored on a five-point scale (based on Spiegel's eye roll scale) which ranged from 0 (no response) to 4 (extreme response) (see appendix C).

Finally the participants were asked to complete a 'Balloon vs. Bucket of Stones' task, in which they were instructed to stand with their feet shoulder width apart with their arms at shoulder height and to close their eyes. They were then told to imagine that they were holding a 'big metal bucket' in their dominant hand and that their other hand was tied to a helium balloon. The participants were given the suggestion that their dominant arm was becoming heavy through being asked to imagine that the bucket was being filled with 'large, heavy stones' as well as the suggestion that their other arm was getting lighter by asking them to imagine that their arm was being pulled up by the balloon. Once a sufficient response was elicited, the participants were asked to open their eyes. Their response to the test was once again measured on a five-point pictorial scale ranging from 0 to 4 (see appendix D).

The participants received the instructions for the Head-Roll and Balloon vs. Bucket of Stones tests by means of a voice recording provided by a trained hypnotherapist (please refer to appendix I (disk)); this ensured that all participants received the instruction in the same way and in the appropriate manner to elicit a response in highly suggestible individuals. In addition, a researcher was present at all times to offer any assistance that the participant required as well as to observe and record the participants' responses to the tasks. At no point were the participants induced into full hypnosis.

Following their completion of the hypnotic tasks, participants moved on to the second stage of the experiment in which they were asked to complete two computer-based tasks. The first of these tasks was a response-time task involving a finger-press measure. To complete this, the participant placed their index and middle fingers on the 'H' and 'J' keys of a computer keyboard and were asked to look at a computer screen upon which pictures of a hand were shown in succession as well as a written instruction for an action (lift index finger when you see a 1 or lift middle finger when you see a 2). In some of the trials the hand was carrying out the same action as the instruction dictated, in others it was doing the opposite. In each trial, the participant viewed a neutral photograph of a hand (all fingers down) for 800ms and then a response photograph (with either middle or index finger lifted up) with a response cue number (1 for index, 2 for middle) shown above the photograph, these were displayed for 2700ms or until participant made a response. There were 120 trials of randomly presented response stimuli, of which there were an equal number for each possible response, once the participant had completed this task, the average response time for the task was recorded by the researcher.

The final task that participants carried out was also a computer-based task investigating their action-planning preference: whether they are faster at responding to inverse or forward-action planning scenarios. This task was set out in an ABAB pattern in which the participant first performed a forward-action planning block (A) of 26 trials before moving on to an inverse-action planning block (B) for 20 trials before repeating the pattern. In the forward-action planning section, the participants were first presented with an 'action' and had to then decide whether the subsequently presented outcome could be attained by carrying out this action or not by pressing the 'Z' key if it would, and 'M' if it would not. In the inverse-action planning section, the participants were presented first with a 'goal' and had to then decide whether the subsequently presented 'action' was suitable to achieve this goal or not by again pressing the relevant keys. Each trial of this task was presented in the same way: there was a fixation cross displayed for 500ms followed by a black screen (also displayed for 500ms). Following this, the participants were shown the first line of the scenario for 1200ms and then the second line also for 1200ms (this line either displayed an 'action' (forward action planning) or a 'goal' (inverse action planning)). This was then replaced by a third line of text (either an outcome (forward) or an action (inverse) which remained on the screen for a maximum of 2600ms or until the participant made a response. This measure was used to establish whether a participant found it easier to engage in inverse-action planning over forward-action planning by monitoring the condition in which they made faster decisions.

Once the participants had completed these tasks they were debriefed by the researcher and were also given a printed handout of the debrief which contained the contact details for both researchers as well as the principle investigator. The participants were once again reminded of their right to withdraw and were informed that if they had, at any point, any questions about the research or if they wanted their data removed from the study, they should not hesitate to contact one of the people listed on their debrief. Copies of the brief and debrief are given in appendix G and appendix H respectively.

After all the data had been collected, they were entered into a Microsoft Excel spreadsheet document. At this stage, any participants who displayed an error rate of above 15% on either the Brass task or the action-planning task had their data removed as it would indicate that they were not paying full attention to the task or they had not taken the experiment seriously. In order to determine whether a participant was faster in the forward or inverse action planning scenarios, the remaining participants' scores for the inverse planning task were subtracted from their scores for the forward planning task. In this way, a positive number indicated that they were faster in inverse planning trials whereas a negative number indicated that they were faster in forwards planning trials. In order to determine whether a participant was faster in the compatible trials or the incompatible trials in the Brass task, their score for the compatible trials was subtracted from their score for the incompatible trials. In this way, as with the action planning, a positive score meant that they were faster in the compatible trials than in the incompatible trials.

The results of the remaining participants were then subjected to a z-ratio analysis in order to standardise the scores to account for variability in results that could have arisen from individual differences, testing location and experimenter differences. These standardised scores were then used to carry out Pearson correlational analyses in order to determine the strength of the relationship, if any, between the

measures of hypnotic suggestibility and ideomotor action. Following this, as HIP has been shown not to correlate well with other measures of hypnotisability, all participants' scores for the HIP were removed and the remaining data were re-analysed as outlined above.

Two-tailed repeated measures t-tests were also carried out to see whether there was a significant difference between participants' response times in the two action-planning conditions and also to see whether there was a difference in the time taken to complete compatible trials and incompatible trials of the Brass task.

Results

The mean and standard deviation for the time taken to complete the two action-planning conditions are given in Table 1.

Table 1: Mean and standard deviation for forward and inverse action planning scores

	<i>M</i>	<i>SD</i>
Forward action planning	889.63	186.57
Inverse action planning	931.40	189.31

The results in Table 1 show that on average, participants were faster at forward action planning than inverse action planning. A two-tailed repeated measure t-test revealed this difference to be significant ($t(25) = 2.81$, $p = .009$).

Table 2: Mean and standard deviation for compatible and incompatible Brass Task scores

	<i>M</i>	<i>SD</i>
Compatible	409.87	48.45
Incompatible	464.69	63.65

The results in Table 2 show that participants were also faster in the compatible trials of the Brass task than they were in the incompatible trials. A two-tailed repeated measures t-test revealed that this difference was also significant ($t(25) = 8.94$, $p < .001$).

Table 3: Cross-correlations between tasks (HIP included)

	<i>r</i>
Brass/action	.37
Brass/hypnosis	.34
Action/hypnosis	.24

From the above table it can be seen that all correlations show a positive relationship which indicates that the effect of hypnotic suggestibility on the ability to engage in ideomotor action was in the direction predicted.

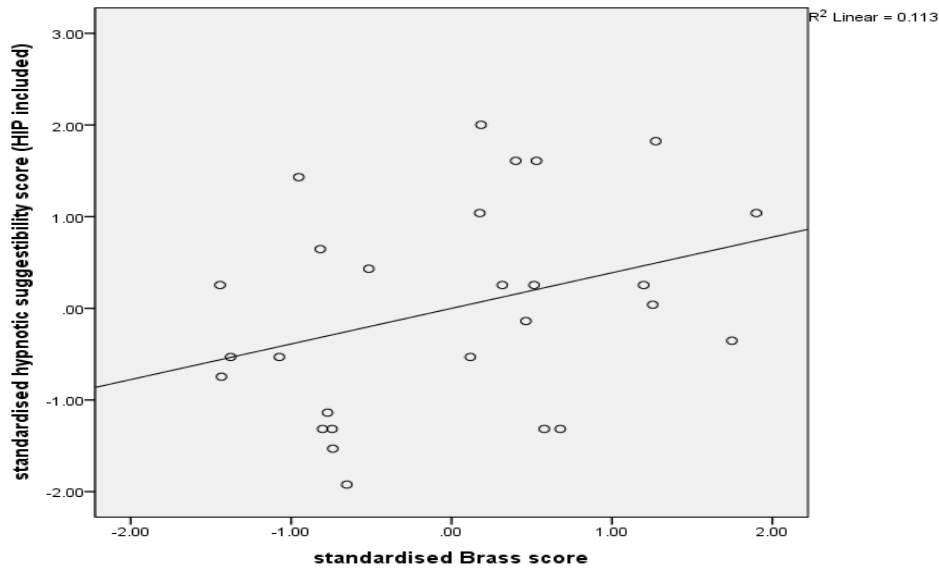


Figure 1: Scatterplot showing the relationship between hypnotic suggestibility and participants' Brass task score ($n = 27$)

The data in figure 1 show a linear positive relationship. A Pearson correlation showed this relationship to be statistically significant, $r = +.34$, $n = 27$, $p < .05$, one-tailed.

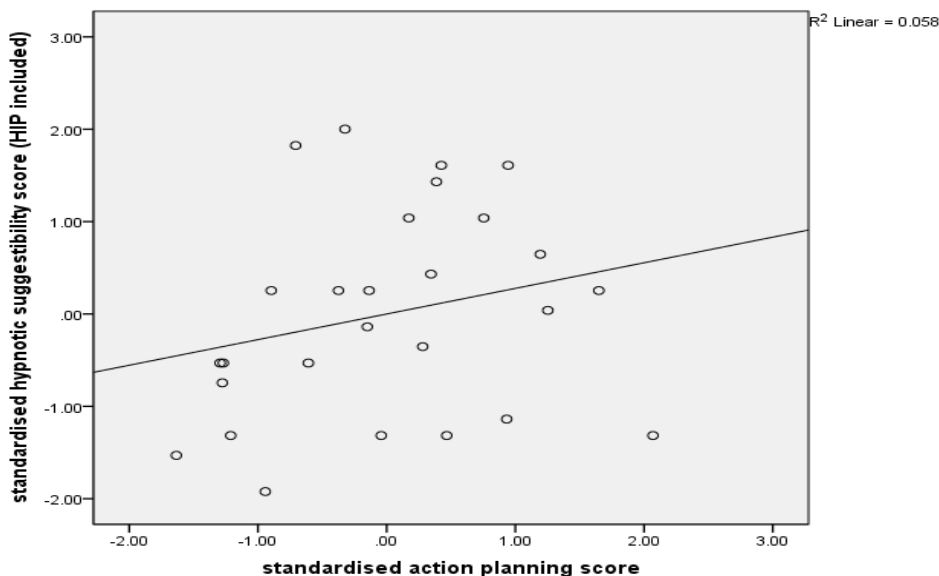


Figure 2: Scatterplot showing the relationship between hypnotic suggestibility and participants' action planning scores ($n = 27$)

The data in figure 2 also show a general linear positive relationship, a further Pearson correlation did not however reveal this relationship to be statistically significant, $r = +.24$, $n = 27$, $p = .114$, one-tailed.

Table 4 shows the correlations between the measures after the scores for the HIP were removed from the analysis.

Table 4: Cross-correlations between tasks (HIP removed)

	<i>r</i>
Brass/action	.37
Brass/hypnosis	.37
Action/hypnosis	.35

From the above table, one can see that by removing the HIP from the analysis, the correlations between the measures have improved somewhat and that the relationships still appear to be in the predicted direction.

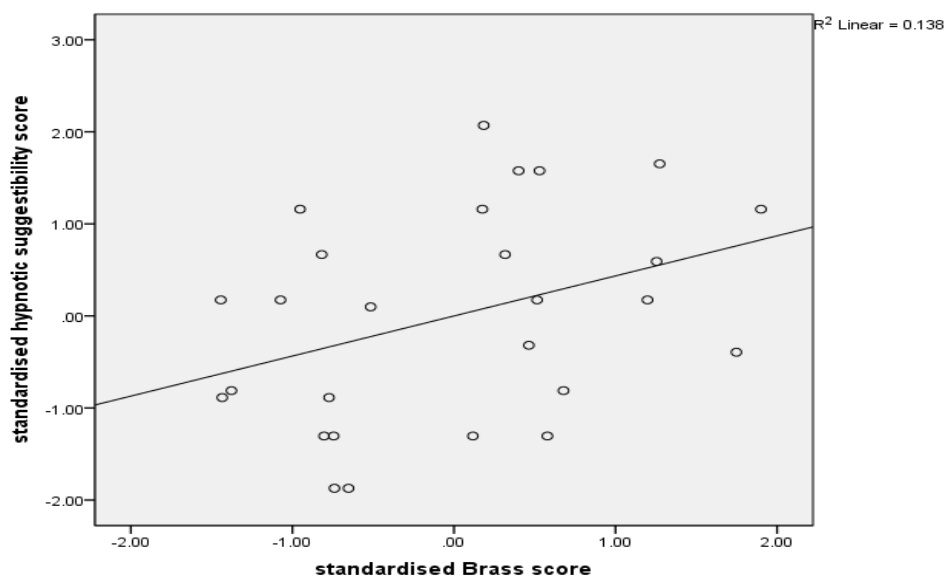


Figure 3: Scatterplot showing the relationship between hypnotic suggestibility and participants' scores for the Brass task, with HIP scores removed (n=27)

Figure 3 shows that even with HIP scores removed from analysis; there remains a linear positive relationship between hypnotic suggestibility and participants' Brass task performance. A Pearson correlation revealed this relationship to be statistically significant, $r = +.37$, $n = 27$, $p < .05$, one-tailed.

Figure 4 shows that there is still a linear positive relationship between hypnotic suggestibility and action planning and a Pearson correlation showed that without HIP, this relationship is statistically significant, $r = +.35$, $n = 27$, $p < .05$, one-tailed. The relationship between standardised action planning and Brass task performance scores also showed a positive relationship and a Pearson correlation revealed that this relationship was significant, $r = +.37$, $n = 27$, $p < .05$, one-tailed. This relationship would indicate that the action planning task is an appropriate measure of an individual's propensity to engage in ideomotor action as it shows a significant correlation with an existing measure. This linear positive relationship is shown in Figure 5 below.

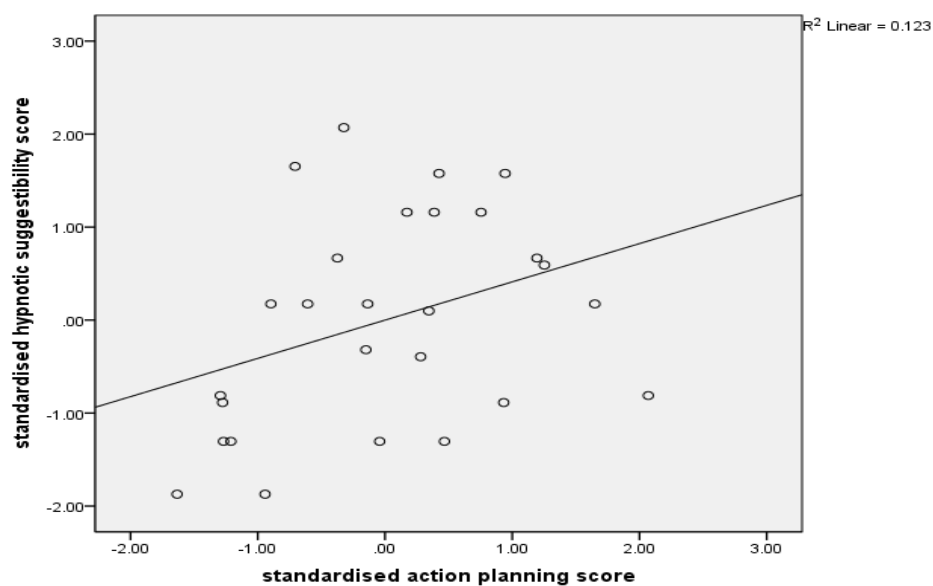


Figure 4: Scatterplot showing the relationship between hypnotic suggestibility and participants' action planning scores with HIP removed.

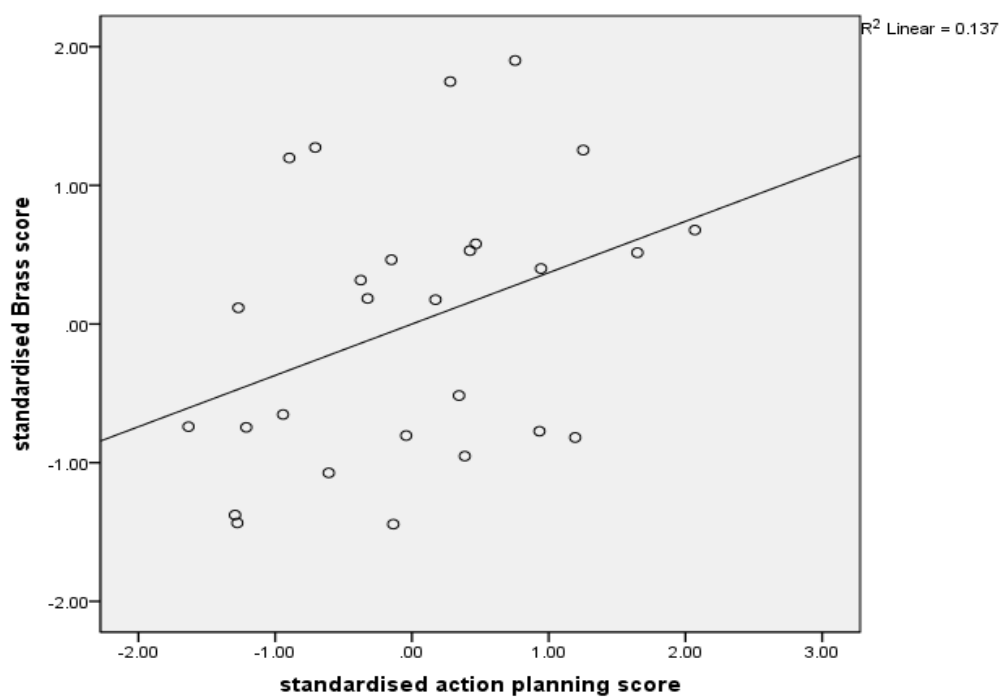


Figure 5: Scatterplot showing the relationship between a participants' Brass task scores and action planning scores.

Discussion

The relationship between a person's hypnotic suggestibility and their likelihood to engage in ideomotor action was shown to support the hypothesis that the more suggestible a person is, the faster they will complete tasks that have a high ideomotor action compatibility, such as the compatible trials of the Brass task and the inverse action planning trials of the action planning task. There were significant positive correlations found between a person's hypnotic suggestibility and their scores for the Brass task both with HIP scores included in and excluded from the analysis. This supports the previous findings of Brass et al (2000) that people perform faster in ideomotor compatible trials than they do in incompatible trials. However, a significant relationship between the participants' scores action-planning tasks and their hypnotic suggestibility was only found when the HIP scores were removed from the analysis. This could be explained using the findings of previous research which has shown that the Eye-Roll test of the HIP does not correlate strongly with other measures of hypnotic susceptibility (Orne et al, 1979), this research found that when the hypnotic induction factor of the HIP was removed from analysis, the eye-roll test only presented a correlation of .08 which suggests that the eye-roll test is not a valid measure of hypnotic suggestibility (Orne et al, 1979).

With the removal of the HIP from the analysis, a significant relationship was found between hypnotic suggestibility and standardised action-planning scores which affords support for the experimental hypothesis as it suggests that people that score more highly on hypnotic suggestibility scales complete inverse action planning tasks faster than those who are not as highly suggestible and faster than forward action planning tasks. A reason for this effect could be that inverse action planning tasks follow the same principles as ideomotor action in that it is the imagined end goal that elicits an action that is appropriate for attaining this goal. Highly suggestible people that are adept at utilising ideomotor action in their daily lives should be able to use the presented goal within the inverse action planning scenarios to mentally perform the action needed to attain this goal, and thus respond faster than those individuals that do not usually experience ideomotor action effects.

The findings outlined above would indicate that individuals that are more highly suggestible to hypnosis are more likely to be able to engage in ideomotor action than those who are not as highly suggestible. Yet, from the results found in this study, it is not possible to determine the direction of this relationship: it cannot be concluded whether a person is more hypnotisable because they engage more readily in ideomotor action or whether they engage in ideomotor action more readily because they are more suggestible. Further research into this field could attempt to overcome this by using ideomotor action tasks in an attempt to make people more susceptible to hypnotic suggestion. If it is possible to make people more suggestible by training them to use ideomotor action, it could then be suggested that it is an ability to engage in ideomotor action that causes some people to be more hypnotisable than others and not hypnotic suggestibility that leads to a person being more likely to utilise ideomotor action in their daily lives.

Despite the significant relationships found between hypnotic suggestibility and ideomotor action, it could be argued that the hypnotic suggestibility tests utilised by this study may not be a valid measure of suggestibility. This can be seen in the fact that the measures used were only improvised measures that have not previously

been tested on an experimental level with existing measures of suggestibility to ensure that they do measure what they intend to measure. Future research should attempt to counter this limitation by testing suggestibility using standardised measures of suggestibility such as the Carleton University Responsiveness to Suggestion Scale (CURSS) (Spanos, Radtke, Hodgins, Bertrand, & Stam, 1981) or the Harvard Group Measure of Hypnotic Suggestibility (Shor & Orne, 1962). If a relationship between suggestibility and ideomotor action measures is still present, it would serve to provide more substantial support for the findings of the current study. However, the standardised measures of suggestibility recommended are not without their own limitations, for example they contain large volumes of items that are not related to ideomotor suggestion which could prevent a significant relationship from being detected.

It could also be argued that the hypnotic suggestibility scores for the participants may not have been an accurate measure of the individuals' suggestibility as they were not collected by trained hypnotherapists (although the audio files used were). Therefore, future research should attempt to have the data for the suggestibility measure be collected by someone that is trained in hypnotherapy so that they can more accurately recognise the level of response exhibited by participants and therefore provide a more accurate understanding of each participant's hypnotic suggestibility.

Another potential limitation of the hypnosis measures used in this study is that the tasks were very long (ranging from three to nine minutes in duration). This meant that many of the participants found it hard to remain focused on the tasks (in particular the Balloon vs. Bucket of Stones measure) for the duration. In this case, the response that the task elicited in the participants may not have been indicative of their actual suggestibility. On one particular occasion during the Balloon vs. Bucket of stones, a participant was observed lowering their arms, stretching and then once again placing their arms in their original position. This would indicate that in order to obtain a true indication of an individual's hypnotic suggestibility, future research should ensure that the measures of suggestibility used do not require a participant to stand or sit in an uncomfortable position for a long period of time as this could cause them to lose focus on the task and could therefore result in inaccurate recordings of their suggestibility. A delayed re-test could also be carried out which would highlight any obvious differences between participants' scores in the initial test and their scores on the re-test. This would allow the investigator to determine which participants may not have been paying full attention to the task in the initial tests and thus their data can be removed from the analysis so that it does not affect the significance of any relationship found between measures.

It was also found that in general, participants performed significantly faster in forward action planning scenarios within the action planning task than they did in inverse action planning tasks. This was expected to be the case as it should be easier, in general, for people to imagine an action's consequences than it would be to determine what actions need to be carried out to achieve a certain goal. However, this effect could be due to the fact that the sentences used within the forward action planning scenarios were shorter than those used in the inverse scenarios and thus it would take people less time to read them and as a result their response times will be lower. To overcome this limitation, future research should attempt to use scenarios

of a stipulated length for both forward and inverse scenarios, in this way there should be no confounding variable in the form of reading time to account for the differing response times between conditions.

The action planning test used in this study did however support previous findings that there are two distinct methods of action planning: forward and inverse. Previous research has found that within the central nervous system (CNS), there are neural circuits called 'internal models' which simulate aspects of the sensorimotor system. Through computational studies, it was found that there were two distinct methods of action control: forward methods that enable a person to determine the causal relationship between actions and their sensory consequences; and inverse methods which are the opposite and enable a person to determine which actions are needed to achieve desired outcomes (Wolpert, Doya & Kawato, 2003). However, the current study is one of the first to have successfully shown, on an experimental basis, that individuals differ in their preference for using either of the two models and thus have their own 'action planning style'.

One further potential limitation of this study could be that a relatively small sample was used to provide the data. Future research should attempt to carry out this research using a much larger sample that covers a wider range of the population than was possible within this study. This would provide results that are more indicative of the general population and improve the ecological validity of the results found in the current study. The small sample size could also account for the relatively low correlations found in this study; a larger sample size with a wider range of scores could result in higher correlations being found between the measure of hypnotic suggestibility and ideomotor action.

Future research could also attempt to show a relationship between hypnotic suggestibility and ideomotor action by using neuroimaging techniques such as fMRI. By using these techniques, any overlap between brain regions activated during hypnosis and those engaged in ideomotor action could be highlighted. This would lend additional support to the results of this study and would show a biological basis for the relationship between a person's hypnotic suggestibility and their ability to engage in ideomotor action.

The current research has important implications for understanding why some people are more suggestible than others. The results of this study suggest that those who are more suggestible to hypnosis are less able to inhibit ideomotor action effects and that this is the reason why they respond more effectively to hypnotic suggestion. This research has also opened up several avenues for future research which would further explore the relationship between suggestibility and ideomotor action. However, from the information available at present, it is reasonable to suggest that highly hypnotisable individuals are much more likely to be able to engage in ideomotor action than those who are less hypnotisable and that this enables them to complete ideomotor compatible tasks more quickly than their non-suggestible counterparts.

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