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An investigation into the relationship between hypnotic suggestibility and tendency to engage in ideomotor action

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Abstract

The relationship between hypnotic suggestibility and tendency to engage in ideomotor action was measured in 71 psychology undergraduates at Plymouth University. Each participant's level of hypnotic suggestibility was measured with a series of suggestibility tests, and their tendency to engage in ideomotor action was measured with two computer-based tasks - an action planning task and an imitation task. It was found that participants were faster at ideomotor-compatible tasks, such as backward action-planning trials ($t(59) = -3.1, p = .003$) and congruent imitation trials ($t(57) = -14.46, p < .001$). It was also found that participants made more errors in non-ideomotor-compatible tasks, such as forward action-planning trials ($t(59) = -3.28, p = .002$) and incongruent imitation trials ($t(57) = -6.75, p < .001$). This suggests that people find it easier to engage in ideomotor action, as they responded faster and more accurately in ideomotor-compatible tasks. Furthermore, a pairwise correlation found a relationship between suggestibility and error rates in the imitation task ($r = +.36, n = 56, p = .007$, two-tailed). Increased error rates in the imitation task could be a result of having fewer inhibitory thoughts. This would prevent the participant from overriding their automatic, ideomotor responses, leaving them vulnerable to suggestion, as they cannot override these either. This indicates that some people are more suggestible than others as they have fewer inhibitory thoughts. Implications for the development of tailored medicine and hypnotherapy are discussed.

Introduction

Ideomotor theories were formulated as an explanation as to how intentions and goals can produce actions without conscious thought, as opposed to older theories of sensorimotor action, which claimed that humans are passive in the environment and merely respond to stimuli (Morsella, Bargh & Gollwitzer 2009). For example, you may have found yourself reaching for a light switch upon entering a dimly lit room, or shaking someone's hand simply because they extended theirs. Actions to achieve goals, such as these, can be produced effortlessly, automatically and without thought. Individual differences are present, however, in the tendency to engage in ideomotor action, prompting questions as to how ideomotor action works.

In 1852 British physiologist William Carpenter coined the term ideomotor action, in order to provide a mechanism whereby involuntary motor action could result from ideas (Spitz, 1997), however, it is Thomas Laycock, a member of the same research team, who is credited with the discovery of the mechanism (Tischener, 1929, as cited in Stock & Stock, 2004). Laycock (1845) utilised a physiological approach to psychology and his work revealed that the symptoms of rabies, such as convulsions, were not only involuntary and reflex-like, but could also be triggered by the mere idea of drinking water. This allowed Laycock to conclude that thoughts and ideas could have an effect on motor activity, in this case reflexes. Having said this, Laycock's work is limited, as rabies patients have no voluntary control over their actions or behaviour, thus preventing Laycock's theory to be applied to the general population or to voluntary actions, as in, actions for which one sets themselves a goal to achieve (Stock & Stock, 2004).

This limitation, however, was overcome by Carpenter (1852) who attempted to identify a psychological explanation for supposedly supernatural events, as occultism was popular at the time (Hyman, 1999, as cited in Stock & Stock, 2004). Carpenter theorised that those who participated in séances were in a form of hypnotic state. He explained that, in this state, the participant's will was suspended as a consequence of interfering with the cognitive processes that govern it. This allows the participant to be influenced and directed by ideas suggested to them, causing them to perform actions without being aware of doing them, almost reflexively. Carpenter's observations suggest that when the will (ideas) is suspended, voluntary actions cannot be made, as access to cognitive processes has been prevented.

Furthermore, in hypnotic states, this prevention of access to cognitive processes means inhibitory ideas are unavailable, meaning given suggestions face no opposing thoughts. Subsequently, Carpenter (1852) created the term ideomotor as motor activity derived from ideas. This was supported by other researchers of the time, such as Faraday (1853), who was also attempting to find alternative explanations for paranormal events. Faraday's observations involved the phenomenon of table turning, and also led him to conclude that the mere suggestion that the table may turn in a particular direction was enough to create such an event. Faraday concluded that ideas and suggestions caused the participant's attention to be directed at achieving the outcome of that suggestion unconsciously.

Together these works imply that suggestions and ideas are enough to trigger motor responses, other scholars, however, were more interested in understanding the link between mind and body that could enable such a mechanism (Stock & Stock, 2004).

Lotze (1852, as cited in Stock & Stock, 2004) supported the notion that ideas could trigger actions but questioned as to what mechanism could provide such a function, as humans have no conscious control over the nerves and tendons that allow motor activity. Lotze theorised that such a mechanism must be the result of learning from day one of infancy, allowing the mind to associate movements and the resulting sensations. Once such an association has been made, the mind only has to desire a particular sensation or state for the movement associated with that state to occur. This theory, however, requires a bidirectional relationship to exist between movements and sensations, in order for voluntary action to occur.

To overcome this, Harless (1861, as cited in Stock & Stock, 2004) developed a model to explain how motor activity and sensations could become associated and thus create a bidirectional relationship. Harless theorised that movements produce sensations, which in turn create sensory images of that movement. These sensory images are linked to motor elements in the brain and spinal cord and are strengthened through repetition, until the sensory image without the motor element is enough to produce the desired movement. Further repetition of the movement means that smaller excitations of the sensory elements are needed to trigger the same movements.

William James (1890) integrated Harless' model (1861) with Carpenter's (1852) earlier occultism work, to further develop ideomotor theory. James agreed with Carpenter that an idea or a suggestion could result in motor activity, yet he disagreed that this was exclusive to the hypnotic states Carpenter had referred to. Instead, in accordance with Harless' model explaining how motor actions and ideas could become associated, James proposed that all learned actions could be ideomotor actions, explaining that a goal or idea was enough to produce a sensory image, and thus result in an action (Stock & Stock, 2004).

Evidence to support James' (1890) theory of ideomotor action comes from Elsner and Hommel (2001), who conducted a series of experiments seeking to find this bidirectional relationship between the motor and sensory cortices. Their studies tested the notion that repeated co-occurrences of self-executed motor actions and a sensory event could create an association between them. The first part of the study was a learning phase, in which pressing the left key produced a low-pitched tone, whilst pressing the right key produced a high-pitched tone. After this, participants entered a test phase where the tones from the previous phase would be played to them. Participants were free to choose which key to respond with, but Elsner and Hommel (2001) found that participants were faster and more likely to choose a response that matched the sensory effect (tone) from the learning phase, pointing towards the conclusion that a bidirectional association between motor and sensory cortices does exist. Further support for a bidirectional relationship between the motor and sensory cortices comes from a study by Guillot, Lebon, Rouffet, Champely, Doyon and Collet (2007), who measured EMG activity in muscles for real and imagined actions. They found there was a significant increase in activity in the muscles involved in the imagined action, despite no actual movement occurring. As imagining an action resulted in activity in the muscles, it can be concluded that a bidirectional relationship may exist between motor and sensory cortices, thus supporting the theories of James' (1890), Lotze (1852) and Harless' (1862).

James (1890) developed ideomotor theory further by explaining why not all ideas, thoughts or suggestions result in motor activity being executed. James posited that an action would only be performed if it did not meet an inhibitory idea, which would prevent the action from being carried out. This builds upon Carpenter's (1852) earlier work, which found that when the participant's will was suspended – preventing processes which determine the will from functioning - people were more likely to engage in ideomotor action. James (1890) added that individual differences are also present, meaning that those who have fewer inhibitory thoughts are more likely to engage in ideomotor action and respond to suggestions.

This could also explain why some people are more susceptible to hypnotic suggestions than others, as Eysenck (1943) stated that suggestions, such as ideomotor suggestions (that prompt actions), are closely related to hypnosis. Eysenck conducted a suggestibility test, known as the Body Sway test, in which participants must stand with their eyes closed whilst being told they are falling either forward or backwards. He found that introducing the idea of falling, to some participants, led to them falling forward almost immediately, yet this could be prevented if inhibitory thoughts were made – supporting ideomotor theory that ideas in the mind can be translated into action. Eysenck (1943) concluded that people who responded to suggestibility tests were also more easily induced into hypnotic states, whereas those who didn't respond to suggestibility tests were not induced into hypnotic states. This built upon work by McDougall (1908, as cited in Eysenck, 1943), who theorised that hypnosis restricted consciousness, forcing processes to use a restricted number of channels and resources, impairing one's ability to use inhibitory processes, therefore heightening suggestibility (Eysenck, 1943).

This theory has subsequently been supported by other psychologists, such as Spiegel (1995), who stated that hypnotic states restricted the processing of thoughts and motor processes, and by Baernstein (1929). Baernstein demonstrated the role of individual differences in suggestibility with an experiment in which participants were given a drug that inhibits higher brain activity. Baernstein found that inhibiting higher brain activity made suggestible participants more suggestible, but did not have any effect on participant's who had previously not been suggestible. This study suggests that people become more suggestible when their ability to inhibit thoughts was removed, supporting earlier research from Carpenter (1852) and James (1890). The drug had no effect on the participant's who were not suggestible because, as they had no tendency to engage in ideomotor action, they did not require inhibitory processes to prevent them from carrying out suggested actions.

This evidence prompted further questions as, if mere suggestions were enough to trigger motor responses, then perceiving an action or the consequences of an outcome should also produce such a response. Subsequently, Greenwald (1970) demonstrated that if an event, such as a red flash of light, has been learned to follow a particular action, such as pressing a response key, then the red flash of light will prompt the execution of that action as a consequence. This suggests that the perception of an action is able to prompt an action response in the observer.

In order to test this Brass, Bekkering, Wohlschläger and Prinz (2000) conducted a series of experiments in which participants had to execute a finger gesture whilst observing either the same or a different finger gesture on a computer screen. Brass

et al. (2000) found that participants were much faster at executing the expected (correct) gesture when it was congruent with the gesture performed by the on screen hand, supporting the notion that perceiving an action primes the execution of this action in the observer. Furthermore, they also found that error rates increased when the on screen hand was incongruent to the participant's expected response, suggesting that the gesture performed by the on screen hand was interfering with the participant's response.

For the present research, participants undertook a suggestibility test and two ideomotor action tasks, in the form of an action planning task and an imitation task, derived from Brass et al.'s (2000) research, both of which recorded response times and error rates. The action-planning task tested an individual's propensity to engage in ideomotor action by requiring them to respond to everyday scenarios. These would be presented as either ideomotor-compatible scenarios (backward action) or non-ideomotor-compatible scenarios (forward action). Ideomotor scenarios required the participant to work from a goal (outcome) to an action, and determine whether the given action would produce this goal or not. Whereas, for the non-ideomotor scenarios, they were to work from an action to a goal (outcome) and determine whether or not this outcome follows from the action. It's predicted that those who tend to engage in ideomotor action will complete the backward action scenarios faster, but will make more errors in the forward action scenarios.

The imitation task, derived from Brass et al.'s (2000) earlier work, which found perceiving actions triggered the relative ideomotor action response, was the second task to measure propensity to engage in ideomotor action. This task presented an image of a hand on screen, which was matched to the participant in terms of gender and handedness, and would elicit a movement in the form of a finger raise. It's expected that those who tend to engage in ideomotor action will respond faster on ideomotor-compatible trials (where image and instruction match), but will make more errors in the non-ideomotor-compatible trials (where image and instruction don't match), as they will be unable to inhibit their automatic ideomotor response.

As previously mentioned, Eysenck (1943) stated that ideomotor suggestions are similar to hypnosis and James (1890) proposed that people were more likely to engage in ideomotor action whilst in hypnotic states, as their will was suspended, preventing inhibitory thoughts. Subsequently, it's expected that there will be a relationship between hypnotic suggestibility and likelihood to engage in ideomotor action. This will be demonstrated by participants who are more suggestible scoring faster response times and fewer errors in ideomotor-compatible tasks, due to having less inhibitory thoughts to oppose the suggestions, and scoring slower times and more errors in the non-ideomotor-compatible tasks.

Method

Participants

Seventy-one (50 female, 21 male) psychology undergraduates from Plymouth University participated in this study, as required by a compulsory research methods module. Participants would be required to listen to hypnotherapy, look at stimuli and respond with their right hand. As a result, exclusion criteria for this study meant only right-handed people could participate, who had corrected to normal hearing and

vision and full motor control in their right hand.

Materials

Instructions for the imitation and action planning tasks were provided on screen, since they were both computer-based tasks. The computer used for these tasks was a Viglen Genie S2 with a Windows 7 operating system and a Philips Brilliance 21.5" LED 221P3LPYES P-line monitor, with a Logitech K120 keyboard for input. Both these tasks and the suggestibility test were run using a stimulus delivery program called Presentation (version 16.3).

The instructions for the suggestibility tests were provided in the form of an MP3 format recording of a trained hypnotherapist, which was played to participants via the program Presentation and delivered with Unitone HD 3030 headphones. Participant's responses were video recorded with Canon HD Legria HF20 E cameras and interpreted using printed hypnotic suggestibility rating scales based on the Harvard Group Test for Hypnotic Suggestibility (Shor & Orne, 1962). The suggestibility test rated participants on four tasks: eye closure, hand raise, head drop and a books and balloons measure.

Design and Procedure

This study used a within subjects design, in which all participants were given the same tasks in the same order. Upon arrival, participants were allocated a private booth and sat at a computer. Here they were given a brief, which detailed the study, provided instructions and reminded them of their right to withdraw and that all data collected would be anonymous and confidential. The experiment would only begin once they had read and agreed to the brief and then signed the consent form.

The first part of the experiment was a computer-based task, testing whether there was a difference in response times and error rates for forward or backward (ideomotor-compatible) action-planning. This task employed an ABAB design, in which participants would be given four practice trials, before going on to complete 20 trials of forward action-planning scenarios, followed by 20 trials of backward action-planning scenarios and then this cycle would be repeated. In forward action-planning trials, a fixation cross would be displayed on screen for 500ms, which was then followed by a black screen for 500ms. Next participants were shown a scenario, such as "you are in a car" for 1200ms, then an action, such as "you push the accelerator" or "you push the brake" for 1200ms and then an outcome, such as "you will go faster" for 2600ms or until the participant responded. The participant was to decide whether or not the given outcome could be a result of executing the given action. To respond, participants would press the 'J' key with the index finger of their right hand if they thought it did follow, or the 'K' key with the middle finger of their right hand if they thought it did not follow.

In the backward action-planning (ideomotor-compatible) trials the fixation cross and black screen were shown again in the same way. Then participants were shown a scenario, such as "you are in a car" for 1200ms, then a goal, such as "you want to go faster" for 1200ms and then an action, such as "you push the accelerator" or "you push the brake" for 2600ms or until the participant responded. This time the participant was to decide whether or not the given action would result in the given goal and would respond in the same manner as the forward action planning trials.

Both tasks recorded response times and error rates to determine whether a participant had a preference for forward or backward (ideomotor) action-planning.

Once the action-planning task was complete, participants' levels of suggestibility would be measured using tests from a recording of a hypnotherapist. For this, participants were moved to sit at the back of the booth to give them more space, and were given headphones to wear. Once comfortable, the video cameras would be turned on and the recording would be started. The hypnotherapist would first relax the participant and then use suggestibility measures of eye closure, hand raising, head dropping and a books and balloons task.

The first suggestibility test measured eye closure, with a simple yes or no criteria, and was conducted by encouraging the participant to relax and suggesting that they would like to close their eyes, as they were getting heavy and tired.

The second suggestibility test was a hand raise measure, which used an eight-point Likert scale, ranging from 0 (no response) to 7 (extreme response). In this test, the participant was told to focus on their non-dominant hand, which should be resting on their thigh. They were told to raise the palm of their hand, leaving just their fingertips touching their thigh, it was then suggested that their hand was beginning to feel lighter and lift off their thigh. Participants' responses were measured by comparing the change in angle and extent of hand raise, as a consequence of the suggestions.

The third suggestibility test was a head drop measure, which used a five-point Likert scale, ranging from 0 (no response) to 4 (extreme response). Participants were instructed to relax and close their eyes, but to also sit up straight. Then, it was suggested that their head was beginning to feel heavy and would be much more comfortable if it were to fall forwards, dropping their chin to their chest. This time, participants' responses to the suggestions were recorded by comparing the change in the angle and extent of head dropping.

The final suggestibility task was a books and balloons test, which again utilised a five-point Likert scale. For this test the participants were instructed to hold their arms out in front of them, with their palms facing upwards. Then, they were to imagine a large, heavy book being placed in their left hand and that a large balloon had been tied to their right wrist. They were told to visualize the colour, size and shape of these objects and it was suggested that the book was heavy, weighing the arm down lower, whilst the balloon was making their arm feel lighter, lifting it higher. Participants' responses to these suggestions were again measured by comparing the change in angle of and extent of movement in each arm.

Once this test had been completed, the hypnotherapist would awaken the participants by instructing them to open their eyes and informing them that all normal sensations had returned. The researcher would then ensure the participant was happy to continue before beginning the final part of the study, which was a computer-based imitation task, based on Brass et al.'s (2000) previous study which suggested that perceiving an action could trigger an ideomotor action response in the observer, resulting in imitation of the perceived action.

For this task, participants were sat in front of the computer where they would read

instructions for the task ahead. Once started, the participant would need to continually depress the '<' key with the index finger of their right hand and the '>' key with the middle finger of their right hand. For each trial, gender-matched images of a right hand would appear on screen. The first image of a hand would not be performing an action (neutral) and would be shown for 800ms, this would be followed by an image of a hand performing an action, in which either the index or middle finger was raised, for 1200ms or until a response was made. Accompanying the action image would be a small number in a circle slightly above the hand, instructing the participant how to respond correctly. A number one meant the participant should raise their index finger off the '<' key, whilst a number two meant they should raise their middle finger off the '>' key. This instruction, however, would not always be congruent with the action performed by the image of the hand and participants would be given eight practice trials, before going on to complete 120 trials, randomly presented with equal numbers of congruent (ideomotor-compatible) and incongruent (non-ideomotor-compatible) trials. Again, response times and error rates were recorded in order to investigate whether or not participants were faster at congruent trials and how many errors were caused by incongruent trials.

Once completed the participants were given a debrief, informing them again of their right to withdraw their data but also supplying them with contact information, should they have any questions or concerns about the study, particularly the hypnotherapy.

The data was then entered into a Microsoft Excel spreadsheet, enabling the removal of participants who showed error rates of 20% or above, as this suggested they had not understood or paid full attention to the tasks.

Four two-tailed repeated measures t-tests were then conducted on the participants' scores for response times and percentage error rates between forward and backward action trials and between congruent and incongruent imitation trials. This was to determine whether there was a significant difference between these ideomotor-compatible and non-ideomotor-compatible trials.

Next, pairwise correlations were conducted; in order to test whether or not there was a relationship between hypnotic suggestibility and ideomotor action. To run these correlations, overall scores for response times and error rates in each task had to be calculated. To do this, action planning scores for response times and error rates in backward action trials (ideomotor-compatible) were subtracted from those in forward action trials. This was then repeated for the imitation task, with scores for response times and error rates in the congruent trials (ideomotor-compatible) being subtracted from those in the incongruent trials. As a result, if participants were faster and made fewer errors in the ideomotor-compatible trials, then this would result in a positive score for them, whereas, if they were faster at non-ideomotor-compatible tasks this would result in a negative score. These scores were then correlated with each participant's suggestibility score, which was an average calculated from their responsiveness to each suggestibility test.

Results

Descriptive statistics revealing the mean scores and standard deviations for response times and percentage error rates for both the action-planning task and imitation task can be found below in Table 1.

Table 1: Means and standard deviations for response times (s) and percentage error rates (%) in the action-planning task (n = 59) and imitation task (n = 57).

	Response Times		Percentage Error Rates	
	M	SD	M%	SD%
Backward Action	964.68	202.17	5.20	4.82
Forward Action	994.61	213.95	7.15	5.06
Congruent Imitation	391.14	74.13	2.90	3.79
Incongruent Imitation	448.07	91.64	7.53	5.52

The results in Table 1 show that participants were faster in the backward action planning trials than in the forward action planning trials. A two-tailed repeated measures t-test found this difference to be significant $t(59) = -3.1, p = .003$. It also shows that participants were faster in the congruent imitation trials than in the incongruent trials. A two-tailed repeated measures t-test found this difference to be significant also $t(57) = -14.46, p < .001$, which supports the results of Brass et al. (2000).

Table 1 also displays results concerning percentage error rates for each task and shows that participants made more errors in the forward action planning trials than in the backward action trials. A two-tailed repeated measures t-test found this difference to be significant $t(59) = -3.28, p = .002$. Table 1 also shows that participants made more errors in the incongruent imitation trials than in the congruent trials and a two-tailed repeated measures t-test found this difference to be significant $t(57) = -6.75, p < .001$, also corroborating Brass et al.'s (2000) earlier work.

It was predicted that scores for response times and percentage error rates would be interrelated with hypnotic suggestibility. To test this separate, pairwise Pearson correlations were conducted.

Table 2: Cross correlations of response times and error rates across tasks. (** = significant at .005)

Measures	r
Suggestibility Score / Imitation RT	-.16
Suggestibility Score / Imitation Error	.36 **
Suggestibility Score / Action Planning RT	-.07
Suggestibility Score / Action Planning Error	.02
Action Planning RT / Action planning Error	-.14
Action Planning RT / Imitation Error	-0.6
Action Planning Error / Imitation Error	.07
Action Planning Error / Imitation RT	.01
Imitation RT / Action Planning RT	.20
Imitation RT / Imitation Error	-.20

Table 2 shows that there was a positive correlation between suggestibility score and imitation score in error rates in the direction predicted, although, there are no other relationships. Figure 1 depicts a linear positive relationship between suggestibility score and error rates in the imitation task and a Pearson correlation revealed that this relationship was statistically significant, $r = +.36$, $n = 56$, $p = .007$, two-tailed, showing that more suggestible participants made more errors in the incongruent imitation trials.

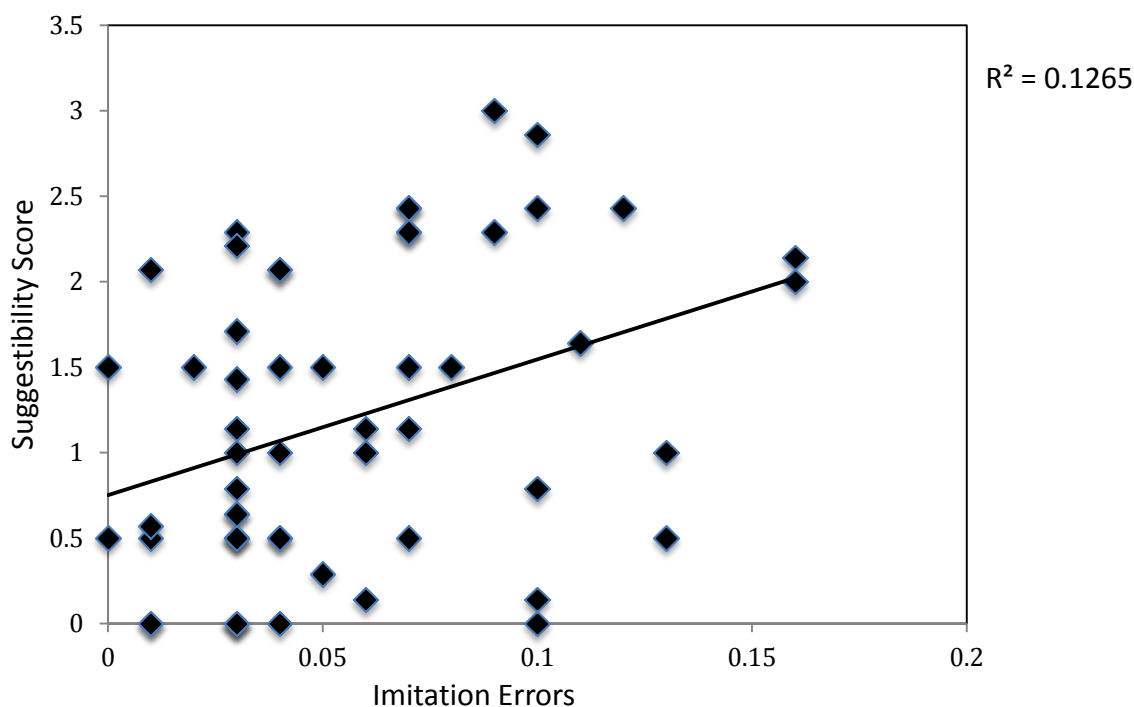


Figure 1: Scatterplot showing the relationship between hypnotic suggestibility and error rates in the imitation task ($n = 56$).

Discussion

This study investigated the relationship between hypnotic suggestibility and propensity to engage in ideomotor action. To do this, participants' scores on a suggestibility measure were correlated with their scores for response times and error rates in two tasks designed to measure ideomotor action.

The first hypothesis predicted that participants would score faster response times on ideomotor-compatible tasks, and would score higher error rates on non-ideomotor-compatible tasks. Table 1 reveals that the results are consistent with the hypothesis, as participants were faster at the backward action planning trials and congruent imitation trials, whilst they made more errors in the forward action planning trials and incongruent imitation trials. Subsequent analysis found these differences to be highly significant, thus replicating previous work by Brass et al. (2000) who also found that participants were faster at ideomotor-compatible tasks, but more error prone on non-ideomotor-compatible tasks.

Brass et al. (2000) concluded that these observations were a result of an interference effect, whereby the perception of an action (the finger movement) is enough to influence the response a participant will give, which also supports Greenwald's (1970) previous research. This results in higher error rates in the incongruent imitation trials, as an ideomotor action response is executed upon perceiving the action, producing a response that is incorrect to the given numerical instruction. Consequently, it could be suggested that a similar mechanism is at work for the action-planning task. Here, it was found that participants made significantly fewer errors in the backward action (ideomotor-compatible) trials, and could be due to the goal or outcome being presented first, which primes the participants towards the correct response. Furthermore, as participants were faster and made fewer errors in ideomotor-compatible tasks, it can be concluded that these observations are due to the tasks themselves and not the result of a speed-accuracy trade-off.

The results also show that a significant correlation was found between hypnotic suggestibility and percentage error rates in the imitation task (Figure 1), which is in line with the prediction that there would be a relationship between suggestibility and ideomotor action. This signifies that participants who are more suggestible committed more errors in the incongruent imitation trials than less suggestible participants did. This is to be expected, as theories by James (1890) and Eysenck (1943) posited that those who are more suggestible have less inhibitory thoughts to prevent ideomotor action and that access to these is prevented when in hypnotic states.

Consequently, highly suggestible participants are unable to override and prevent the automatic execution of an ideomotor action in response to the perceived movement image, resulting in the incorrect response being given. This result, therefore, provides evidence for the theory that people who are more suggestible tend to engage in ideomotor action more so than less suggestible people, as they are unable to inhibit ideomotor processes. Thus, this research has established a link between hypnosis and ideomotor action and in doing so has provided support for the theories of James (1890), Eysenck (1943) and Greenwald (1970).

Having said this, no further significant relationships between suggestibility and ideomotor action were found, which partially goes against the hypothesis, as the action-planning test of ideomotor action appears to have had no relationship with suggestibility. However, this could simply mean that the action-planning task was not as good a measure of ideomotor action as thought. The action-planning task required participants to read and understand scenarios in order to make judgments based upon them, therefore requiring higher-level cognitive processes than the imitation task. Perhaps if this task was operationalised differently, such as a in the form of a pictorial version, then it would reduce the need for higher-level processes, thus making it easier to process and increase its suitability as a measure of ideomotor action.

There was, however, a negative correlation between suggestibility score and response times in both the imitation and action planning tasks. Although this was not significant, it was in the expected direction, as those who are less suggestible should have slower response times. This could be, according to James (1890), because they are able to prevent their ideomotor response and select a different response instead, which slows down their response. Therefore, it is surprising this result did

not reach significance, however, it is possible to verify this result by replicating the study with a larger sample.

This study has added to the understanding of hypnosis, as error rates were significantly correlated with suggestibility. This indicates that suggestible people have less inhibitory thoughts, which is why they are unable to stop the execution of an ideomotor action and as a result make an incorrect response. This data, however, is correlational not causal, meaning that increased suggestibility does not necessarily cause increased ideomotor action (as a result of fewer inhibitory thoughts). Furthermore, the direction of the relationship cannot be determined, thus one cannot be certain whether it is suggestibility that influences ideomotor action or whether it is ideomotor action that influences suggestibility. This could be tested in an experiment in which the suggestibility levels of participants could be measured before and after a training phase encouraging participants to use ideomotor action more frequently. If after the training phase they show an increased level of suggestibility, then it could be concluded that a tendency to engage in ideomotor action heightens suggestibility.

A better understanding of the mechanism behind hypnosis could have broad applications, specifically in terms of hypnotherapy as a treatment. For example, recent advancements in gene mapping and DNA sequencing have paved the way for personalised medicine (Ginsburg & McCarthy, 2001). That is to say, soon clinicians could treat patients on a case-by-case basis, and choose treatments tailored to work more effectively for them. The current study suggests that there is a relationship between suggestibility and ideomotor action as a result of fewer inhibitory thoughts. Thus, hypnotherapy may be more effective for patients with fewer inhibitory thoughts, as it should be easier to induce hypnotic states. Consequently, in future, a patient's suggestibility level could be measured, which would assess the suitability of hypnotherapy as a treatment for the patient.

For example, Hasan et al. (2014) conducted a study comparing the effectiveness of hypnotherapy and nicotine replacement therapies at reducing smoking. They found that hypnotherapy patients were more than three times as likely to have abstained from smoking 26 weeks later than those who used nicotine replacement alone. This has huge implications for public health and the effectiveness of hypnotherapy as a treatment, but furthermore, could be even more effective for patients who are highly suggestible. Having said this, even if the patient is not highly suggestible, other studies, such as Schweiger Gallo, Pfau, and Gollwitzer (2012), have shown it is possible to train people to become more suggestible. Perhaps if patients were taught to reduce their inhibitory thoughts and to increase their tendency to engage in ideomotor action, they may become more suggestible and more responsive to the hypnotherapy.

To conclude, the current study has, in the main, provided evidence to support the hypothesis that a relationship between suggestibility and ideomotor action exists, as participants that were more suggestible accrued higher error rates in the incongruent imitation trials. This indicates that more suggestible participants are less able to prevent ideomotor responses, as a result of having fewer inhibitory thoughts. These findings have raised further research questions, such as the directionality of this relationship and how exactly suggestibility affects ideomotor action and vice versa. In

addition to this, these findings could also be applied to hypnotherapy, specifically in terms of investigating the role of ideomotor action prevalence on suggestibility, which could lead to more effective, patient specific treatments.

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