CONSEQUENCES OF INDIVIDUAL DIFFERENCE IN MENTAL IMAGERY ABILITY

by

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Abstract

Previous work has suggested that individuals differ in mental imagery ability and the way in which they recruit and routinely engage in cognitive tasks that require mental imagery. The present study investigates what the consequences of these individual differences are. Specifically, we examined whether training individuals to engage in visual motion mental imagery may have effects in other cognitive tasks such as the comprehension of linguistic descriptions of motion. To test this, we utilized the motion aftereffect illusion to gain an implicit measure of visual motion imagery ability before and after two different training conditions (imagery training where people either did or did not have to attend to motion-related information). We also measured the motion aftereffect from language following training. To measure language comprehension, participants were given a surprise memory test for the stories that they heard in the linguistic aftereffect task. Participants showed a priming effect from language comprehension rather than an aftereffect. There did not appear to be a relationship between the size of the motion aftereffect from language and language comprehension in this sample. This research helps us to better understand the relationship between mental imagery and language comprehension.

Consequences of Individual Difference in Mental Imagery Ability

When asked to visualize a country scene which involves trees, mountains, and a lake, what do you see? When asked to consider the contours of the landscape or the color and shape of the lake, how vivid is this image for you? Is the experience of imagining this image as vivid as the experience of actually viewing it? In measuring how vivid these images are for some people, stable differences in self-reports of mental imagery vividness are suggestive of individual differences in mental imagery ability and vividness. Individuals vary in their self-reports of what these mental images look like and how vivid these experiences are for them (Isaac, Marks, & Russell, 1986), and implicit measures of the quality of mental imagery also show systematic individual differences (Dils & Boroditsky, 2010). What, if any, are the consequences of these individual differences on other cognitive tasks that rely on mental imagery? This thesis examines this question in the context of mental imagery of visual motion.

In a study of the vividness of mental imagery between individuals, Isaac, Marks, and Russell (1986) studied the differences between individuals in self-reports of the vividness of motion in mental imagery. The Vividness of Visual Imagery Questionnaire (VVIQ) is a tool used by researchers to find self-evaluated scores of the vividness of a still mental image. The VVIQ questionnaire consists of 16 questions that ask participants to consider these mental images and then rate them on a 1-5 scale in which 1 represents that the mental image was not vivid at all and 5 represents that it was highly vivid. Isaac et al. utilized a similar questionnaire, the Vividness of Movement Imagery Questionnaire (VMIQ), to test the reliability of these measures. Participants read descriptions of a different action scenes and filled out the VMIQ to rate their experiences of creating imagining movement. The study found that the scale is a valid instrument in calculating the variation of visual vividness of mental motion in between individuals.

Isaac and Marks also studied individual differences in visual and movement imagery between various demographic groups using both the VVIQ and VMIQ (1994). Results suggest that higher imagery vividness ability can be found in girls between the ages of 8 and 9 and in boys in between the ages of 10 and 21 than in other age groups for each respective gender. Overall, it was found that females reported more vivid mental imagery than males from the ages of 10 to 39, with reduced movement vividness in females at the age of 50 or older for both visual and motor imagery. The study also observed how people with different specializations vary systematically in imagery ability. Children who were reported to have poor movement control also exhibited poor imagery skills or no imagery skills at all. College students who were involved in sports exhibited more vivid imagery than students with majors in other academic fields, including physics, English, and surveying. Of the elite athletes as well as air traffic controllers and pilots in this study, all reported more vivid imagery than control groups. This suggests that individual differences may be found using these self-report measures that are consistent with people’s other abilities and experiences. It remains unclear whether individuals are either engaging (and training) mental imagery ability through their occupation or are self-selecting into fields that already require innate, strong mental imagery skills.

While measures such as the VVIQ enable us to explicitly measure mental imagery ability, self-report scales may capture different aspects of mental imagery ability as compared to implicit measures. For example, explicit measures might capture differences in the subjective experience of mental imagery, whereas implicit measures might capture more objective differences in ability. Previous research has utilized the motion aftereffect (MAE) as an objective, implicit measure of mental imagery ability (Winawer & Huk, 2010; Dils & Boroditsky, 2010). The motion aftereffect is an illusion which is caused by prolonged exposure to a moving, visual stimulus in a single direction, and then when attention is shifted to a non-moving stimulus, the individual perceives motion in the opposite direction. The motion aftereffect is a result of fatigue effects on direction-selective neurons in visual cortex, which shift the balance of visual motion signals in a way that causes false motion signals to arise (Anstis, Verstraten, & Mather, 1998).

Winawer, Huk, and Boroditsky (2010) found that it is possible to quantify the motion aftereffect from mental imagery of motion. Participants were asked to imagine horizontal gratings that moved in either an upward or downward direction for either a 6 or 60 second interval, which was used to induce a motion aftereffect illusion. They were then shown a series of dots that varied in coherence levels for which participants had to make judgements of whether they moved in an upward or downward direction. The dots appeared to move in the direction opposite to the direction of the imagined movement, which is consistent with a MAE. The results suggest that mental imagery from motion causes a MAE even when simply imagining motion. The results also reveal considerable variability in the magnitude of the motion aftereffect experienced by individuals, suggestive of the fact that these may be due to stable individual differences in mental imagery ability.

The motion aftereffect, then, aids as a reliable implicit measure of mental imagery between individuals. Dils and Boroditsky (2010) studied whether or not the variability is systemic across different forms of mental motion. Participants were asked to imagine motion and then asked to judge the direction of a dot stimulus presented to them. Those same participants were given linguistic descriptions of motion and had their motion aftereffect sizes measured. Participants who showed a larger motion aftereffect from imagery also showed a larger motion aftereffect from language and vice versa, suggestive of the fact that differences in the motion aftereffect across individuals are not random.

It could be that these individual differences reflect either innate or experience-based mental imagery abilities. Innate abilities suggest that individuals may have inborn differences in how accurately they may be able to activate perceptual representations in the absence of a stimulus. Experience-based abilities suggest that individuals may engage in routine tasks that enable them to train their abilities to activate perceptual representations in the absence of a stimulus. Gagliardi and Dils (2010) studied the possibility of an experience-based explanation of individual differences by comparing groups of visual motion experts and visual motion novices. On language trials, participants listened to stories describing either upward or downward motion. On imagery trials, participants were asked to imagine stripes drifting in an upward or downward direction. Participants then had to judge the direction of motion in a field of moving dots as a measure of the size of the MAE from imagery or language. Lastly, participants were asked to retell the stories they had heard in the beginning of the experiment with the most amount of detail as possible. Results of this experiment suggested that while participants were more likely to show a priming effect than a motion aftereffect, there were differences in the magnitude of this effect between visual motion experts and novices. These findings raise important questions about whether it is that people who routinely do tasks that require mental imagery cause themselves to have strong mental imagery skills or if it is that people with naturally strong mental imagery skills self-select into fields that require a higher degree of mental imagery precision. To better understand the causes of these differences would require a mental imagery training study.

A study testing whether mental imagery can be a learned ability was conducted by Campos, Gomez-Juncal and Perez-Fabello (2008). They suggest that, through practice and training, mental imagery can be improved. The researchers utilized different types of imagery (normal, bizarre (atypical), and mixed). They developed a task in which participants viewed simple and complex sentences that consisted of normal situations, atypical situations, or a combination of both. Participants read these sentences and were then asked to rate the vividness of the mental image they created using a five-point Likert scale. After 24 hours, subjects were asked to repeat imagery formation and rate these sentences again. They were also asked how often they utilized some sort of mental imagery in their everyday life. Researchers found that the vividness ratings of the imagery were higher when participants were asked to repeat imagery formation than in their first imagery vividness ratings. Additionally, participants that utilize more mental imagery in their daily lives had higher vividness scores than those who had fewer experiences. These results suggest that some imagery training may improve subjective reports of mental imagery vividness.

Other work suggests that training mental imagery ability can enhance memory through bizarre imagery (Campos, Gomez-Juncal, & Perez-Fabello, 2008; McDaniel & Einstein, 1986; & Tess, Hutchinson, Treloar, & Jenkins, 1999). A finding by McDaniel and Einstein (1986) suggests that bizarre imagery can lead to better recall as it facilitates recall in various conditions. Bizarre sentences are created when sentence frames containing common noun pairs, such as "The man smoked the cigar," and "The hen pecked the worm," are rearranged to form bizarre sentences, such as "The man pecked the worm," and "The hen smoked the cigar" (McDaniel & Einstein, 1986). Tess, Hutchinson, Treloar, and Jenkins (1999) tested students’ learning about the poets William Blake, Samuel Coleridge, Percy Shelley, John Keats, and Lord Byron. Participants in the bizarre imagery condition viewed poets in flamboyant clothing while participants in the control condition viewed them in era-appropriate attire. Participants were shown slides of the poets and were free to recall each poet in whichever way they chose. After a distractor task, participants were shown the slides again with each in a different order and asked to take a recall test. Results indicated that participants who were in the bizarre imagery condition were able to recall more poets than those in the control condition, suggesting that bizarre imagery strengthens recall. The study also suggests that bizarre imagery enhances performance on both immediate recall and delayed retention tasks. The researchers concluded that adding audio-visual materials that include bizarre imagery can benefit students in the classroom.

Mental imagery training can be seen to improve language comprehension in children. In previous research, it was found that children with specific language impairments, when trained to engage in mental imagery, were able to improve story comprehension (Joffe, Cain, & Mariç, 2007). Two groups of children were recruited for this study: an Specific Language Impairment (SLI) group and a typically developing children group. They were both given the same story comprehension questions. Both groups were given training to be able to produce mental imagery for sentences and stories over five sessions. By recording pre and post intervention scores, researchers were able to find improvements in question answering performance in the group of SLI children, but not in typically developing children. This suggests that training in mental imagery is an effective intervention for increasing story comprehension abilities, at least in children suffering from a language impairment.

Additional research examines the effects of mental imagery on memory. A study by Pressley (1976) investigated the effects of using mental imagery to improve memory of prose in healthy children. The group of experimental children were given a sample sentence and shown images on a projector while control group children were simply asked to do whatever they could to remember the same material later but were not shown any images. Experimental group children were told to create mental images that bore similarity to the one they were presented with and created their own mental images. In post-tests relating to the story, children who practiced creating mental images were better able to recall information. The study suggests that mental imagery training can be taught in classroom settings and be used for improving memory. This not only suggests a relationship between mental imagery ability and memory recall but also suggests that practicing creating mental imagery can help improve memory of stories.

In addition to memory performance, a study by Driskell, Copper, and Moran (1994) suggests that mental practice enhances physical performance. A meta-analysis of literature involving mental practice suggests that mental practice does in fact enhance performance so long that the mental practice is more cognitive than physical, the retention interval between practice and performance is short, and the duration of the actual mental practice is long. Mental practice has been seen to also benefit patient populations. Mental imagery has been suggested to be able to increase muscular strength in healthy participants as well as patients with immobilized upper extremities or anterior cruciate ligament (ACL) (Slimani, Tod, Chaabene, Miarka, & Chamari, 2016). Mental imagery is seen to be able to improve motor tasks such as in combat sports (Slimani & Cheour, 2016). Mental imagery has also been seen to benefit motor function in patients with upper-limb hemiparesis (ULH) in combination with physical practice (Page, Levine, Sisto, & Johnston, 2001).

Mental imagery can also be seen to benefit professionals in their job skills. A study by Shorrock and Isaac (2010) similarly looked at the effects of mental practice on performance in air traffic controllers. Air traffic controllers suggest that they use mental pictures to be able to do their jobs. The researchers suggest that mental imagery significantly impacts performance of cognitive tasks. They posit that mental imagery can assist air traffic controllers in various ways, including imagining traffic scenarios, making aircraft separation judgements, and being able to learn and practice skills. This suggestion that mental imagery can impact performance can be seen in a multitude of professions, including in the world of sports. In a study conducted by Isaac (1992), trampolinists were asked to mentally practice their routines and showed that trampolinists in the mental practice condition were significantly better able to improve their performance in comparison to those in the control condition, suggesting that mental practice is in fact important in motor skill learning. The benefits of mental practice can also be seen in golf in a study by Frank, Land, Popp, and Schack (2014) in which golfers were asked to create mental representations of the putt. The study's findings suggested that mental imagery along with practice was better able to improve performance. This also suggests that cognitive adaptation during motor learning can be promoted through mental practice.

Studies also suggest that mental practice can enhance surgical skill. In a study by Arora et al. (2011b), novice surgeons performed virtual reality (VR) laparoscopic cholecystectomies. It was shown that mental practice for these surgeons resulted in better quality of performance in these surgeries. Practicing mental imagery has also been able to assist in stress management for novice surgeons (Arora et al., 2011a). Overall, studies now suggest that mental practice and imagery may be a better way for novice surgeons to optimize performance and acquire skills as well as for experienced surgeons to practice, maintain, and learn new skills (Cocks, Moulton, Luu, & Cil, 2014).

Mental practice can benefit music performance. Expert musicians employ a fair amount of mental imagery in memorizing and improving their performance (Lotze, Scheler, Tan, Braun, & Birbaumer, 2003). Bernardi, Schories, Jabusch, Colombo, and Altenmüller (2012) studied a group of pianists who were asked to memorize piano pieces. Participants memorized music with either mental practice or physical practice. It was found that mental practice alone was able to assist in music learning. Mental practice in combination with physical practice was able to produce results that were indistinguishable from the participants that only physically practiced the piano pieces. The study suggests that strengthening the internal representation of the musical piece with short physical practice may be valuable to musicians' performances.

While previous studies have had people practice what they were ultimately tested on, this study tests whether generally imagining motion helps in understanding stories that describe visual motion. Essentially, it tests whether a transfer of ability from one cognitive task (visual motion mental imagery) could affect another (language comprehension) using unrelated material. Participants completed a training task that measured the effectiveness of training through the motion aftereffect from imagery and language, and then tested whether the motion aftereffect from language predicted performance on story comprehension measures. The training task consisted of an experimental condition in which participants maintained speed information (motion-related) from drifting gratings in their working memory and a control condition in which participants maintained contrast information (motion-unrelated) from drifting gratings in their working memory. We utilized the motion aftereffect illusion to measure changes to the size of the MAE from mental imagery and language as a function of training condition. By using a speed and contrast training task, we seek to find whether training in mental imagery will result in participants having larger motion aftereffects and subsequently better language comprehension skills. We predicted that the motion aftereffect from imagery would increase more following speed training than contrast training. We also predicted this benefit would extend to the motion aftereffect from language. Lastly, we predicted that speed training would lead to better story comprehension than contrast training.

Methods

Participants

Twenty-four participants were recruited using the Purchase College Psychology Participant Pool and in the broader Purchase College community. Two researchers collected data on this project. All participants provided informed consent to participating in the study. Participants received compensation in the form of 2 credits per hour completed in this study or the alternative of $10 per hour completed with a chance for paid subjects to earn $10 more in bonuses if they were able to increase performance.

Design and Overview

The research design of this study was a mixed design. It compared the effects of speed and contrast training on mental imagery precision and language comprehension. The independent variables will be the speed and contrast training conditions (manipulated between subjects) and the pre- and posttests of motion aftereffect size from mental imagery (a repeated measure). The dependent variables of this study will be the size of the motion aftereffect (both from language and mental imagery), and language comprehension as measured by memory for the stories in the linguistic MAE task.

Upon arriving for the study, participants were first asked to read and sign an informed consent form. Participants were asked to complete a motion aftereffect pretest to test for the size of the motion aftereffect from imagined motion. They were randomly assigned to either the perceptual training or the mental imagery training conditions of this task. They then underwent three training sessions for approximately 20 minutes each over three days. The first session immediately followed the pre-test on day one. The second session was held on its own on day two, and the third session was completed day three, along with the posttests. The first posttest observed if there was a change in the magnitude of the motion aftereffect from mental imagery.

The second measured the motion aftereffect from linguistic descriptions of motion. Lastly, participants completed a memory test in which they were asked to recall as much detail as possible from the stories they heard in the second posttest. Participants then filled out a demographics questionnaire, were debriefed, and received compensation for their time.

Materials

Motion aftereffect measure.

Adaptation materials: language. A set of stories were adapted from the Dils and Boroditsky (2010) study. A total of 12 unique stories were used with literal motion language suggesting upward and downward motion, resulting in 24 stories. This literal motion language condition used motion language that describes the movement of physical objects (e.g., squirrels, ping pong balls). These stories were broken up and given in four installments: a long initial installment for 40 seconds, and three subsequent installments for 8 seconds each. Participants heard either the upward or downward version of each story, but not both.

Adaptation materials: mental imagery. Participants were asked to imagine striped sinusoidal gratings drifting either upward or downward. These gratings were presented similarly to the manner in which the language installments were presented. The first long installment lasted 40 seconds and three subsequent installments lasted 8 seconds each.

Test materials. The test materials consisted of a visual field filled with random dots that had net motion coherence either upward or downward. Participants were asked to judge the direction of the dot motion. The proportion of dots that were coherent varied across trials. The degree of motion coherence is utilized to quantify the size of the motion aftereffect.

Training task materials. Black and white oriented horizontal gratings, similar to those presented in the motion aftereffect measure, with motion upwards and downward. Gratings were presented at varying speeds, spatial frequencies, and contrast levels.

Memory test. A surprise memory test asked participants to fill in as much detail as they can to be able to measure the size of the motion aftereffect. Participants were prompted through a statement such as “You have just listened to a story about squirrels. To the best of your ability, recall as much detail as possible.”

Procedure

Pretest. Participants were invited to the first meeting in which they underwent a pretest and the first training session. This meeting lasted 60 minutes, 40 of which were dedicated to the pretest with the following 20 minutes dedicated to the first of the training sessions. The pretest for participants was used to test for the size of the motion aftereffect from imagined motion. This was a replication of the Dils and Boroditsky (2010) imagery task in which, on each trial, participants were asked to imagine horizontal stripes moving in an upward or downward direction. Then they were presented with a random dot stimulus in which they were asked to judge whether the dots are moving upward or downward. There was a total of 48 trials.

Training. Participants were then randomly assigned to one of two conditions: the control contrast training condition or experimental speed training condition. On each training trial for both conditions, participants were shown a striped, sinusoidal grating followed by a five second delay and subsequently another grating. Participants in the control condition were asked to judge whether the contrast of the gratings were identical or different. Participants in the experimental condition were asked to judge whether the speed of the gratings were identical or different. The second day of training consisted only of this training procedure.

Posttests. The third day of training was 90 minutes, beginning with the last 20-minute training session. It was then followed by the posttests that consisted of the same motion aftereffect from mental imagery measure used in the pretest and a linguistic version of the task. The linguistic task will have the same trial structure as the mental imagery task, except that instead of imagining moving gratings, participants will be asked to listen to a segment of one of the stories described above before judging the direction of moving dots. The posttests lasted approximately 50 minutes.

Memory test. Lastly, participants will be asked to complete a surprise memory test in which they will be asked to write out each story they heard in the linguistic post-test, word-for-word, in as much detail as they can remember. Online raters from Amazon's Mechanical Turk will score the quality of subjects' retelling of the stories. Participants retelling of the stories they heard were rated by three online raters from Amazon's Mechanical Turk.

Results

The size of the motion aftereffect illusion was computed for each participant by subtracting the proportion of "up" responses following "upward" adaptation from the proportion of "up" responses following "downward" adaptation. If the difference was positive, this indicated a motion aftereffect, while if the number was negative, this suggested a priming effect. These scores were computed for both the imagined and linguistic motion trials.

Independent-samples t-tests were conducted to compare participants in the experimental and control conditions on (1) the size of the motion aftereffect after training, (2) the size of the linguistic motion aftereffect, (3) story retelling quality, and (4) the amount of motion found in the retelling. On the measure of the size of the motion aftereffect after training, there was no significant difference between the control group (M = -0.02, SD = 0.13) and the experimental group (*M* = 0.10, *SD* = 0.22), *t*(19) = -1.62, *p* = .122, *d* = -0.71 (Figure 1). On the measure of the size of the linguistic motion aftereffect, there was no significant difference between the control group (*M* = -0.15, *SD* = 0.19) and the experimental group (*M* = -0.17, *SD* = 0.29), *t*(18) = 0.20, *p* = .843, *d* = 0.09 (Figure 2). On the measure of the story retelling quality, there was no significant difference between the control group (*M* = 26.01, *SD* = 18.49) and the experimental group (*M* = 23.85, *SD* = 14.09), *t*(18) = 0.29, *p* = .776, *d* = 0.13 (Figure 3). On the measure of the amount of motion found in the retelling, there was no significant difference between the control group (*M* = 2.00, *SD* = 0.83) and the experimental group (*M* = 1.70, *SD* = 0.72), *t*(18) = 0.87, *p* = .398, *d* = 0.39 (Figure 4).

Correlations were computed to test for relationships between the size of the motion aftereffect after training, the size of the linguistic motion aftereffect, story retelling quality, and the amount of motion found in the retelling. The size of the motion aftereffect after training was marginally correlated with the size of the linguistic motion aftereffect, *r* = 0.401, *p* = .080 (Figure 5). The size of the motion aftereffect after training was also not correlated with the story retelling quality, *r* = -0.016, *p* = .947 (Figure 6) nor with the amount of motion found in the retelling, *r* = -0.065, *p* = .785 (Figure 7). The size of the linguistic motion aftereffect was not correlated with the quality of the story retelling, *r* = 0.112, *p* = .638 (Figure 8) nor with the amount of motion found in the retelling, *r* = 0.101, *p* = .673 (Figure 9). The quality of the story retelling was significantly correlated with the amount of motion found in the retelling, *r* = 0.972. *p* < .001 (Figure 10).

Discussion

This study aimed to answer questions about the consequences of individual differences on mental imagery. To test this, we trained participants to imagine motion-related and motion-unrelated information, and we measured the degree to which this training improved mental imagery and language comprehension. Our prediction that speed training would lead to better story comprehension than contrast training was not supported. Results from the study showed no significant difference between training conditions on the size of the motion aftereffect after training, the size of the linguistic motion aftereffect, story retelling quality, nor the amount of motion found in the retelling. This suggests that any effects of mental imagery training may not transfer to other types of tasks, like language comprehension. There was a marginal correlation between the size of the motion aftereffect from mental imagery on third day of training and the size of the motion aftereffect from language on that same day. This finding is consistent with previous evidence of individual differences in the motion aftereffect by Dils & Boroditsky (2010).

There also did not appear to be a linear relationship between the size of the motion aftereffect from language and language comprehension in this sample. This finding, however, may be due to the fact that story retellings were poor overall due to fatigue effects by the end of the study. Participants consistently showed a priming effect from language comprehension, not an aftereffect, which might also be consistent with shallow language processing overall. Because performance was poor overall between subjects, there was a restricted range issue for our correlational analyses.

While findings suggest mental imagery training may not transfer to language comprehension of unrelated topics, it is important to consider a variety of limitations and future directions this research may want to consider. Firstly, 20 minutes of training per day for three days of training may not have been enough to improve performance substantially. Further research in this topic may wish to have participants come in for more sessions of training as well as for more consistent trainings. Due to scheduling issues, some participants ended up with extended gaps in training which may have also affected our data. Therefore, having participants come in more consistently for more days of training may result in different outcomes. Also, future research may ask participants to engage in different training. Rather than having participants in the experimental condition be limited to a single dimension of training (only engaging in speed judgements), participants might be asked to attend to multiple dimensions of visual motion simultaneously. Finally, it could be helpful to provide participants with a few different strategies to try out during training.

This study helps to understand what the possible consequences of individual differences in mental imagery ability are through use of an implicit measure. Routine engagement in visual motion mental imagery may assist in language comprehension and may have implications for language comprehension skills in the classroom and in testing settings. Many standardized exams such as the SATs, GREs, and GMATs test students' language comprehension abilities. It is therefore important to understand whether and when training in visual motion mental imagery may benefit students in performance on such exams.

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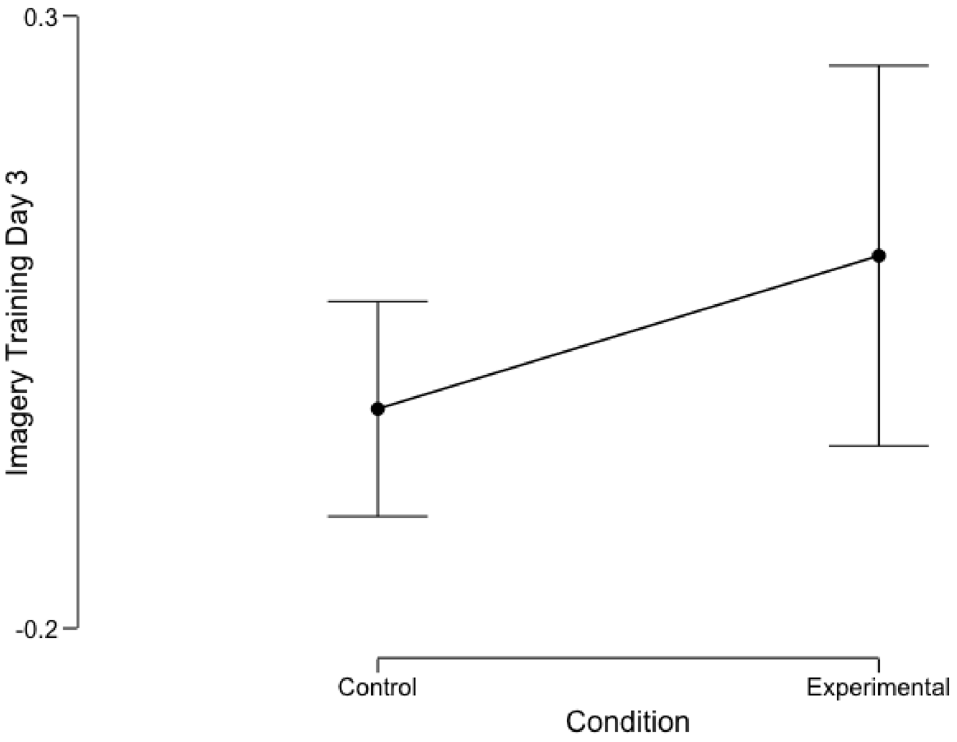

Figure 1. MAE from mental imagery after training broken down by condition. Error bars represent confidence intervals.

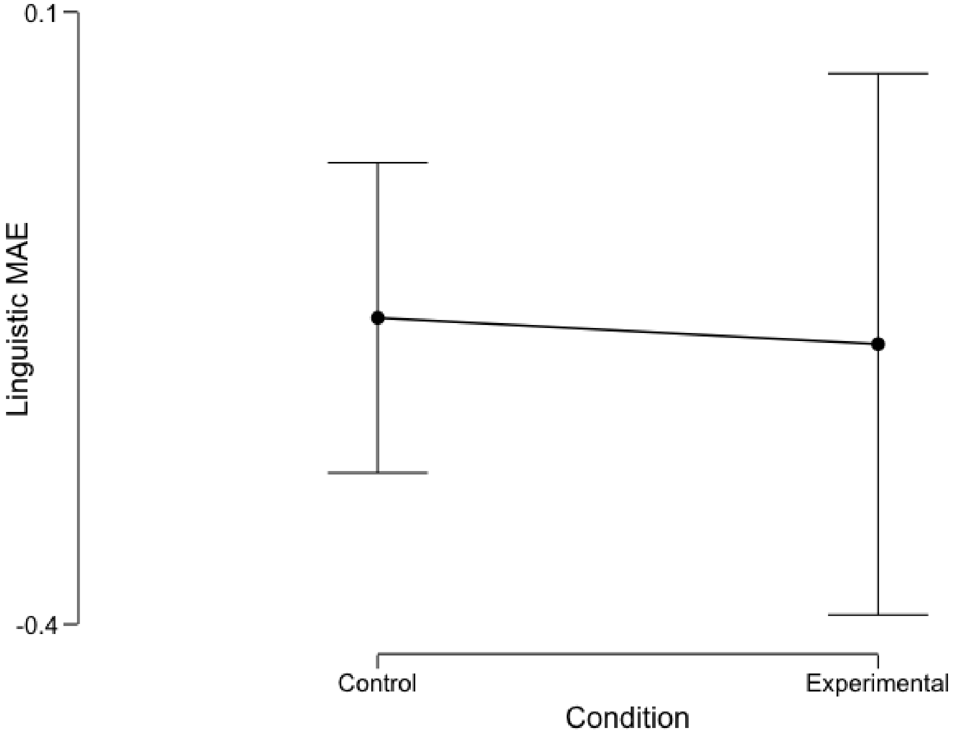

Figure 2. MAE from language after training broken down by condition. Error bars represent confidence intervals.

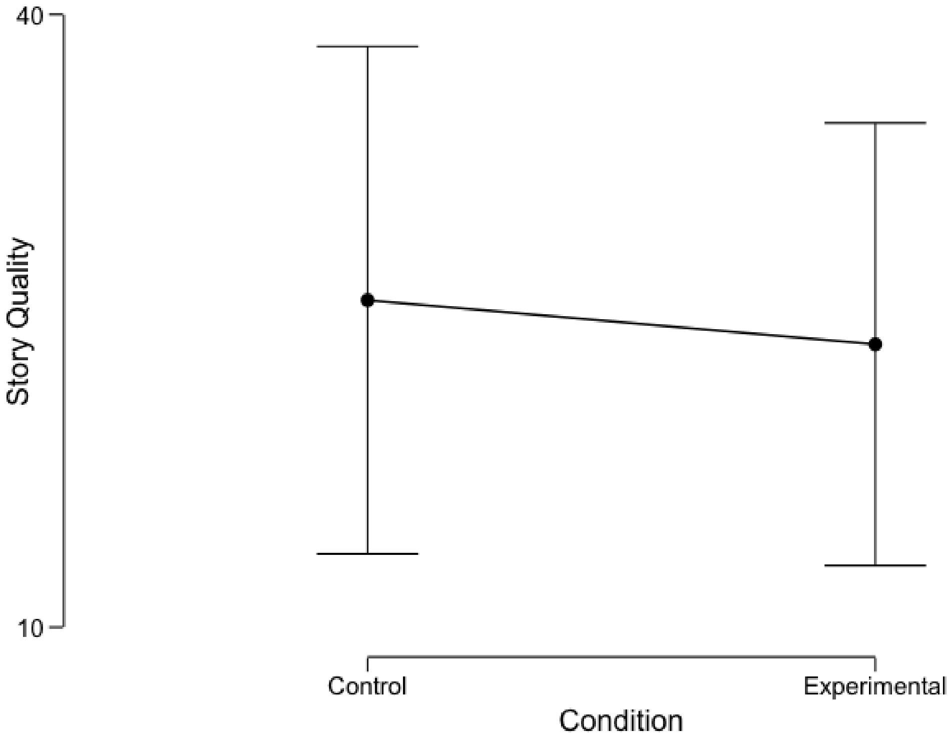

Figure 3. Story quality ratings broken down by condition. Error bars represent confidence intervals.

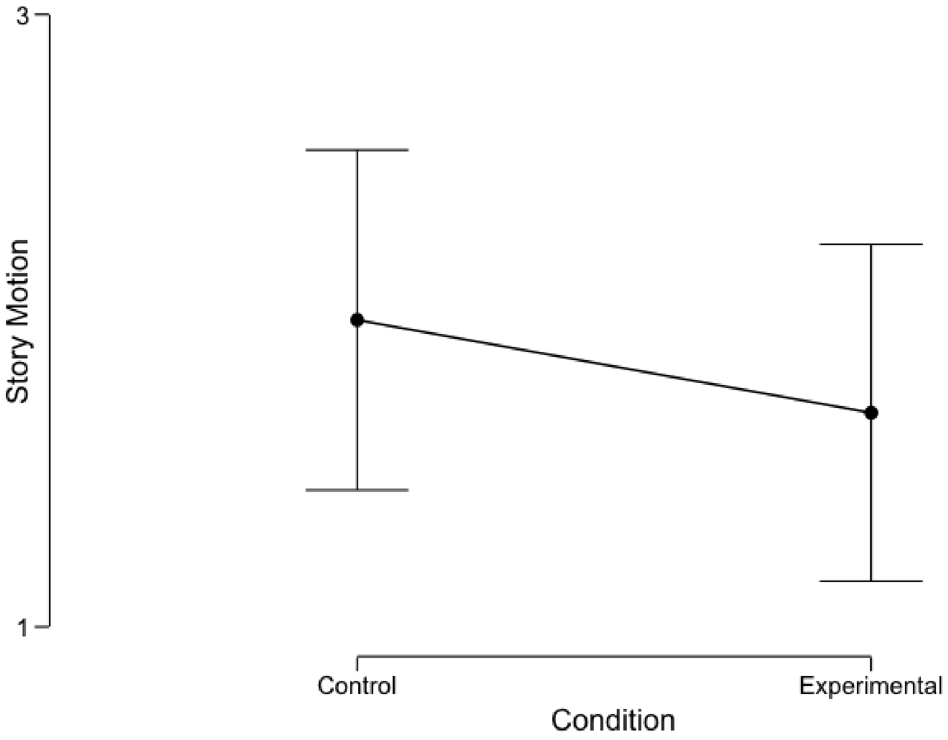

Figure 4. Story motion ratings broken down by condition. Error bars represent confidence intervals.

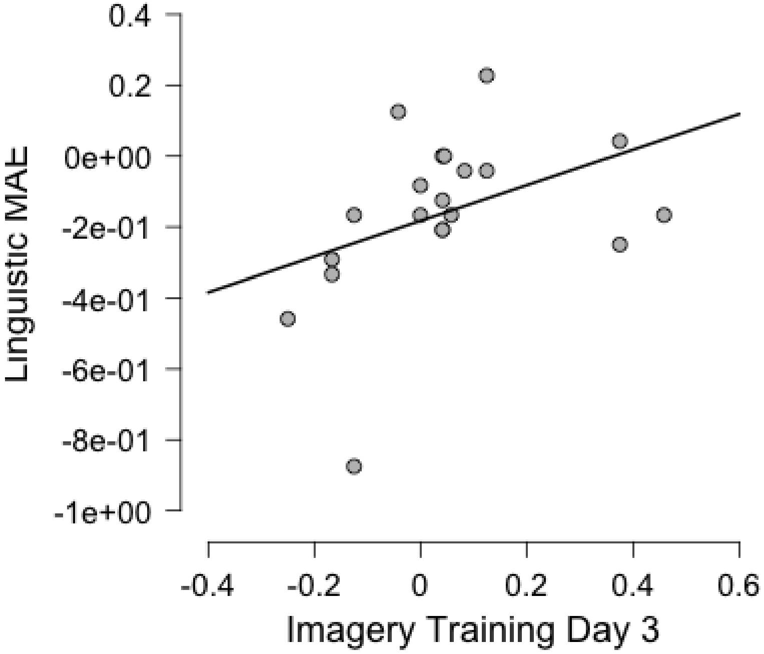

Figure 5. Linear relationship between MAE from imagery and language.

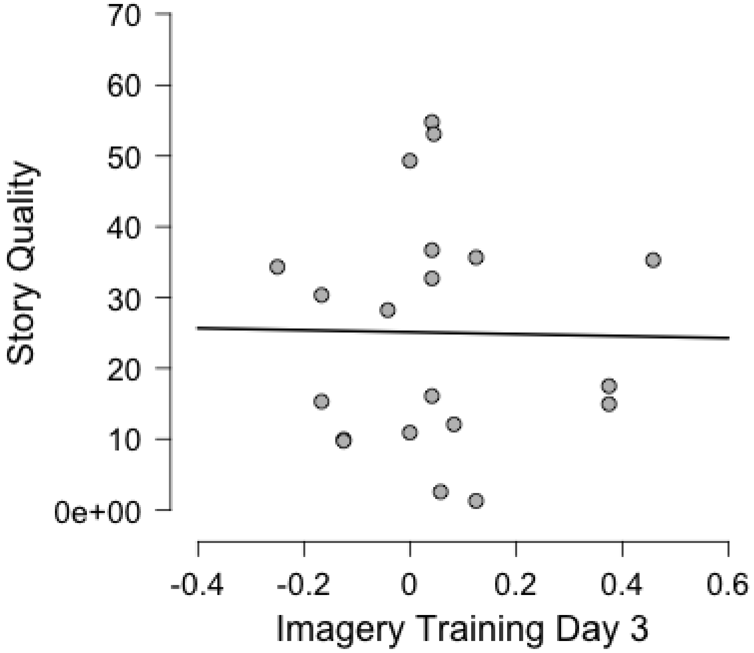

Figure 6. Linear relationship between MAE from imagery and story quality ratings.

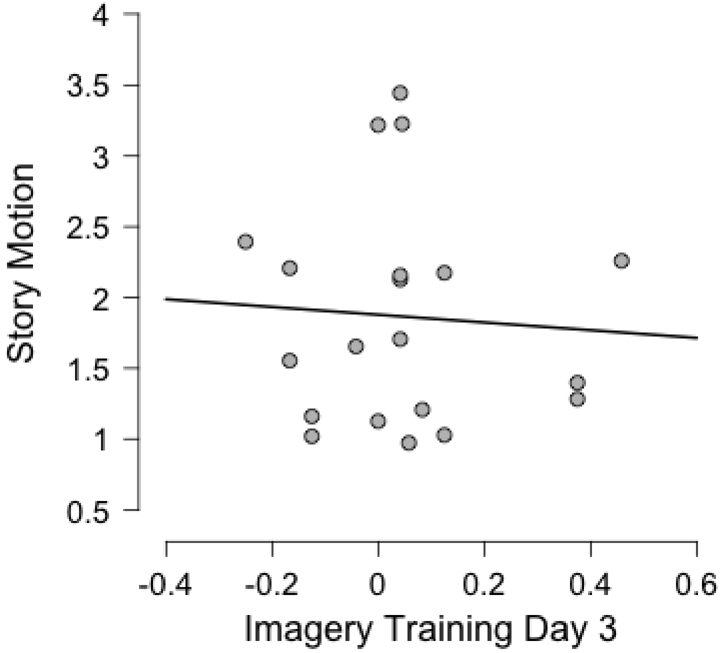

Figure 7. Linear relationship between MAE from imagery and story motion ratings.

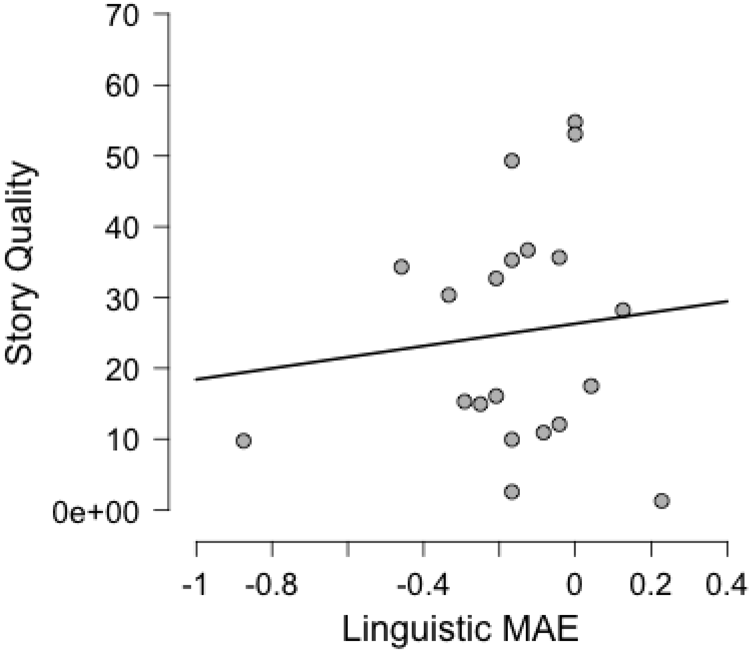

Figure 8. Linear relationship between MAE from language and story quality ratings.

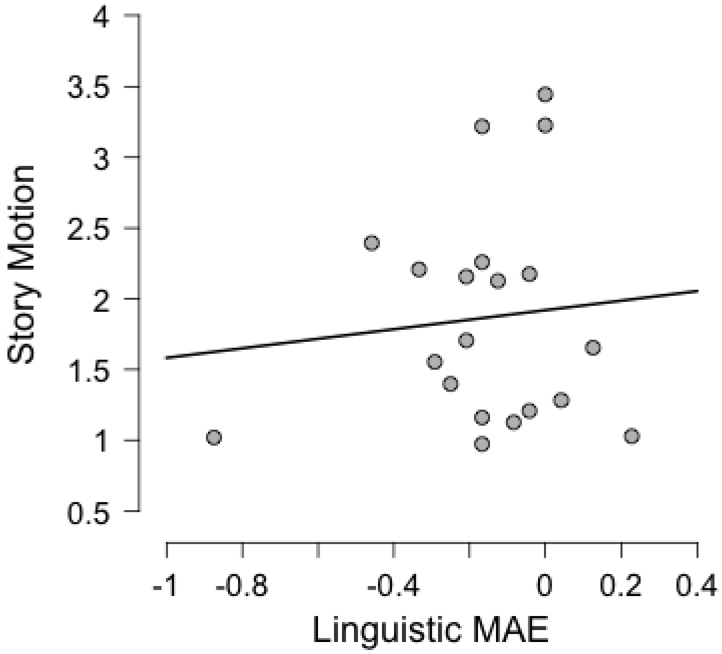

Figure 9. Linear relationship between MAE from language and story motion ratings.

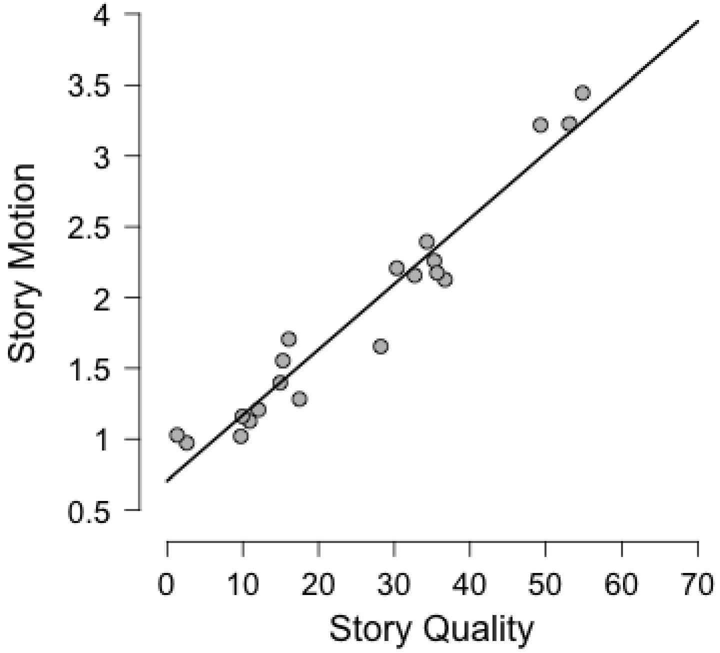

Figure 10. Linear relationship between story quality ratings and story motion ratings.