INVESTIGATING METACOGNITIVE BIASES: CONNECTIONS BETWEEN FLUENCY EFFECTS AND BELIEFS IN INDIVIDUALIZED LEARNING STYLES

by

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ABSTRACT

Previous work illustrates that people's judgments of the memorability of stimuli is affected by the perceptual features of those stimuli, even when there is no actual difference in memory (Rhodes & Castel, 2008). There is, however, a gap in the research about how such metacognitive illusions relate to other common misconceptions about how memory works. The present study examined the connection between so-called perceptual fluency effects and the common misconception that students learn best when content is presented in line with their individualized learning styles (e.g., auditory learners, visual learners, etc.). Participants were asked questions to gauge their perceptions of learning styles, then studied and made judgments about words that were presented in either large or small fonts (a manipulation that has been shown to affect judgments, but not actual memory performance). After a delay, participants took a free recall test, and were asked to make a global judgment about whether they remembered the large or small words better. We found that 43.47% of participants endorsed visual learning styles, 21.75% endorsed kinesthetic learning styles, 8.69% endorsed auditory learning styles, and the other 26.09% did not endorse a specific learning style. We also examine the relationship between learning styles and fluency effects.

Keywords: individualized learning styles, fluency effects, judgments of learning, metacognitive biases

Investigating Metacognitive Biases:
Connections Between Fluency Effects and Beliefs in Individualized Learning Styles

Metacognitive illusions, or a mismatch between what we believe to be true about cognition and what is actually true, can influence how cognitive resources are allocated. False beliefs about how learning works, for instance, can lead learners to study using suboptimal strategies. Focusing on the wrong information while learning, or using unhelpful techniques to learn it, has implications for classroom performance: students who try to memorize vocabulary terms and their definitions for an exam that will actually test them on deeper conceptual information may find themselves with a lower grade than expected.

Misconceptions about perceptual fluency

One area in which metacognitive illusions have been assessed is at the intersection between memory and perception. For example, auditory information, such as loud or quiet volumes, can change participants' judgments of learning (Rhodes & Castel, 2009). Judgments of learning (JOLs) measure participants' metacognitive judgments about how likely they are to remember a given piece of information later on -- e.g., "How likely are you to remember this word later, on a scale from 0 (not at all likely) to 10 (very likely)?" The effect of auditory variation on metacognition and memory was tested by presenting words in either a loud or quiet volume to participants, then assessing both JOLs and later recall performance. Participants gave higher JOLs to the words at loud volume -- thus indicating that they thought those words were easier to remember -- but there was not actually a difference in the memory recall. Other perceptual information, such as the size of the font in which a to-be-remembered word is presented, can also influence memory predictions (Rhodes & Castel, 2008). That is, participants

give higher JOLs for the words presented in larger font sizes, but when they actually recall the words, there is not a difference in recall between words presented in the two font sizes. Both of these studies showed evidence of mismatches between perceived and actual memory: there was not a difference in memory recall even though the participants thought that there was a difference in remembering the loud vs quiet or large vs small cues. Castel et al. (2012) also found that different types of cues result in different types of metacognitive judgments, such that saying "yes" after reading the word in the memory task resulted in participants' giving different judgments of learning than saying the word aloud. In the current study, we are investigating the connection between an already-established illusion - dubbed the "font size effect" - and its connection to another potential metacognitive illusion: individuals' belief in individualized visual, auditory, and kinesthetic learning styles.

Misconceptions about learning styles

In the current work, we refer to a belief in learning styles as the concept that individuals have different ways of learning that works best for them (Pashler et al., 2008) -- more specifically, that learning in compatibility with their given learning style will benefit a learner while learning in a different style will harm them. Many teachers of differing levels of education use guide books based on a thriving industry of learning styles in the classroom. For example, there are tools such as the VARK Questionnaire to help students identify their learning style, which has been used in contexts from education to business. To assess the scientific validity of this popularly-held belief, Pashler and colleagues (2008) tested whether there was one learning style that worked best according to preference and concluded that there is not enough evidence for learning styles and that more research needs to be done.

Another study that examined individual learning styles was done by Morehead et al. (2016). The authors tested the amount of knowledge that students and instructors have about study strategies and whether their beliefs in study skills were correct or not. Students did have some accurate beliefs about studying and learning. For example, there was a moderate, marginally reliable relationship between students endorsing testing as a learning strategy, which has been shown to benefit performance (McDermott, Agarwal, D'Antonio, Roediger III, & McDaniel, 2014) and their GPA (Morehead et al., 2016), such that higher GPAs were associated with a greater likelihood of endorsing evidence-based strategies. However, the study revealed that there can be much improvement in choosing the best study strategy because both students and instructors do not choose the most efficient study skills aligned with their perceived individual learning style. This is important to know because even though students might believe they have a learning style, their study skills are not aligned with it; which is another reason why students and teachers need to be informed of the validity of learning styles. This leads us to our current study in which we test if students' perceived individual learning style affects their judgments of learning on a memory test.

The current study

There may be further underlying metacognitive mechanisms linking these two metacognitive illusions. For example, beliefs about intelligence may also affect judgments of learning on a memory test. Miele, Finn, and Molden (2011) examined the differences of JOLs based on what participants thought about intelligence. Participants that believed intelligence is fixed made higher JOLs for words in larger font because they were using the "easily learned, easily remembered" heuristic that explains how people interpret encoding

fluency when assessing their own memory -- that is, that a piece of information that is learned easily has a higher likelihood of being remembered later. Participants who believed intelligence is malleable made higher JOLs for the words presented in smaller font because they interpreted it as effortful encoding.

In the current study, we asked participants about their individual learning style before the memory portion of the experiment to demonstrate the connections between fluency effects and beliefs in individual learning styles. We hypothesized that a belief in one metacognitive bias might be related to a belief in another. For example, if someone believes in an individualized learning style, they will also believe in the fluency effect on JOLs. Our secondary hypothesis was that metacognitive beliefs may be related to overall beliefs about intelligence; if someone believes intelligence is fixed, they will also endorse a specific learning style.

Method

Participants

Thirty-six Texas Christian University (TCU) Psychology students participated for partial course credit. Participants were tested individually. The age of the participants ranged from 18-27 years. There were 29 female and seven male participants. The ethnicity of the participants included 31 White students, two Asian/Pacific Islander students, and three Hispanic/Latinx students. Approval for this research was obtained from the TCU Institutional Review Board.

Materials and Procedure

Participants first completed the consent form and demographic questionnaire. They were then told that they would be studying words for a later test and that after they studied each word, they would make a judgment about how likely they were to recall that word later, on a scale from

0 (not at all likely) to 100 (certain). They were then told that they would each word for 4s and would have 4s to make each judgment.

After they were given instructions for the memory portion of the experiment, participants were asked questions to gauge their perceptions of learning styles (for questions, see Appendix A). After the learning styles information, participants began the learning phase of the task. Participants studied and made judgments about 42 words that were drawn from a noun word bank (e.g., “counter”, “symbol”). Half of the words were presented in large (48-point) font, the other half were presented in small (18-point) font, as in Rhodes and Castel (2008). Font size was randomized for each item and each participant, as was the presentation order of the words. After studying all words, participants experienced a 2m delay in which they played a distractor game of Tetris. After the delay, participants took a free recall test in which they were asked to type as many of the previously-presented words as they could recall into a box on the screen (the free recall test lasted for 4m; participants were not allowed to advance until the 4m had elapsed). This procedure was then repeated for a second list of new words.

After the second test, participants were asked to make a global judgment about whether they remembered the large or small words better, and completed the Theories of Intelligence Questionnaire (Dweck, 2000), in order to compare to previous work assessing the connection between metacognitive judgments and beliefs about intelligence (i.e., Miele, Finn, & Molden, 2011). This questionnaire can be found in Appendix B. Once the participants completed the study, they were debriefed. The debrief informed participants that so-called “individual learning styles” is not supported by scientific research (Pashler, McDaniel, Rohrer, & Bjork, 2008). The debrief also included the finding that people remember words in different font sizes equally

accurately, even though people *believe* that words in large font are easier to remember (Rhodes and Castel, 2008). The study concluded when we thanked each person for their participation.

Results and Discussion

The present study examined the connection between so-called perceptual fluency effects and the common misconception that students learn best when content is presented in line with their individualized learning styles (e.g., auditory learners, visual learners, etc.). We hypothesized that belief in one metacognitive bias, such as an individualized learning style, was associated with a belief that more perceptually-fluent items (i.e., larger items) are easier to remember compared to less perceptually-fluent items (i.e., smaller items), , another metacognitive bias.

Learning Styles and The Font Size Effect

Results from the learning style questionnaire showed that 43.47% of participants endorsed visual learning styles, 21.75% endorsed kinesthetic learning styles, 8.69% endorsed auditory learning styles, and the other 26.09% did not endorse a specific learning style. While 73.91% of participants endorsed a specific learning style, the other 26.09% either believed in individualized learning styles, but did not think they personally had one or they did not believe in learning styles at all. This finding suggests that even though there is little to no evidence that people learn best when information is presented in their preferred learning style, most undergraduate student participants still *believe* this to be true. That is, we found evidence that the learning styles myth was pervasive in our sample.

To assess the other myth of interest -- that perceptually-fluent items are easier to remember than less-fluent items -- we assessed participants' memory accuracy and metacognition in a replication of the original font size effect studies (see Rhodes & Castel,

2008). Participants gave higher metacognitive judgments (as measured by JOLs) to the words presented in larger font sizes, indicating that they thought larger words would be easier to remember. However, when participants actually recalled the words, there was not a difference in accuracy between words presented in large font versus small fonts. This finding was a replication of the Rhodes and Castel (2008) experiment that found that perceptual information can affect memory predictions.

Figure 1 shows participants' judgments of learning represented by the black bars and participants' actual recall performance represented by the gray bars. Overall, this figure suggests that participants gave higher judgments of learning to large font words than to small font words, but there was no difference in accuracy between larger and smaller font words. In addition, Figure 1 suggests that participants were generally overconfident in their ability to recall words, consistent with Rhodes and Castel (2008).

To assess the potential significance of these differences, we conducted a within-subjects analysis of variance (ANOVA). The ANOVA results demonstrated a marginal interaction between font size and the JOL/recall variable, $F(1, 22) = 3.17$, $p = .09$. As this marginally-significant interaction was of primary interest to the current study, we followed it up with paired-samples *t*-tests. A paired-sample *t*-test revealed that higher JOLs were given to larger words ($M = 49.26$, $SD = 22.32$) than to smaller words ($M = 42.40$, $SD = 21.35$), $t(22) = 2.66$, $p = .01$. A separate paired-samples *t*-test revealed that participants performed equally well in recalling larger ($M = 25.73$, $SD = 10.30$) and smaller words ($M = 24.88$, $SD = 12.27$), $t(22) = 0.35$, $p = .73$.

Connections between metacognitive beliefs

The above results suggest that both metacognitive misconceptions -- learning styles and perceptual fluency -- were exhibited by our sample. To examine a potential relationship between these two biases, we conducted a correlation. More specifically, we conducted a point-biserial correlation to determine whether there was a relationship between participants' belief in learning styles (coded as yes or no) and the difference score between their JOLs for large and small font words (i.e., the extent of their misconception that larger font words are easier to remember than smaller words). In contrast to our expectations, there was not a significant relationship between beliefs in these two metacognitive biases, $r = .19$, $p = .38$. We propose two potential explanations for the lack of this effect: one, that there truly is no relationship between these two constructs, or two, that there is not enough variance in learning style beliefs (~75% endorsed versus ~25% did not) to reveal a correlation using this type of test.. However, the relationship between belief in learning styles and perceptions about intelligence was significant, $r = .42$, $p < .05$, such that increased belief in intelligence as fixed was associated with endorsing a specific learning style. This finding suggests that fixed beliefs about intelligence were related to having a belief in learning styles. While more work is needed to explore this relationship, it does provide an interesting connection: it may be that students who believe in learning styles are more likely to be rigid in their thinking about intelligence in general -- for example "I'm a visual learner and that's just how it is -- I learn best this way, and need to stick with this rather than trying new techniques."

Conclusion

The present study revealed a relatively high incidence of student's false beliefs that they have an individualized learning style (see Pashler et al., 2008). In addition, we replicated previous findings regarding false beliefs about the effect of perceptual fluency on memory.

While we found a significant positive relationship between beliefs in learning styles and beliefs that intelligence is fixed, we did not find evidence for our primary hypothesis that the two misconceptions of perceptual fluency effects and individualized learning styles were positively associated.

Ideas for future research include examining whether changing participants' beliefs about learning styles affect their beliefs about learning and intelligence. For example, it may shed light on these false beliefs to conduct an experiment in which researchers manipulate whether participants' naive beliefs about learning styles are left alone (control group) or are given information (backed by scientific articles) that learning styles are not supported by evidence, even though people *believe* that they exist (e.g., presenting the debriefing material used in the current study to half of participants before they began the tasks). Then, researchers could compare whether challenging these beliefs about learning styles would affect other metacognitive beliefs, such as those about the connection between fluency and learning or about intelligence in generale.

Implications of these findings include the notion that teachers take care when emphasizing learning styles to their students, given the dearth of evidence to support such claims. That is, educators who are proponents of teaching to match (or mesh with) students' so-called learning styles should, according to Pashler and colleagues (2008), instead teach using a variety of methods: visual, auditory, kinesthetic, and otherwise. In addition, educators should be aware of their students' and their own beliefs about learning and how it might impact their ability to encode and retain information. Meanwhile, students should be aware that even though they might have a preference towards an individualized learning style, there is no evidence to support that their preferred learning style will help them perform better on a memory test. In

sum, the current study suggests that beliefs in learning styles are quite common in an undergraduate sample, and are related to belief in intelligence as a fixed entity, which has theoretical implications for memory and metacognition research, as well as practical implications for student learning.

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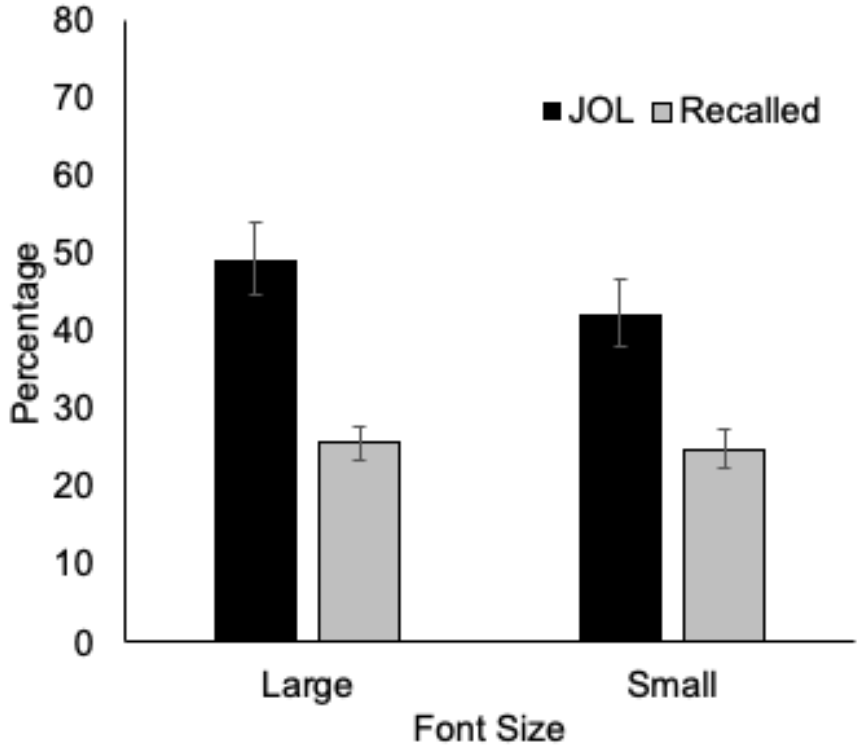
Figure 1

Percentages for JOLs and Recalled Words of Differing Font Sizes



Note. The percentage of JOLs and recalled words are shown for large and small font sizes (error bars show standard errors).

Appendix

APPENDIX A: Learning Style Questionnaire

Many students endorse the idea that they have a particular "learning style" -- for example, that they are a visual learner who learns better when information is presented visually, or that they are an auditory learner who learns better when information is presented auditorily, or that they are a kinesthetic learner who learns better when information is presented physically (for example, by acting it out). Do you have a learning style?

- o Yes, I am a visual learner
- o Yes, I am an auditory learner
- o Yes, I am a kinesthetic learner
- o Yes, I have a learning style but it is not listed
- o No, I do not have a learning style but I believe others have them
- o No, I do not believe in learning styles such as visual/auditory/kinesthetic learning styles

How confident are you in the answer you just provided? Please use a scale from 0 to 100, where 0 indicates "not confident at all" and 100 indicates "certain."

Learning scientists have identified different learning styles. Some people learn information in different ways; each of us has our own learning style and we learn best when we're presented information in the way that matches with our learning style. Please read the information about learning styles on the following pages.

Some students seem to learn better when the information is presented auditorily (auditory learners). Others seem to learn better when the information presented through pictures (visual learners). Still others learn better when the information is presented in a way that allows them to move their body (kinesthetic learners).

For example, consider students studying a foreign language. They're learning translations for words like pencil, desk, and food.

An auditory learner learns best if they say the words and their translations aloud, or hear them repeated aloud by the instructor.

A visual learner learns best if they see these words written out on paper, perhaps with pictures of each of the items beside the translations (e.g., a picture of a pencil beside the translation for "pencil").

Finally, a kinesthetic learner learns best if they are able to physically act out the information (e.g., imagining writing with a pencil when learning the translation for "pencil," or actually writing with one).

After reading this information, which of the following options is closest to *your* learning style?

o Visual learning style

o Auditory learning style

o Kinesthetic learning style

o None of the above

How confident are you in the answer you just provided? Please use a scale from 0 to 100, where 0 indicates "not confident at all" and 100 indicates "certain."

APPENDIX B: Theories of Intelligence Questionnaire

Each item was answered on the following scale:

Strongly Agree Agree Somewhat Agree Somewhat Disagree Disagree Strongly Disagree

You have a certain amount of intelligence, and you can't really do much to change it.

Your intelligence is something about you that you can't change very much.

No matter who you are, you can significantly change your intelligence level.

To be honest, you can't really change how intelligent you are.

You can always substantially change how intelligent you are.

You can learn new things, but you can't really change your basic intelligence.

No matter how much intelligence you have, you can always change it quite a bit.

You can change even your basic intelligence level considerably.