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Does Easily Learned Mean Easily Remembered? It Depends on Your Beliefs About Intelligence

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Abstract

Because numerous studies have shown that feelings of encoding fluency are positively correlated with judgments of learning, a single dominant heuristic, *easily learned = easily remembered* (ELER), has been posited to explain how people interpret encoding fluency when assessing their own memory. However, the inferences people draw from feelings of encoding fluency may vary with their beliefs about why information is easy or effortful to encode. We conducted two experiments in which participants studied word lists and then predicted their future recall of those items. Results revealed that subjects who viewed intelligence as fixed, and who tended to interpret effortful encoding as indicating that they had reached the limits of their ability, used the ELER heuristic to make judgments of learning. However, subjects who viewed intelligence as malleable, and who tended to interpret effortful encoding as indicating greater engagement in learning, did not use the ELER heuristic and at times predicted greater memory for items that they found more effortful to learn.

Keywords

judgment, memory, heuristics, learning, metacognition, fluency

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During self-paced study, the easier it feels to learn new information—for example, the simpler the information (Koriat, Ma'ayan, & Nussinson, 2006) or the quicker the learning (Koriat & Ma'ayan, 2005)—the more confident people are about their ability to recall it in the future (i.e., the higher their judgments of learning, or JOLs). The consistency of these findings over a wide range of studies has led to the suggestion that people uniformly use an *easily learned = easily remembered* (ELER) heuristic to interpret experiences of encoding fluency during learning (e.g., Koriat, 2008). However, recent research on decision making suggests that interpretations of encoding fluency are profoundly influenced by people's naive theories about what their experiences of fluency mean (Briñol, Petty, & Tormala, 2006; Labroo & Kim, 2009; see Schwarz, 2004). Therefore, as opposed to being universal, the heuristics used to interpret encoding fluency during learning may show important variations among individuals holding different naive theories. In the experiments we report here, we investigated whether use of the ELER heuristic depends on people's naive theories about the nature of human intelligence.

Research on naive theories of intelligence (TOIs; Dweck, 1999; Molden & Dweck, 2006) has shown that people who believe that intelligence is a fixed entity (i.e., *entity theorists*) tend to attribute their academic performance to innate ability more often than to effort, whereas people who believe that intelligence can be developed incrementally (i.e., *incremental theorists*) attribute their performance to effort as much as they attribute it to ability. In addition to differing in their attributions of effort, entity and incremental theorists differ in their interpretations of effort (Blackwell, Trzesniewski, & Dweck, 2007). Because entity theorists see their performance as largely diagnostic of their innate and stable abilities, they tend to infer that effort or difficulty experienced during a task indicates that these abilities are lacking (otherwise the task would have been easy). In contrast, because incremental theorists are more likely to view their performance as diagnostic of the effort they have dedicated to the task, they tend to infer that this effort indicates that they are working hard to improve their abilities.

On the basis of these findings, we hypothesized that entity theorists should interpret effortful encoding as a sign that they are reaching the limits of their ability to learn new information and should therefore report lower JOLs as encoding fluency

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decreases (in line with the ELER heuristic). In contrast, incremental theorists should not judge effortful encoding as a sign of limited ability or report lower JOLs simply on the basis of decreases in encoding fluency. Indeed, when they can clearly interpret increased effort in terms of greater task engagement, they might even report higher JOLs as encoding fluency decreases (the opposite of the ELER heuristic; cf. Miele & Molden, 2010).

Experiment 1

In an initial test of these hypotheses, participants studied Indonesian-English vocabulary pairs that varied in how easy they were to encode. Participants spent as much time as they liked studying each pair and then reported a JOL regarding their recall of that pair on an upcoming memory test. Because increases in self-paced study time are associated with decreases in the perceived fluency of encoding (Koriat & Ma'ayan, 2005), we examined how people's TOIs interacted with two separate (albeit correlated) sources of variance in study time. The first source was the manipulated ease (i.e., fluency) of the vocabulary pairs, and the second source was the natural variation in people's study times that emerged across levels of difficulty. Regardless of the source, we predicted that entity theorists would show a greater tendency than incremental theorists to use the ELER heuristic. That is, we predicted that entity theorists would give relatively low JOLs as both item fluency decreased and unmanipulated study time increased, but that incremental theorists would not.

Method

Participants. Seventy-five native-English-speaking students at Columbia University and Washington University in St. Louis participated for payment or course credit.

Materials. Stimuli consisted of 54 Indonesian-English vocabulary pairs taken from a study by Kornell and Son (2009). Eighteen were high-fluency cognate pairs (e.g., *Polisi*-*Police*), 18 were medium-fluency pairs, in most of which the Indonesian word was connected with a familiar English word (e.g., *Bagasi*-*Luggage*), and 18 were low-fluency pairs consisting of words with no apparent connection (e.g., *Pembalut*-*Bandage*).

Procedure. Vocabulary pairs were presented sequentially in a random order. After studying each pair, participants reported a JOL indicating their confidence (0–100%) that they would recall the English target if given only the Indonesian cue on an upcoming cued-recall test. After studying all of the pairs, participants completed this recall test. Test items were displayed in a random order, and participants had unlimited time to respond to each one. Finally, participants completed a well-validated eight-item TOI questionnaire (Dweck, 1999), which asked them to rate their agreement (on a scale from 1 to 6) with such statements as "Intelligence is something basic about a person that cannot be changed." These ratings were averaged to form a single continuous index of belief in the relative stability or malleability of intelligence ($\alpha = .96$). Although TOIs were measured and analyzed continuously, for ease of exposition, we label subjects who (on average) agreed that intelligence is fixed as entity theorists and those who agreed that intelligence is malleable as incremental theorists.

Results and discussion

Dependent variables were analyzed using analyses of covariance, with the continuous TOI index as a covariate. Simple-effects analyses were conducted at 1.5 standard deviations above the midpoint of the TOI index for entity theorists and 1.5 standard deviations below the midpoint for incremental theorists (Aiken & West, 1991).

An initial analysis confirmed that the item-fluency manipulation did affect study times, $F(2, 146) = 43.92$, $p < .001$, $\eta_p^2 = .38$. Participants studied low-fluency items ($M = 5.87$ s, $SE = 0.55$) longer than medium-fluency items ($M = 4.73$ s, $SE = 0.42$), $t(73) = 5.54$, $p < .001$, and medium-fluency items longer than high-fluency items ($M = 2.81$ s, $SE = 0.17$), $t(73) = 6.33$, $p < .001$. There was also a marginal main effect of TOI on overall study times, such that entity theorists spent more time studying ($M = 5.59$ s, $SE = 0.74$) than did incremental theorists ($M = 3.46$ s, $SE = 0.68$), $F(1, 73) = 3.07$, $p = .08$, $\eta_p^2 = .04$; however, this effect was not qualified by a significant interaction, $F(1, 73) = 2.18$, $p = .12$, $\eta_p^2 = .03$ (Greenhouse-Geisser correction: $p = .14$).

To test our primary hypothesis, we submitted JOLs and recall performance to separate repeated measures analyses of covariance, with item fluency as the within-participants factor. These analyses revealed that both dependent measures were affected by item fluency, Fs$(2, 146) > 464.65$, ps $< .001$, η_p^2s $> .86$, such that JOLs and recall performance were highest for the high-fluency items and lowest for the low-fluency items. In addition, TOI had a main effect on recall, $F(1, 73) = 6.22$, $p = .02$, $\eta_p^2 = .08$, but not on JOLs, $F(1, 73) = 0.66$, $p = .42$, $\eta_p^2 = .01$, such that recall performance was higher for entity theorists than for incremental theorists (perhaps because of entity theorists' longer study times). However, more important, the predicted Item Fluency × TOI interaction emerged for JOLs, $F(2, 146) = 3.00$, $p = .05$, $\eta_p^2 = .04$ (Greenhouse-Geisser correction: $p = .07$), such that the more incremental people's TOIs were, the lower the JOLs they reported for the high-fluency items ($r = .25$, $p = .03$), but not for the medium- or low-fluency items (rs $< |.05|$, ps $> .68$). The same interaction did not emerge for recall performance, $F(2, 146) = 0.46$, $p = .63$, $\eta_p^2 = .01$ (Greenhouse-Geisser correction: $p = .60$), which suggests that the differential effects of manipulated item fluency on entity and incremental theorists' JOLs were due to differences in their interpretation of encoding fluency as opposed to differences in their actual encoding of the vocabulary pairs.

To more closely examine the nature of these item-fluency effects, we tested whether TOI influenced the absolute

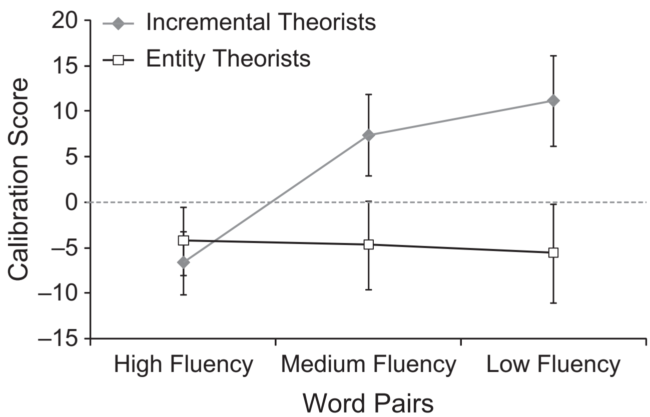

Fig. 1. Mean calibration score as a function of item fluency in Experiment 1. Scores were calculated by subtracting participants' recall performance from their judgment of learning at each level of item fluency. Results are plotted at 1.5 standard deviations above (entity theorists) and 1.5 standard deviations below (incremental theorists) the midpoint of the theory-of-intelligence index. The dashed line represents perfect calibration. Error bars represent standard errors of the mean.

accuracy of participants' JOLs (Dunlosky & Metcalfe, 2009). We did this by computing calibration scores, which were calculated by subtracting each participant's mean recall score from his or her mean JOL at each level of item fluency (Finn & Metcalfe, 2007; Koriat, Sheffer, & Ma'ayan, 2002). These scores directly measured the extent to which participants' subjective interpretations of fluency yielded JOLs that deviated from their actual memory for the items. Because item fluency was negatively correlated with manipulated item difficulty, the ELER heuristic served as a valid cue for recall success (Koriat, 2008). Thus, to the extent that participants were using this heuristic, their scores should have been well calibrated (i.e., should have showed no difference from zero) at each level of item fluency. If, however, participants were using the reverse heuristic (i.e., if they interpreted the effort associated with high- or low-fluency items as signs of decreased or increased learning, respectively), they should have been underconfident for the high-fluency items (as indicated by a significantly negative calibration score) or overconfident for the low-fluency items (as indicated by a significantly positive calibration score).

As shown in Figure 1, analyses of calibration scores also revealed the predicted Item Fluency × TOI interaction, $F(2, 146) = 3.48$, $p = .03$, $\eta_p^2 = .05$ (Greenhouse-Geisser correction: $p = .04$). Results for entity theorists were consistent with use of the ELER heuristic: Their calibration scores were accurate at all three levels of item fluency, ts$(73) < |1.14|$, ps $> .25$. In contrast, incremental theorists' scores were consistent with a reversal of the ELER heuristic; incremental theorists went from being marginally underconfident for high-fluency items, $t(73) = -1.92$, $p = .06$, to being marginally overconfident for medium-fluency items, $t(73) = 1.66$, $p = .10$, and significantly overconfident for low-fluency items, $t(73) = 2.22$, $p = .03$.

For the next set of analyses, we computed within-participants Spearman's correlations between self-paced study times and JOLs within each level of item fluency, and then we averaged the three correlations for each participant.[1] Because this procedure collapsed across the effects of the item-fluency manipulation, it provided a separate test of our TOI hypothesis in terms of natural variations in participants' study times that were independent of item difficulty. An analysis of the mean correlations revealed a significant moderating effect of TOI, $F(1, 73) = 6.39$, $p = .01$, $\eta_p^2 = .08$. As Figure 2 shows, results for entity theorists were consistent with the ELER heuristic; they exhibited a significantly negative correlation between study time and JOL ($\bar{r}_s = -.10$, $SE = .05$), $t(73) = 2.11$, $p = .04$. However, incremental theorists showed a reversal of the ELER heuristic; they exhibited a significantly positive correlation ($\bar{r}_s = .09$, $SE = .04$), $t(73) = 2.12$, $p = .04$. Additional repeated measures analyses (which excluded 3 participants because of lack of variability) indicated that these TOI effects did not differ significantly across levels of item fluency, $F(2, 140) = 0.95$, $p = .39$, $\eta_p^2 = .01$.

Experiment 1 strongly suggested that encoding fluency differentially affects metacognitive judgments of entity and incremental theorists. Although this was true even when controlling for the effects of item difficulty on JOLs (i.e., when examining calibration scores), our conclusions would be strengthened if the same results emerged when the manipulation of encoding fluency was entirely independent of item difficulty. We implemented such a manipulation in Experiment 2.

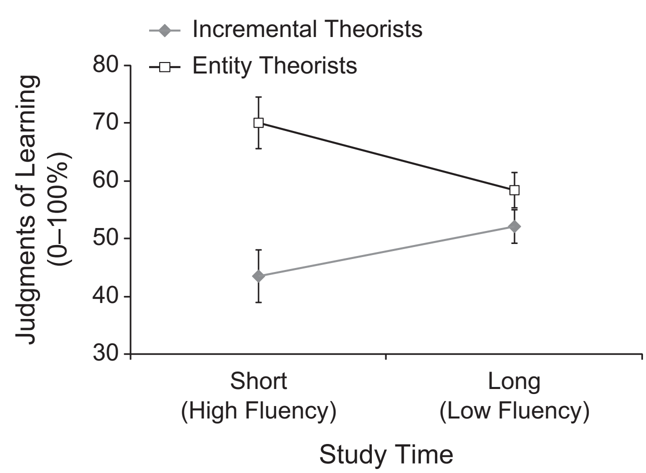

Fig. 2. Mean judgments of learning as a function of study time in Experiment 1. Results are estimated at 1.5 standard deviations above and below the overall mean of square-root-transformed study times and 1.5 standard deviations above (entity theorists) and 1.5 standard deviations below (incremental theorists) the midpoint of the theory-of-intelligence index. On the basis of previous research, we assumed that shorter study times were associated with higher fluency, and longer study times were associated with lower fluency. Estimates were derived using hierarchical linear modeling and are for visualization only (i.e., they were not used for significance testing). Error bars represent standard errors of the mean.

Experiment 2

Past research has shown that perceptual cues, such as font clarity, can affect people's feelings of fluency independently of how objectively difficult a particular item is to encode (see Schwarz, 2004). For instance, Rhodes and Castel (2008) showed that, as would be expected from the use of the ELER heuristic, participants provided higher JOLs when word-list items were presented in a perceptually fluent, large font than in a perceptually disfluent, small font, even though font size had no effect on recall performance. Therefore, if entity theorists use the ELER heuristic and incremental theorists do not, only entity theorists' JOLs should decline with decreasing font size.

Method

Participants. Forty-one native-English-speaking Columbia University students participated for course credit.

Materials. Following research by Rhodes and Castel (2008), we created two word lists from a pool of 26 nouns normed by Kucera and Francis (1967). Each list contained 9 words, and the two lists were equated for frequency and length. For each participant, one list was presented in 18-point Arial font and the other in 48-point Arial font. The font size for each list was counterbalanced across participants. (The remaining 8 items, which served as primacy and recency buffers, were excluded from all analyses.)

Procedure. The words were presented in random order. Participants viewed each item for 4 s and then had 5 s to report a JOL in the same manner as in Experiment 1. They then spent 3 min on a filler task and another 3 min attempting to recall the items. Finally, participants completed the TOI questionnaire used in Experiment 1 ($\alpha = .95$) and a two-item manipulation check asking them to rate, on a scale from 1 to 8, how difficult it was to read the words displayed in the larger font and the words displayed in the smaller font.

Results and discussion

All dependent variables were analyzed using the same methods as in Experiment 1. Analyses of perceived reading difficulty revealed only the expected main effect of font size, $F(1, 38) = 19.90$, $p < .001$, $\eta_p^2 = .34$. Furthermore, there were no effects of font size or TOI on participants' actual recall (overall $M = 35.0\%$, $SE = 2.69$). This meant that it was unnecessary to calculate calibration scores that corrected for performance differences, and thus our primary analyses focused on untransformed JOLs.

As shown in Figure 3, average JOLs showed the same main effect of font size as reported by Rhodes and Castel (2008), $F(1, 39) = 6.48$, $p = .02$, $\eta_p^2 = .14$. However, this effect was qualified by the predicted Item Fluency × TOI interaction,

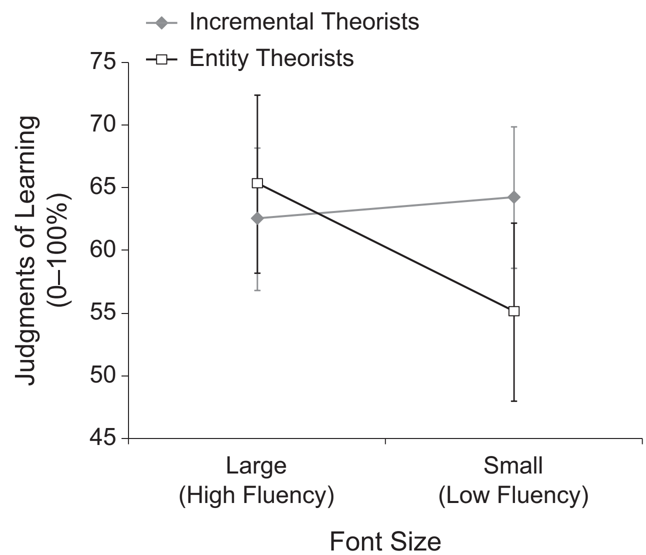

Fig. 3. Mean judgments of learning as a function of font size in Experiment 2. Results are plotted at 1.5 standard deviations above (entity theorists) and 1.5 standard deviations below (incremental theorists) the midpoint of the theory-of-intelligence index. On the basis of previous research, we assumed that the large font size was associated with higher fluency and the small font size was associated with lower fluency. Error bars represent standard errors of the mean.

$F(1, 39) = 5.93$, $p = .02$, $\eta_p^2 = .13$. Consistent with what we expected for participants who used the ELER heuristic (given that there were no differences in recall), findings showed that entity theorists gave higher JOLs for large-font items than for small-font items, $t(39) = 3.11$, $p = .003$. In contrast, incremental theorists' JOLs were not influenced by font size, $t(39) = 0.67$, $p = .51$, which indicates that they did not use the ELER heuristic.

General Discussion

These experiments demonstrate that naive theories of intelligence influence how people interpret experiences of encoding fluency when forming JOLs. In Experiment 1, entity theorists appeared to use the ELER heuristic and made relatively low (but accurate) JOLs when study time was long and item fluency was low. Incremental theorists showed a reversal of the ELER heuristic and made relatively low JOLs when study time was short and item fluency was high. These results, which controlled for differences in recall performance, are consistent with the two parts of our hypothesis. First, we predicted that entity theorists would interpret high levels of encoding effort associated with low fluency as an indication that they were reaching the limits of their ability to remember new information. Second, we assumed that incremental theorists would interpret high levels of encoding effort as an indication that they were working hard to improve their ability to remember the information (see also Miele & Molden, 2010). Experiment 2 further supported this hypothesis by showing the same pattern of results when fluency was manipulated independently of any differences in recall performance, thus eliminating the possibility that the observed effects were due to differences in entity and incremental theorists' responses to objectively easy or difficult items.

A difference between the two experiments worth noting is that although incremental theorists did not show any evidence of using the ELER heuristic in either experiment, their judgments appeared to reflect the use of an opposing fluency heuristic in Experiment 1 only. In Experiment 2, their judgments did not appear to be affected by the fluency manipulation. A possible explanation for this difference is that because study time was self-paced in Experiment 1, incremental theorists could attribute their experiences of encoding effort to their level of engagement in the task (i.e., to a goal-driven source; Koriat et al., 2006) and thus could employ a *highly engaged = easily remembered* heuristic (which is consistent with their beliefs about learning; see Dweck, 1999). However, because study time was fixed in Experiment 2, incremental theorists may have been more likely to attribute their experiences of encoding effort to the difficulty of the task (i.e., to a data-driven source) and may have been less likely to use an engagement-related heuristic (see Miele & Molden, 2010). Future studies should directly investigate this possible role of self-paced versus externally paced study time in entity and incremental theorists' interpretations of their fluency experiences.

Our findings have important implications for research on metacognition and learning. Rather than being universal (Koriat, 2008) or learned from experience alone (Unkelbach, 2006), the ELER heuristic may be but one interpretation of encoding fluency that people derive from their beliefs about intelligence (cf. Molden & Dweck, 2006). Therefore, two crucial goals for future studies will be to examine how differences in entity and incremental theorists' JOLs affect their choices about how to allocate study effort and then to develop theory-specific strategies for optimizing these choices. In general, our findings also suggest that researchers should consider stable individual differences in people's belief systems when attempting to understand metacognitive monitoring and control.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Note

1. Spearman's correlations were computed because study times exhibited positive skew.

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