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The effects of categorical relatedness on judgements of learning (JOLs)

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On-line monitoring during study can be influenced by the relatedness shared between the cue and target of a paired associate. We examined the effects on people's judgements of learning (JOLs) of a different kind of relatedness, which occurs in a list organised into sets of categorically related words and unrelated words. In two experiments, participants studied a list of words organised into a series of sets of four categorically related words or four unrelated words. In Experiment 1, JOLs were made immediately after each word had been studied, and JOL magnitude was greater for related than unrelated words. In Experiment 2, JOLs were delayed after study and, as expected, they were substantially greater for related sets of words. Serial position effects (an increase in JOL magnitude across the words of a related set) were evident with immediate JOLs but not with delayed JOLs. The relatedness effect was not present early in the list for immediate JOLs but was present throughout the list for delayed JOLs. We conclude by discussing some preliminary explanations for these new phenomena.

Metacognitive monitoring during study involves evaluating the degree to which a to-be-remembered item has been learned. This evaluation can be measured by a judgement of learning (JOL), which is a subjective judgement regarding one's confidence in whether a studied item will be remembered in the future (Arbuckle & Cuddy, 1969; Nelson & Narens, 1990). Prior research has focused on the accuracy of JOLs (Dunlosky & Nelson, 1992, 1997; Kelemen & Weaver, 1997; Nelson & Dunlosky, 1991) and the sensitivity of JOLs to different study cues (Begg, Duft, Lalonde, Melnick, & Sanvito, 1989; Benjamin, Bjork, & Schwartz, 1998; Carroll, Nelson, & Kirwan, 1997; Dunlosky & Matvey, 2001; Koriat, 1997; Matvey, Dunlosky, & Guttentag, 2001; Matvey, Dunlosky, Shaw, Parks, & Hertzog, 2002).

JOLs appear to be based on an inference about future memory performance. This inference can be based on certain cues that are present when an item is studied (Dunlosky & Matvey, 2001; Koriat, 1997; Matvey et al., 2001, Schwartz, 1994). One of the cues that has the strongest influence on JOLs is the degree of relatedness shared between the cue and target of a paired associate (Dunlosky & Matvey, 2001; Koriat, 1997; Matvey et al., 2001). The purpose of this article is to investigate the effects of a different kind of relatedness on JOLs—relatedness that is shared across a series of categorically related words in a study list.

When presented with a list of categorically related words (e.g., apple, pear, orange, grape), participants have the opportunity to engage in relational processing of the similarities shared between the words. This relational processing

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during study is a potential source of information that participants can monitor. This kind of relatedness is also a diagnostic cue for JOLs because relational processing that results from such an organised list can itself enhance recall (Mandler, 1967) or can do so in concert with item-specific processing (Hunt & Elliot, 1980; Hunt & McDaniel, 1993). Our primary concern here is less with the effects of relational processing on memory than on whether people will use such information as a basis for their JOLs. Will this cue influence JOLs? To provide preliminary answers to this question, we consider evidence and theory from JOL research based on paired-associate learning.

Item relatedness for paired associates refers to the relationship shared between the stimulus and response of an individual pair. The presence of such a relationship often leads to a substantial increase in the JOL made for that pair compared to a JOL made for a pair of words that does not contain such a relationship (Dunlosky & Matvey, 2001; Koriat, 1997). Although the item relatedness in paired associates may seem qualitatively different from item relatedness in the context of a list of single words, consider that when a paired associate consists of two related words (e.g., church–steeple), it can support the same kind of relational processing as that found between related words in a list (Einstein & Hunt, 1980; Mandler, 1967). In effect, the paired associate functions as a two-item list (Mandler, 1967). Given this rationale, a prediction is that relatedness among individual words on a list will influence JOLs.

Nevertheless, it remains an open question as to whether categorical relatedness shared across individual words will influence JOLs. An alternative possibility is that a person considers each item of a list individually when making JOLs. In this case, each item can be viewed psychologically as an independent JOL trial. According to Koriat's (1997) cue-utilisation framework, relatedness for a paired associate is an *intrinsic* cue that discloses a particular item's "a priori ease or difficulty of learning" (p. 350). Such intrinsic cues are predicted to have a substantial influence on JOLs (for further discussion, see Dunlosky & Matvey, 2001). By contrast, relatedness for individual words pertain to relational processing *across* these words, which better represents an extrinsic cue that pertains to "the encoding operations applied by the learner" (Koriat, 1997, p. 350). Extrinsic cues are expected to have a relatively minimal influence, suggesting that relational processing across words in a list may not affect people's JOLs.

Accordingly, a major goal of the present research was to investigate whether categorical relatedness shared across words on a list can influence the magnitude of JOLs. Assuming such an influence is demonstrated, other questions arise, such as: How might serial position within a set of related words influence JOLs? Will they increase monotonically across the words, or will the JOLs increase for the first few words and then level off? Another goal of the present experiments was to answer these empirical questions, which in turn will provide insight into how people make JOLs.

EXPERIMENT 1

In Experiment 1, participants studied a list of individually presented words for a test of free recall. The words in the list were grouped into four related sets and four unrelated sets. Related sets consisted of four categorically related words that were presented consecutively within the list (e.g., chair, couch, table, desk). Unrelated sets consisted of four unrelated words that were also presented consecutively within the list (e.g., piano, hat, dog, car). For each word, a JOL was made immediately after that word's presentation within the list. After all words were studied and judged, participants attempted to recall the words from the list.

Method

Design and participants. Relatedness (either related sets or unrelated sets of words) was manipulated within a list, making this a within-participant manipulation. A total of 28 undergraduates participated in the study for credit in an Introductory Psychology course.

Materials and procedure. Experimental items consisted of 80 concrete nouns ($C > 6.00$). These words were selected from 20 semantic categories with four words selected from each category. We used these words to create five lists of items with each list containing 32 words.

Each list of items included four related sets of words and four unrelated sets of words. Each related set consisted of four words that came from the same semantic category (e.g., peach, grape, cherry, plum). Each category was represented once by a related set across all five lists. Each unrelated set of words consisted of four words that shared no obvious association (e.g., corn, football, perch, lily). Unrelated sets were constructed by selecting one word at random from each of the other 16 related sets of words from the other four lists. These 16 words were then grouped randomly into the four unrelated sets for that list. Each unrelated set appeared once across all five lists. The order of the eight sets of words within a list was randomised for each participant.

The assignment of a list to a participant was counterbalanced across the total number of participants. Because the list variable produced no main effects on our dependent measures and entered into no interactions with any other variables (all *F*s < 2), we do not discuss it further. Macintosh computers were used to present items and record JOL and recall data.

Participants were instructed to study a list of words for a later memory test. Each word was presented individually for 5 seconds in the centre of the computer screen. Following offset of the word, participants made a judgement of learning (JOL) for the word they had just studied. Participants were instructed: "Judge how likely you will be able to recall the word on the upcoming recall test. Type either 0, 20, 40, 60, 80, or 100, with 0 = you are absolutely sure you will NOT recall the word, 20 = 20% sure, 40 = 40% sure, 60 = 60% sure, 80 = 80 % sure, 100 = you are absolutely certain that you WILL recall the word." After their JOL, participants were presented with the next word in the list. After making a JOL for the last word in the study list, participants engaged in an unrelated distractor task for 5 minutes to eliminate any recency effects on free recall performance.

After the retention interval, instructions for the free recall test were administered. Participants were instructed to try and recall as many of the words as they could from the study list and were given an unlimited amount of time to do so. Participants verbally indicated when they were finished recalling words from the study list.

Results and discussion

All reliable effects have $p < .05$.

Recall performance. For each participant, we computed the mean percentage of correctly recalled words for both related and unrelated sets of words. Free recall was greater for related words, $M = 76.56$, $SEM = 0.02$, than for unrelated words, $M = 44.41$, $SEM = 0.03$, $t(27) = 7.25$. Thus, relatedness in the present context produced a relatively large effect on recall performance, making it a valid cue for JOLs.

Judgement-of-learning magnitude. For each participant, we computed a median JOL for related words and a median JOL for unrelated words. We computed means across all participants for these medians. JOLs were reliably greater for related words, $M = 48.93$, $SEM = 3.57$, than for unrelated words, $M = 40.71$, $SEM = 3.74$, $t(27) = 2.77$, $SED = 2.96$, which provides the first demonstration of an effect of categorical relatedness on people's judgements of learning.

Serial position. Given that categorical relatedness had an overall influence on JOL magnitude, questions pertaining to serial position effects arise. In particular, will JOLs rise monotonically across words in a related set, or will they show an initial increase in magnitude and then subsequently level off? As we argue in the General Discussion, the particular form of these serial position effects is relevant to understanding how categorical relatedness influences JOLs. To examine them, we computed a median JOL for each participant at each serial position (separately for related sets and unrelated sets) and then computed means across these median values. The values are presented in Table 1.

We analysed these means with a 2×4 ANOVA, with repeated measures on both factors. A main effect was found for Relatedness, $F(1, 27) = 8.12$, $MSE = 277.29$, and the Relatedness $\times$ Serial Position interaction, $F(3, 81) = 8.86$, $MSE = 171.17$, was also reliable. The interaction reflected both the lack of a reliable increase in JOL magnitude from the first to fourth positions within

TABLE 1
Experiment 1: JOL magnitude for within-set serial position

	Within-set serial position			
Set	*1st*	*2nd*	*3rd*	*4th*
Related	40 (4)	50 (4)	53 (3)	53 (4)
Unrelated	49 (4)	44 (4)	38 (4)	40 (4)

Cell entries are means of individual participants' median JOL values. Standard errors of the mean are in parentheses.

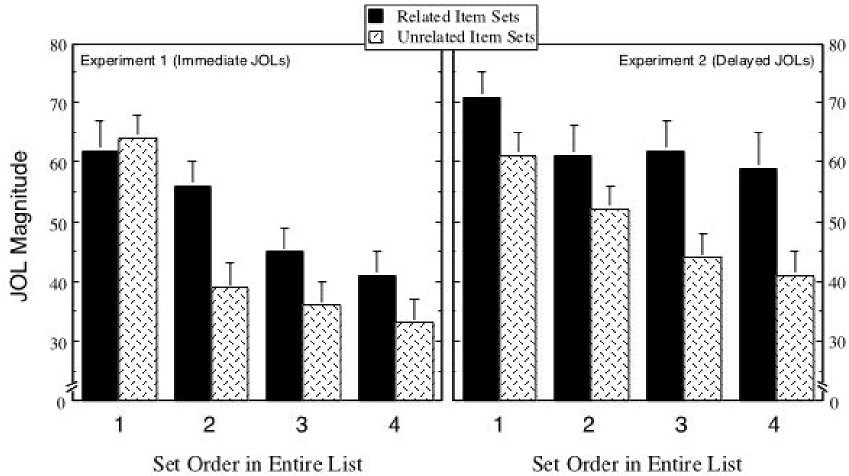

Figure 1. Means of individual participants' median JOLs for related and unrelated sets as a function of set order for Experiments 1 and 2.

unrelated sets, $t(27) = 1.94$, $SED = 4.24$, $p < .06$, and a reliable increase from the first to fourth positions within related sets, $t(27) = 3.31$, $SED = 3.77$. More important, we examined the difference in JOL magnitude between each pair of adjacent serial positions within the related set of words. JOLs differed between the first and second serial positions, $t(27) = 2.50$, $SED = 3.70$, and no other comparisons between adjacent positions were reliably different, all ts < 2.

Set order. The relatedness effect in this experiment may seem relatively small. When relatedness is manipulated in paired associates, it typically produces a major effect on JOLs (e.g., Dunlosky & Matvey, 2001; Koriat, 1997). We presented related words in four sets spread throughout a larger 32-item list. One possibility is that the relatedness effect may be present for some of these sets and not others, depending on a set's position within the list.[1] The net result would be to diminish the relatedness effect on JOLs.

We evaluated the likelihood of this possibility by examining whether a relatedness effect occurred for each of the four ordered pairs of related and unrelated sets (e.g., JOLs from the first related set vs JOLs from the first unrelated set). For each participant, we calculated a median JOL for each of the eight sets within their list. The means of these median values are presented in the left panel of Figure 1. A 2 (Relatedness) × 4 (Set Order) repeated-measures ANOVA revealed reliable main effects for Relatedness, $F(1,27) = 11.19$, and for Set Order, $F(3,81) = 26.7$. The main effect for Set Order reflected the overall decrease in JOL magnitude for sets appearing later in the list. This particular pattern was confirmed by a subsequent post-hoc contrast, $F(1,81) = 77.08$. The interaction was also reliable, $F(3,81) = 3.29$. Given the reliable interaction, we conducted separate planned contrasts on the relatedness effect within each of the four pairs of sets. Reliable relatedness effects were found for the second pair, $F(1,81) = 15.83$, the third pair, $F(1,81) = 5.81$, and for the fourth pair, $F(1,81) = 3.30$, but not for the first pair, $F < 1$.

Does a serial position effect exist within each related set? To answer this question, we calculated a mean of participants' individual JOL values for each serial position within each related set. These values are presented in Table 2. A 4 (Set Order) × 4 (Serial Position) repeated-measures ANOVA revealed main effects for Set Order, $F(3,81) = 10.64$ and for Serial Position $F(3,81) = 7.03$, but no reliable Set Order × Serial Position interaction, $F < 1.5$. Although the interaction was not reliable, one possible outcome of the set order hypothesis is that serial position effects are present for every set but the first. This outcome could produce a non-significant interaction and therefore we conducted additional post-hoc contrasts on the serial position effect within each related set. A reliable serial position effect was found within the second set, $F(1,243) = 11.45$, the third set, $F(1,243) = 4.81$, and the fourth set, $F(1,243) = 7.26$, but not within the first set, $F < 1.5$.

[1] We thank Tim Perfect and Jim Van Overschelde for suggesting this possibility.

TABLE 2
Experiment 1: JOL magnitude for within-set serial position for related sets

	Within-set serial position			
Set order	*1st*	*2nd*	*3rd*	*4th*
1st	59 (5)	64 (6)	63 (5)	62 (5)
2nd	44 (5)	49 (5)	61 (5)	61 (5)
3rd	38 (4)	43 (4)	48 (5)	48 (4)
4th	33 (4)	46 (5)	41 (5)	42 (5)

Cell entries are means of individual participants' JOL values for each serial position. Standard errors of the mean are in parentheses.

Relative accuracy of the judgements of learning. Given our focus on JOL magnitude in terms of evaluating our hypotheses, we were less concerned with JOL accuracy in this study. However, for archival purposes, we analysed JOL accuracy. For each participant we computed a gamma correlation (Nelson, 1984) between JOLs and recall for words from related sets, words from unrelated sets, and across all words in the list. Mean gamma correlations were then computed for these conditions across all participants. These correlations for related words, $M = 0.32$, $SEM = 0.10$, unrelated words, $M = 0.40$, $SEM = 0.08$, and across all items, $M = 0.37$, $SEM = 0.06$, were not reliably different, $F < 1$.

EXPERIMENT 2

Results from the first experiment demonstrated that categorical relatedness influences people's JOLs. The second experiment was conducted to evaluate the degree to which this outcome extends to JOLs that are delayed after study. Once again, we examined JOLs made on single words that were presented in related and unrelated sets. We used a blocked-list design in which all words of a given set were first presented individually for study. Then these words were presented again, and participants made a JOL for each of them. Of major import was whether categorical relatedness would again influence JOLs, and if so, how would JOLs be related to serial position for the related sets of words. Concerning the latter, when participants make delayed JOLs, they may have access to categorical information shared across the words of a related set. If this cue is accessed, it can be applied to all words of a related set (even the first one presented), and hence the serial position effects will be minimised.

Method

Participants, materials, and procedure. A total of 27 undergraduates participated for extra credit in an Introductory Psychology course. The materials and procedure used for Experiment 2 were identical to those from Experiment 1 with the following exceptions. For each set in the list, words were presented one after another without JOLs after the offset of each item. Following the presentation of the last word in a set (i.e., the fourth word), the first word of the same set was presented again as the prompt for a JOL. Participants then proceeded to make JOLs for each of the other three words of the set, with the words presented for JOLs in exactly the same order as they had been presented for study. Thus, each set was presented twice, once without JOLs after each word and once with JOLs after each word.

Results and discussion

Recall performance. As in the first experiment, we calculated the mean proportion of correctly recalled words separately for related and unrelated words, and then computed a mean across all individuals. Recall was reliably greater for related words $M = 74.31$, $SD = 0.17$, than for unrelated words, $M = 46.54$, $SD = 0.24$, $t(26) = 6.56$, $SED = 0.04$.

Judgement-of-learning magnitude. For each participant, we calculated a median JOL for both related and unrelated words. Means for related and unrelated words were then calculated for these medians. JOL magnitude was reliably greater for related words, $M = 62.96$, $SD = 23.67$, than for unrelated words, $M = 47.41$, $SD = 21.04$, $t(26) = 5.29$, $SED = 2.94$.

Serial position. For each participant, we computed a median JOL at each serial position for both related sets and unrelated sets. We computed means across these median values, which are reported in Table 3.

A 2×4 ANOVA, with repeated measures on both factors, revealed a main effect of Relatedness, $F(1, 26) = 37.13$, $MSE = 321.62$, and a reliable Relatedness $\times$ Serial Position interaction, $F(3, 78) = 6.72$, $MSE = 63.97$. JOLs declined from the first to the fourth serial positions for unrelated sets of words, $t(26) = 2.56$, $SED = 3.47$. By contrast, for related sets of words, JOLs showed no

TABLE 3
Experiment 2: JOL magnitude for within-set serial position

	Within-set serial position			
Set	*1st*	*2nd*	*3rd*	*4th*
Related	60 (5)	63 (5)	65 (4)	64 (4)
Unrelated	52 (4)	48 (4)	47 (4)	44 (4)

Cell entries are means of individual participants' median JOL values. Standard errors of the mean are in parentheses.

TABLE 4
Experiment 2: JOL magnitude for within-set serial position for related sets

	Within-set serial position			
Set order	*1st*	*2nd*	*3rd*	*4th*
1st	70 (5)	71 (5)	73 (4)	72 (6)
2nd	58 (5)	57 (6)	62 (6)	65 (5)
3rd	59 (6)	59 (6)	61 (6)	60 (5)
4th	52 (6)	61 (6)	61 (6)	56 (6)

Cell entries are means of individual participants' JOL values for each serial position. Standard errors of the mean are in parentheses.

reliable increase from the first to fourth serial positions, $t(26) = 1.51$, $SED = 2.68$. No reliable differences were found via all paired comparisons between any pair of adjacent serial positions, all ts < 2.

Set order. We examined the influence of set order on the relatedness effect for JOLs as we did in the first experiment. For each participant, we calculated a median JOL for each set of words. The means of these medians are presented in the right panel of Figure 1. A 2 (Relatedness) × 4 (Set Order) repeated-measures ANOVA revealed reliable main effects for Relatedness, $F(1, 26) = 26$, and for Set Order, $F(3, 78) = 7.24$. A subsequent post-hoc contrast revealed that JOLs were reliably higher for the first set of words than for the remainder of the sets, which did not differ, $F(1, 78) = 18.42$. The interaction was not reliable, $F < 1$. Subsequent planned contrasts revealed a reliable relatedness effect for each pair of related and unrelated sets, all Fs > 4.

Given our hypothesis concerning delayed JOLs and serial position, we did not expect serial position effects for JOLs within any of the related sets in this experiment. We calculated a mean JOL across participants' individual JOL values for each serial position within each related set. These means are presented in Table 4. A 4 (Set Order) × 4 (Serial Position) repeated-measures ANOVA revealed no main effects, $F < 2$, and no interaction, $F < 1$. As in the first experiment, we also conducted a subsequent series of post-hoc contrasts testing the serial position effect within each related set. Unlike Experiment 1, none of these contrasts was reliable, all Fs < 3.

Relative accuracy of the judgements of learning. For each participant we computed a gamma correlation between JOLs and recall for words from related sets, words from unrelated sets, and across all words in the list. Mean gamma correlations were then computed for these conditions across all participants. These correlations for related words, $M = 0.33$, $SEM = 0.09$, unrelated words, $M = 0.42$, $SEM = 0.09$, and across all items, $M = 0.45$, $SEM = 0.06$, were not reliably different, $F < 1$.

GENERAL DISCUSSION

To fill an empirical gap in the metamemory literature, we conducted two experiments to investigate how JOLs are influenced by categorical relatedness. In both experiments, words that were related to a common superordinate were associated with an increase in JOL magnitude compared to unrelated words that did not share a common superordinate. In Experiment 1, JOLs increased across serial position within related sets of words but not within unrelated sets of words. Of equal importance, a relatedness effect was not present until the second serial position within sets. When participants' JOLs were delayed in Experiment 2, there were no serial position effects within either related or unrelated sets and a relatedness effect was present for all four serial positions within sets.

How does categorical relatedness produce these effects on JOLs? One possible explanation lies in the different metacognitive processes that may underlie the use of cues for JOLs. Next, we discuss our results in terms of some of the metacognitive processes described in Koriat's cue-utilisation framework.

Hypotheses for the effects of categorical relatedness on judgements of learning

Koriat (1997) discusses two kinds of metacognitive processes that can be used to make a JOL. The first kind of process is described as a nonanalytic inference about a cue's effectiveness for memory. The second kind of process is described as a more analytic inference about a cue's effectiveness for memory.[2]

Nonanalytic inference. A nonanalytic inference is relatively fast and the information on which it is based is often not fully accessible to consciousness. In Koriat's framework, nonanalytic inferences are based on mnemonic cues. Mnemonic cues are described as being based on one's subjective experience while performing a task, with a prime example being the fluency of processing. Fluency of processing has been found to influence JOLs in a number of studies (Benjamin et al., 1998; Hertzog, Dunlosky, Robinson, & Kidder, 2003; Matvey et al., 2001) and is often considered to be a cue that leads to the use of a nonanalytic inference in various judgement tasks including recognition (Jacoby & Whitehouse, 1989) and the rating of preferences (Wilson & Schooler, 1991). Such fluency of processing could occur during the presentation of a related set of words. As the words are presented, priming of shared information (i.e., categorical relatedness) contained in each word can lead to more fluent processing of the subsequent words in the set. This fluent processing (i.e., a mnemonic cue) may lead one to infer that the words will be more likely to be remembered. Although a plausible explanation, one expectation would be that JOLs for related sets will increase monotonically across serial position, with the JOL for each word in a related set being adjusted upwards from the last. Evidence presented in Table 1 is inconsistent with this prediction.

Analytic inference. A somewhat more plausible explanation involves the use of an analytic inference as the basis for the JOL. An analytic inference involves the deliberate use of information about the effectiveness for memory of item characteristics or conditions of study (e.g., encoding operations).

[2] A similar distinction has been made by Koriat and Levy-Sadot (1999) between experience-based and information-based metacognitive judgements.

There are two plausible cues in our experiments that could underlie an analytic inference and provide an explanation for our results. The first cue is the categorical information shared between the words of a set. The second cue is the generation of a mediator during study that associates the words in a set (cf. Dunlosky, Kubat-Silman, & Hertzog, 2003; Dunlosky & Nelson, 1994). Participants would be more likely to generate these mediators in the related sets. Either of these cues would produce relatedness effects. Both cues would also produce serial position effects for the related sets, as participants will not be able to use either cue until the second word of a related set is presented. However, if participants used the generation of a mediator as the basis for their JOLs, we would also expect to see a serial position effect for the unrelated sets. Unrelated sets comprised concrete nouns and participants should have experienced little difficulty in generating mediators for those words (Hertzog & Dunlosky, 2004; Tulving, 1962). However, the lack of a serial position effect in Experiment 1 for unrelated sets suggests that participants were not generating mediators to link the words in these sets. A more precise resolution of this issue represents an important extension of our work. The active generation of mediators during study represents the use of a metacognitive control process (Hertzog & Dunlosky, 2004) that may have important consequences for subsequent learning and retention.

Relatedness for paired associates versus across words

The processes discussed above also provide insight into the differential effects of relatedness on JOLs for paired associates versus across words in a list. In the former case, the effect of relatedness on JOLs is often present in nearly every participant, with a relatively large increase in JOLs from unrelated to related items (e.g., greater than 30% for most participants in Dunlosky & Matvey, 2001). In most outcomes involving paired associates, relatedness has had an equally substantial effect on JOLs and recall performance. In the present case, however, the influence of relatedness was discounted by JOLs: Whereas relatedness had a substantial effect on free recall performance in Experiment 1 (33%) and in Experiment 2 (30%), the corresponding effects on JOLs were much less substantial (only 8% and

15%, respectively). Why would the magnitude of these relatedness effects be substantially different across the two domains?

As discussed in the Introduction, Koriat's (1997) cue-utilisation framework states that various kinds of cue have a markedly different influence on JOLs. Intrinsic cues involve the characteristics of a specific item that reveal its recallability, whereas extrinsic cues involve the conditions of learning or strategies employed to study items. Whereas intrinsic cues are expected to substantially influence JOLs, extrinsic cues are expected to be discounted by JOLs. That is, extrinsic cues will often have a much larger influence on recall performance than on JOLs. Although these cues are not always discounted, the majority of them are (Dunlosky & Matvey, 2001; Koriat, 1997). Most important, both of the cues we describe above as forming the basis of an analytic inference are extrinsic to the particular item being judged (Koriat, 1997). For example, categorical relatedness—which is shared across a set of related words—is not intrinsic to any one of them. Likewise, mediators that are used to link words are not specific to any one word. By contrast, relatedness for paired associates is an intrinsic cue, because a relationship between two words within a pair is intrinsic to that particular item. Thus, although relatedness may operate similarly for the memory of paired associates and single words on a list, the cue of relatedness is qualitatively different across these domains and is presumably responsible for the differential effects of relatedness on JOLs for pairs and individual words.

Set order

Set order moderated the relatedness effect for immediate JOLs, but not for delayed JOLs. For immediate JOLs, much of this influence is due to a serial position effect at the level of the list. Near the beginning of the list, participants made JOLs that were relatively high for words from both related and unrelated sets. As they progressed through the list, participants then lowered their JOLs for both kinds of set (cf. Dunlosky & Matvey, 2001). For unrelated sets this decrease was more pronounced, especially from the first set to the second set. Early in the list, participants are not using relatedness as a cue, as the task of remembering individual words is perceived as relatively easy. This pattern of cue use is reflected in the lack of serial position effects within related sets until the second related set of the list. Using relatedness as a cue partially offsets the overall serial position effect on JOLs, and a relatedness effect occurs. These results also suggest that certain cues use may not influence metacognitive judgements until participants have experience with the task and perhaps develop a belief about task difficulty.

The same pattern of effects was not evident for delayed JOLs. Although serial position effects at the level of the list were also present in the second experiment, JOLs were even higher than in the first experiment for words from the first related set, which resulted in a relatedness effect across the entire list. When making delayed JOLs, even for the first set of words, participants have already processed the entire set and could use a relatedness cue as a basis for their JOLs. The cue is available for all four of the JOLs within a related set and no serial position effect occurs. Even with a reliable relatedness effect, JOL magnitude for unrelated words was higher for delayed JOLs than for immediate JOLs. Introducing a delay between study and JOL is often thought to increase the probability of retrieval of the to-be-remembered word at time of JOL (Kelemen & Weaver, 1997; Nelson & Dunlosky, 1991). However, in this study, given that JOLs are made on single words (cf. Nelson & Dunlosky, 1991), retrieval of the to-be-recalled word is unlikely for either JOL condition. The basis for immediate and delayed JOLs in our study is presumably the same with the exception that delayed JOLs involve the repetition of each word within a set. This repetition could increase the fluency with which the words are processed and lead to the fluency effects we discussed earlier. Increased fluency is also a possible basis for the delayed JOLs made on related words. Across the two experiments, the highest level of JOL magnitude was found for delayed JOLs for related words. The repetition of words prior to making delayed JOLs and the use of a relatedness cue may have led to the relatively high confidence reflected in participants' judgements for these words.

Conclusions

What we have just described is at best an incomplete explanation of the effects that categorical relatedness has on JOLs. This situation is perhaps unavoidable given the preliminary nature of our work Nevertheless, we have described several plausible accounts that should be competitively evaluated in future research. Most important, the current research establishes new phenomena that more closely tie metamemory research with a long-standing tradition of research exploring the effects of categorical relatedness on memory.

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