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# Framing Influences Aggregate Judgments of Learning

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## Abstract

Previous research has focused on what internal and external cues influence metacognitive judgment, but has failed to thoroughly explore the impact of the question itself. Framing is known to influence judgments such as product quality (Levin & Gaeth, 1988) and confidence in trivia answers (Koriat, Lichtenstein, & Fischhoff, 1980). In these experiments, students were asked to estimate their amount of learning and improvement, with either positive or negative frames, or estimate average learning and improvement of students in a hypothetical learning situation. The results were that framing influences judgments of learning in a learning situation, but not in a hypothetical scenario, suggesting a self-enhancement bias.

**Keywords:** metacognition; metamemory.

## Introduction

Judgments of learning, or JOLs, are estimates of one's degree of learning. Aggregate JOLs are judgments of how much material is learned and will be recalled later, while individual item JOLs are estimates of how likely one is to recall a particular piece of information later. These judgments are often based on cues, such as familiarity of the material or speed of recall (Benjamin & Bjork, 1996; Koriat, 1997; Koriat & Ma'ayan, 2005).

Judgments of improvement, or JOIs, refer to estimates of learning rate, measuring how much more information one is likely to learn in an upcoming study trial. This judgment may be essential to decisions about further study; for example, when considering whether to continue, change strategies, or quit (Townsend & Heit, 2010, 2011). These judgments, like JOLs, are likely to be based on indirect cues.

The cue-utilization view described by Koriat (1997) describes metacognitive judgments as inferential, based on heuristics. These would use different kinds of cues, including intrinsic cues, or characteristics of the item being learned, that may be associated with the ease of learning that item; extrinsic cues, which include aspects of the learning situation, such as number of repetitions, and what study strategies were used; and mnemonic cues, such as ease of retrieval, familiarity, and ease of processing (Koriat, 1997).

Another potential factor that might influence these judgments is how the question is framed. Framing influences decisions, and decisions often change when the framing is changed (Tversky & Kahneman, 1981); when situations are framed in terms of losses, there are more risky choices, as opposed to framing in terms of gains, which

shifts preferences towards risk-averse choices. Framing is also known to influence other types of judgments, such as confidence in one's answers to trivia questions (Koriat, Lichtenstein, & Fischhoff, 1980), perceptions of product quality (Levin & Gaeth, 1988), and evaluations of programs or issues (see Levin, Schneider, & Gaeth, 1998, for a review).

Framing something negatively generally results in lower evaluations of that item, as seen in evaluations of products or programs, while framing in a positive light (for example, describing a 75% success rate, as opposed to a 25% failure rate) results in more positive evaluations of that item (Levin, Schneider, & Gaeth, 1998). Similarly, focusing on why one's answer is likely to be wrong reduces the degree of overconfidence in one's answer (Koriat, Lichtenstein, & Fischhoff, 1980). On this basis, we expected that framing metacognitive questions negatively, in terms of unlearned items, would show a similar effect and reduce performance estimates.

Self-enhancement bias (Krueger, 1998), on the other hand, is an effect wherein people judge themselves more positively than an observer would rate them. This occurs when traits that are viewed positively by the participant are being evaluated, and not for traits that are part of negative self-views (Swann, Pelham, & Krull, 1989). Ability to learn and remember information is likely to fall under the positive self-views of a college student, so self-enhancement bias may impact judgments of learning when that ability is questioned in a negative light, just as having participants acknowledge risky behavior may trigger self-enhancing personality ratings and self-enhancing reports of health behaviors (Boney-McCoy, Gibbons, & Gerrard, 1999). Hence, on this basis, one might expect that negative framing would lead to self-serving biases when students make judgments about themselves, as they did in Experiment 1. For comparison, in Experiment 2, students made hypothetical judgments about other students.

## Experiment 1

In this experiment, we were interested in the effects that framing might have on aggregate judgments of learning and improvement. Specifically, framing in this case refers to the specific way that students are asked about these judgments. For example, in terms of aggregate judgments of learning, students would typically be asked how much they *know*, in terms of what percent of the material they will recall, or how many items they will recall; they are not asked what

percent of the material they do *not* know, or how many items they will get incorrect. The way in which students internally frame or conceptualize their judgments may have a profound effect on their judgment magnitude and/or calibration. On the basis of previous research on framing, we expected that framing judgments in terms of how much material is *not* known, rather than how much material is known, would result in significantly lower judgments, but not impact accuracy statistics. On the other hand, a self-serving bias would lead students to give higher judgments of learning when the question is framed negatively, because negative framing may lead students to downplay estimates of what they do not know, whereas positive judgments focus students on what they do know.

## Method

**Participants.** 152 participants from the University of California, Merced psychology subject pool volunteered to participate for class credit. The number of participants in each condition was as follows: 13 in the positive JOL condition, 13 in the positive JOL and JOI condition, 52 in the JOI condition, 36 in the negative JOL condition, and 38 in the negative JOL and JOI condition. Sample sizes were unequal due to time constraint, and it was expected that negative framed judgments might show wider error variance (due to participant confusion, frustration, etc) and require a larger sample size.

**Materials.** The list of 50 Swahili – English word pairs was constructed from the Nelson and Dunlosky (1994) norms. These stimuli have been extensively used in previous metacognitive research. The list of word pairs was constructed in order to include a range of difficulty.

**Design and Procedure.** Participants were presented with the word pairs for a total of six trials. Each trial consisted of a study phase, during which each word pair was viewed in the center of the computer screen for two seconds each. After viewing all words, participants proceeded to a JOL judgment phase (if making JOLs), a test phase, and a JOI judgment phase (if making JOIs). The test phase showed participants each Swahili word, and they then typed in the English translations in response.

During the JOL judgment phase, participants made aggregate judgments of learning. Those in the negative-frame conditions were asked “How many words (out of the 50 word list) will you get incorrect (wrong) on the recall test? Your answer: I will miss \_\_\_ words on the test.” Those in the regular-frame condition were asked “How many words (out of the 50 word list) will you get correct on the recall test? Your answer: I will get \_\_\_ words correct on the test.” During the JOI judgment phase, participants were asked “Of the words you got incorrect (wrong) on the test, how many of those words will you learn in this study trial?

Your answer: I will learn \_\_\_ words.” Those in the JOL/JOI conditions made both JOLs and JOIs.

**Scoring.** Responses on the test trial were marked correct if they matched the target word. No points were deducted for misspellings.

## Results

3 participants were removed from the analysis due to failure to learn any Swahili-English word pairs. 29 participants were removed due to either not entering any judgments, entering extremely outlying judgments, learning less than 5 words after all six trials, or technical errors. The final number of participants included for analysis in each condition was as follows: 28 in the negative JOL condition, 12 in the regular JOL condition, 11 in the regular JOL plus JOI condition, 29 in the negative JOL plus JOI condition, and 40 in the JOI condition, for a total of 120 participants.

**Judgments of Learning.** Figure 1 shows positive versus negative JOLs across trials, along with actual recall rates. For the sake of comparison, negative JOLs were converted to positive values by subtracting the value reported from 50, to get the number of words subjects felt that they would get correct. First, negative JOLs were compared to positive JOLs, to determine the impact of framing on judgment magnitude. Contrary to prediction, JOLs were actually higher when solicited with a negative frame than with traditional wording,  $F(1, 38) = 5.23$ ,  $MSE = 163.34$ ,  $p < .05$ ,  $\eta^2 = .121$ . Collapsing across the conditions (whether or not JOLs were made in conjunction with JOIs) also showed a significant effect of framing, with negative frame JOLs associated with higher values,  $F(1, 78) = 7.99$ ,  $MSE = 249.78$ ,  $p < .01$ ,  $\eta^2 = .093$ .

Regular JOLs were not significantly higher when made in conjunction with JOIs,  $F(1, 21) = 0.68$ ,  $MSE = 123.22$ ,  $p = .42$ ,  $\eta^2 = .031$ , nor were negative JOLs different when made in conjunction with JOIs,  $F(1, 55) = 1.43$ ,  $MSE = 297.92$ ,  $p = .24$ ,  $\eta^2 = .025$ .

Accuracy of JOLs was first investigated by comparing JOLs to recall values in a 2 x 6 (repeated measures) X 2 (between subjects) analysis of variance. There was the typical underconfidence with practice effect (Koriat, Sheffer, & Ma'ayan, 2002), with mean JOL being higher than mean recall on trial 1, but shifting to underconfidence in later trials. JOLs were significantly different from recall in both conditions (positive JOL and negative JOL),  $F(1, 38) = 11.55$ ,  $MSE = 117.76$ ,  $p < .01$ ,  $\eta^2 = .233$ . There was not a significant effect of condition,  $F(1, 38) = 3.96$ ,  $MSE = 441.41$ ,  $p = .054$ ,  $\eta^2 = .094$ , so this measure of accuracy did not quite significantly differ between the two conditions. In addition, collapsing across JOL conditions (whether or not they were made in conjunction with JOIs) shows the same effects, as illustrated in Figure 1, with JOLs being significantly lower than recall values, on average,  $F(1, 78) = 24.35$ ,  $MSE = 142.72$ ,  $p < .01$ ,  $\eta^2 = .238$ , and no significant difference in absolute accuracy for the two

framing conditions,  $F(1, 78) = 3.80$ ,  $MSE = 472.28$ ,  $p = .055$ ,  $\eta^2 = .046$ . When examining mean biases, however, they do show slightly less underconfidence in the negative frame JOLs;  $t(97) = -2.15$ ,  $MD = 4.64$ ,  $p < .05$ .

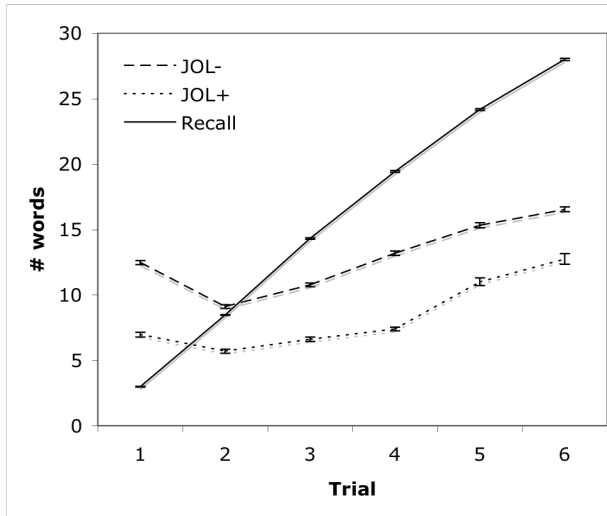


Figure 1. Mean Judgments of Learning and Recall.

**Judgments of Improvement.** As JOIs asked how many out of the wrong words would be learned in the trial, no score conversion was necessary. JOIs were not significantly higher when solicited in conjunction with negative JOLs, compared to when they are solicited with regular JOLs or without any JOLs;  $F(2, 67) = 1.35$ ,  $MSE = 46.53$ ,  $p = .268$ ,  $\eta^2 = .039$ .

Accuracy of JOIs was investigated by comparing JOIs to actual improvements in recall between trials, in a  $2 \times 6$  (within subjects, repeated measures)  $\times$  3 (between subjects) analysis of variance. Results show no significant difference between JOIs and actual improvement over the three conditions,  $F(1, 67) = .001$ ,  $MSE = 24.88$ ,  $p = .98$ ,  $\eta^2 = .00$ , and no difference between conditions,  $F(2, 67) = 0.32$ ,  $MSE = 42.14$ ,  $p = .73$ ,  $\eta^2 = .01$ .

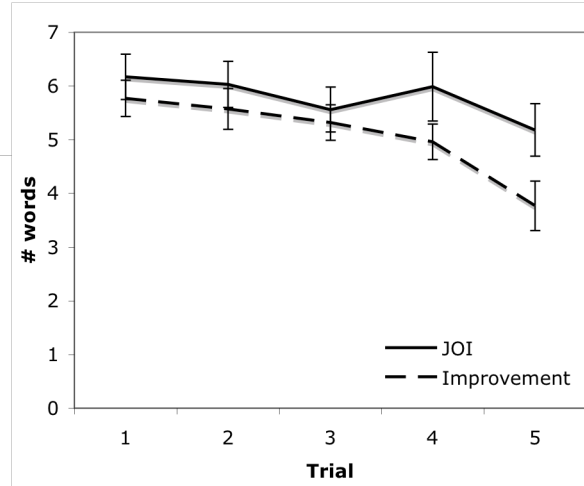


Figure 2. Mean Judgments of Improvement and Recall Improvements.

## Discussion

The key result was that judgments of learning were higher with negative framing than with positive framing. Participants seemed to feel that they learned more if they were asked to report how many words would be incorrect. This result is different than what would be expected from the framing literature. However, the finding can be explained in terms of a self-serving bias such as compensatory self-enhancement, or the possibility that students use different cues for positive versus negative judgments.

JOIs were unaffected by the JOL framing manipulation, however, which lends more support to the self-enhancement hypothesis, as if learners were adding a constant to their estimates. If participants were relying on different mnemonic cues in the negative frame JOL condition, JOIs would likely be influenced in some way.

## Experiment 2

For the second experiment, a survey was administered to a large sample of psychology students. The purpose of the surveys was to extend the findings of Experiment 1, to evaluate students' general ideas about learning situations, without making judgments involving the self. The purpose of this experiment was to see whether the framing effects found in Experiment 1 would appear when judgments are made about others. If the same results appear, this would suggest an explanation that is intrinsic to the nature of judgments of learning. On the other hand, if results differ when judgments are made about others, this would indirectly suggest that the results of Experiment 1 may be due to a self-serving bias.

The surveys were constructed to see how the framing of questions might change responses. In this experiment, students were asked to make estimates of student learning (JOLs) and/or learning rates (JOIs) for a group of students

participating in an experiment like that of Experiment 1, a multi-trial Swahili learning experiment.

## Method

**Participants.** 275 participants from the University of California, Merced subject pool volunteered to participate. 81 students completed survey A, 49 completed B, 91 completed C, and 54 completed D.

**Materials.** Four different surveys were constructed and administered in a between-subjects design. Survey A measured negative JOIs and positive JOLs, survey B positive JOLs, survey C negative JOLs, and survey D negative JOIs. Survey A asked participants to estimate for each of six study trials, of the words that are not learned, how many words students would learn during each study trial (a negative JOI), and how many words total they would know after each study trial (positive JOL). Survey B simply instructed participants to estimate how many words total would be known after each study trial (+JOL). Survey C solicited negative JOLs, in other words, how many words students would not know (get incorrect) after each trial (negative JOL). Survey D asked for negative JOIs only, of the words that are not known, how many words would be learned during each study trial. Students were also asked to indicate if they had participated in a Swahili memory experiment in the past, as this would be likely to influence their judgments of the task.

**Design and Procedure.** Each participant completed only one survey type. Surveys were included as part of a larger questionnaire packet for students to take home. Students were instructed to complete the surveys alone, and in a quiet place. Surveys were returned and entered a week later.

**Scoring.** As in Experiment 1, the negative frame JOLs were converted to positive values by subtracting the values reported from 50.

## Results

22 participants were removed from analysis due to not entering judgments, misunderstanding instructions, or having far outlying judgments. Final numbers of participants for each survey was as follows: 74 for survey A, 44 for survey B, 81 for survey C, and 54 for survey D. Unequal samples were a result of many surveys not being returned.

**Judgments of Learning.** JOLs were significantly different among the surveys,  $F(2, 187) = 5.30$ ,  $MSE = 382.77$ ,  $p < .01$ ,  $\eta^2 = .054$ , with post hoc tests revealing the difference being that survey A JOLs were greater than those of survey B; in other words, JOLs were higher when participants were also asked to provide JOIs. This also meant that survey C, which measured negative JOLs, was *not* significantly different than the JOLs in survey A or B.

JOLs also differed dependent on whether or not survey participants had participated in a Swahili learning experiment in the past,  $F(1, 187) = 46.24$ ,  $MSE = 382.77$ ,  $p < .01$ ,  $\eta^2 = .20$ , with those who had done an experiment giving significantly lower JOLs.

A significant experience x survey interaction  $F(2, 187) = 5.20$ ,  $MSE = 382.77$ ,  $p < .01$ ,  $\eta^2 = .053$  revealed that the difference between the three surveys was much reduced for the participants who had experience with learning Swahili. This can be seen in Figures 3 and 4. No other comparisons were significant.

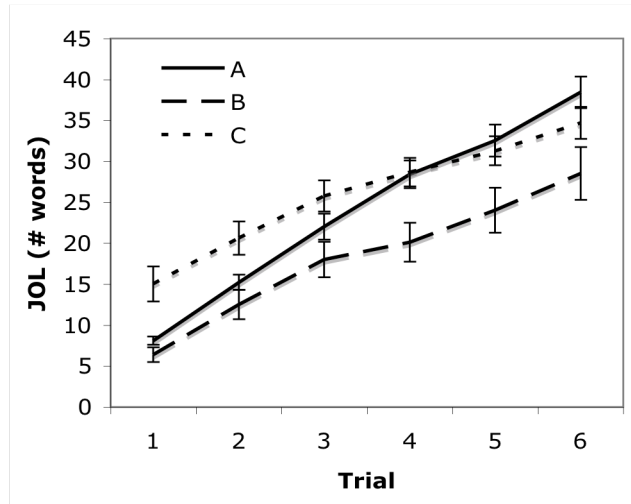


Figure 3. Mean Judgments of Learning, no Swahili experience.

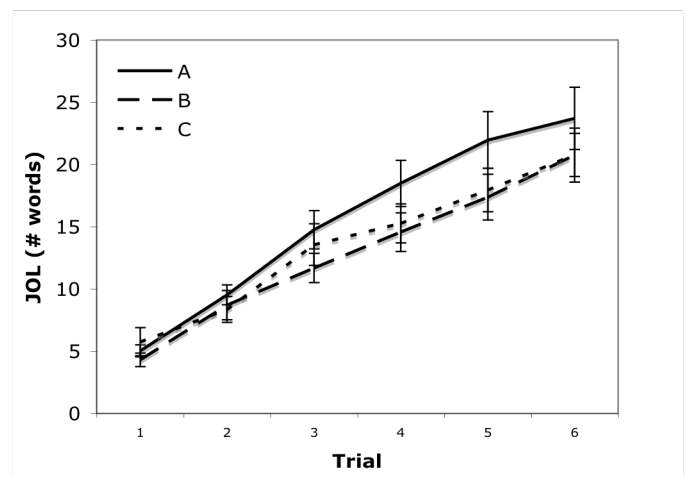


Figure 4. Mean Judgments of Learning, with Swahili experience.

**Judgments of Improvement.** JOIs were not significantly different between surveys,  $F(1, 114) = 0.36$ ,  $MSE = 52.92$ ,  $p = .552$ ,  $\eta^2 = .003$ . Experience with Swahili experiments showed lower mean JOIs,  $F(1, 114) = 5.17$ ,  $MSE = 52.92$ ,  $p < .05$ ,  $\eta^2 = .043$ , though there was not a significant

interaction between survey and experience,  $F(1, 114) = 0.10$ ,  $MSE = 52.92$ ,  $p > .05$ ,  $\eta^2 = .002$ .

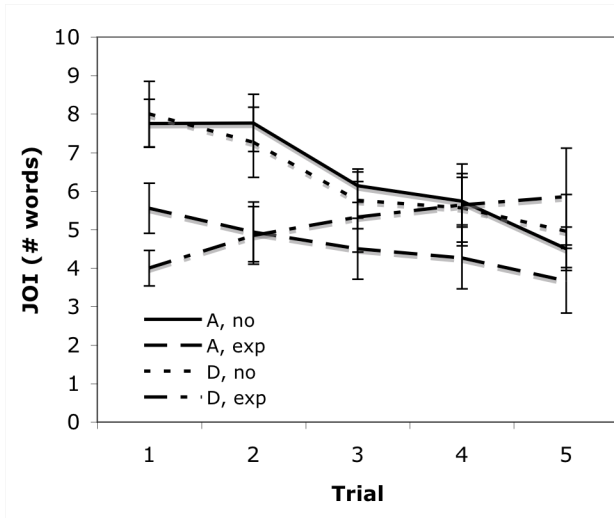


Figure 5. Mean Judgments of Improvement and Survey Experience.

### Discussion

This experiment did not show the difference between positive and negative framing that was observed in Experiment 1. A key difference between Experiment 2 and the previous experiment is that here, rather than being asked to evaluate their own performance in a learning task, participants were asked about other students in a hypothetical learning situation. Although there are other differences between the two experiments, and given that caution is needed when inferring from a null result, the findings do not support the notion that positive versus negative framing has a general effect on JOLs that is independent of context, due to theories of learning and forgetting. The results are consistent with the notion that framing effects may lead to a self-serving bias, so that they affect judgments about one's own learning but not the learning of others, possibly mediated by the use of different cues when making positive versus negative judgments.

### General Discussion

The different findings of the two experiments suggest that something about the experimental context, as opposed to the nature of JOLs, affected judgments. One possibility is self-enhancement; students may judge their own performance higher when asked about how many errors they would make (as opposed to judging the performance of others in a survey, where students may not feel the same need to inflate estimates). Essentially, they may be inflating estimates in Experiment 1 for compensatory purposes.

An alternate explanation is that in the experimental situation, when presented with negative frames, participants focused on slightly different mnemonic cues. For example, when making a positive aggregate JOL they may consider how fluently the items were processed, how familiar items seemed, and what study strategies they used, while negative aggregate JOLs may focus participants to think about different factors, such as how many items seemed difficult, unfamiliar, or were not studied well. When thinking in terms of these cues, students may not have a sense that a lot of items fell under these situations, and thus have inflated performance estimates (via low estimates of the number of incorrect items).

Though we found evidence that negative framing affected the JOLs of material being learned, the effect was not what was expected from the framing literature; it seemed that students believed they had actually learned more words. This data is in contrast with the results of Finn (2008), who found less overconfidence (i.e. lower JOLs) when *individual* JOLs were made in terms of *forgetting*. The findings also appear to be in opposition to typical findings found in attribute-framing experiments (Levin, Schneider, & Gaeth, 1998), which show overall less favorable evaluations with negative frames. Further experiments will attempt to reconcile these findings, however, and also look at restudy choice. It is possible that though it *appears* that participants are giving more favorable evaluations of their performance in the negative frame situation, they may attend more to the amount *not learned*, whereas in the positive frame they may attend more to the amount *learned* and thus they may have a more positive perception of their performance in a positive-JOL situation, and more pessimistic evaluations of their performance in the negative-JOL scenario. If this is the case, they may actually restudy more when making JOLs in the negative frame.

In general, we did not observe effects of JOL framing on JOIs. This suggests that it is unlikely that JOL framing changes the mnemonic cues that learners use when inferring their JOLs; these cues would likely influence JOIs as well. The lack of change in JOIs also reflects the (roughly) parallel slopes of the JOL curves seen in Figure 1, illustrating the bias shift. It is still possible that mnemonic cues underlie the shift in JOLs, but self-enhancement is another possible mechanism that would account for the lack of change in JOIs, but a self-promoting shift in JOLs.

In terms of educational implications, what these results may show is that focusing on the number of errors, or the amount *not* learned, may result in more optimistic self-assessments when making performance predictions. This may be counterproductive, and encourage less time studying than is necessary, especially if students do not self-test (Finn & Metcalfe, 2007), as their JOLs will reflect the more overconfident trial 1 JOLs.

Future experiments will address whether self-enhancement or cue utilization underlies the effect of inflated negative-frame JOLs, and examine the impact of JOL framing on restudy preferences and recall performance.

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