**Action Editor (Dr. Jennifer Wiley)**  
  
**Comment 1:** First, this is a nice set of experiments, and there is a theoretically interesting pattern here. The stimuli are varied within and across studies which is great. Yet, one major weakness was in describing (in operational, empirical terms) the differences in the pairs within and across each study.   
  
Said another way, what is missing is support for the claims about the presence or lack of relatedness or associations, the presence or lack of obvious or perceptible associations, and differences in distances between the concepts. These claims are key to the logic of the paper, but similarities or differences in each of these constructs need to be demonstrated. Because I am still unclear exactly what you manipulated I am not certain what metrics need to be in a table.  But I suggest you add a table on p. 12 (in the section where the materials for 1A are first described). This table needs to report metrics that demonstrate the differences you claim throughout the paper.   
  
What metrics show differences in a priori or a posteriori associations? We need averages (ranges) for each metric for the related, unrelated and mediated stimuli. We need these for all 4 stimulus sets used in the first study (I assume related and unrelated stay the same), and for the two new double mediated sets in the second study. (If related and unrelated change, then include values for each study). Here are some metrics that were mentioned (I do not know which are different names for the same construct): relatedness, strength of relatedness cues, salience of relatedness cues, Nelson's association norms, forward association strength, backward association strength, distance, co-occurrence (suggested by a reviewer), a priori and a posteriori associations.  Please read through the paper carefully to make sure that any time you say one condition had stronger or weaker a priori or FAS that you show this is true.  As for claims whether relations were "obvious" or "perceptible"

I think the norming study (JAM) you reported for just 3 sets was a good start. This is needed for all types of pairs to support your claims.

***Response:*** When developing our forward associates, single-mediated, and double-mediated cue-target pairs, we manipulated the degree of direct association between the cue and target. For forward pairs, direct association was measured in terms of Forward Association Strength (FAS), which was taken from Nelson et al.’s (2004) free-association norms. This measure provides objective and operational information regarding the relations between the pairs. For single-mediated pairs, we selected targets which were not directly related to the cue via FAS (i.e., the FAS between cue and target was 0) but were instead linked through a non-presented mediator, which was directly related to the cue and target via FAS. Double-mediated pairs were developed using the same procedure but the final target was two-steps away from the cue (the FAS between cue and target was again 0). For both backward mediated pair types, we flipped the cue-target order such that the association ran from target to cue, leading us to use backward associative strength (BAS) to describe the relationships between cues, mediators, and targets for these pair types. Thus, the variable we manipulated within and between experiments was the FAS/BAS of the cue-target pairs.

Based on suggestions from Reviewer 3 and yourself, we have added an additional table to the Appendix (Table A3, pg. 46) which reports the mean FAS between each concept in the associative pathway for single and double-mediated pairs, and mean BAS when both mediated pair types were presented in the backward direction. As noted by these tables, the direct associative strength between cue and target in all mediated pair types is 0, indicating the lack of a direct, associative relationship.

As an additional metric, we now include JAMs for all pair types used in Experiment 1A (pg. 20). Overall, JAMs for single-mediated pairs in exceeded JAMs for unrelated pairs (19.70 vs. 11.04), which suggests that participants may have perceived mediated pairs as being more related than unrelated pairs, even though the normative relatedness between cue and target was 0. This finding provides additional motivation for our use of double-mediated pairs in Experiments 2A/2B. Our finding that JAMs for double-mediated pairs did not statistically differ from unrelated pairs in Experiment 2A (pg. 23) is additionally consistent with this account.

Finally, throughout the manuscript, we have sought to streamline our discussion of relatedness effects on JOL reactivity, particularly in the Introduction (Please see our response to Reviewer 2, Comment 2) and have paid special attention to the language used to describe different aspects of relatedness (see our response to Reviewer 1, Minor Comments).  
  
**Comment 2:** Second, please discuss how the proposed relational processing account might relate to an elaboration account. Similar to reviewers, I also had strong overtones of elaboration when I first read the Maxwell & Huff results on pp. 8-9. I am curious how you view the two accounts (as also noted by Reviewer 3). At the same time, I wondered how you tested for awareness of mediators (p. 10)? I thought the second reviewer's suggestions to look at the viewing times during encoding would make a great addition. (It would be helpful for you to confirm that the prior study was also self-paced, and discuss the rationale for this design choice, and whether similar results have been found with fixed presentation time).

***Response:*** We now include a brief description of Chang and Brainerd’s (2025) findings on pgs. 5-6 of the Introduction. Additionally, our revision includes a brief discussion of our findings within the context of their elaboration account (pg. 32 of the General Discussion; please see our response to Reviewer 3, Comment 2). Briefly, the elaboration account is less specific than our relational encoding account. Elaboration simply refers to deep processing of cue-target pairs which could contain item-specific/distinctive processing in addition to relational processing. Relational encoding more specifically qualifies the type of relations that are strengthened via JOLs within this context.

Awareness of mediators was inferred based on participants’ JOLs. As noted on pgs. 18-19 of our initial submission, participants provided JOLs in Experiments 1A/1B which were higher than those reported on unrelated pairs. This suggests that participants may have been able to detect the mediated relationship, likely by guessing the mediator, though we did not directly test for this possibility.

Analyses of response latencies showed patterns which were consistent with other self-paced JOL reactivity studies. Specifically, participants in the JOL groups spent more time encoding all pair types relative to the control group. Additionally, participants in both groups spent less time encoding forward pairs relative to mediated and unrelated pairs. However, across experiments, the Encoding Group × Pair Type interactions were non-significant (*F*s < 1, *p*s ≥ .39), indicating that encoding latency differences between pair types remained consistent between JOL/no-JOL groups. The finding that encoding latencies were consistently faster for forward than both mediated and unrelated pairs (which were equivalent) suggests that unrelated and mediated pairs were perceived as more difficult. For transparency, we now report analyses of response latencies in our Supplemental Materials. We thank Reviewer 2 for this suggestion (please see our response to Reviewer 2, Comment 1).  
  
**Comment 3:** Third, I appreciate the suggestion to include a mini meta-analysis of these studies which will allow you to provide evidence for the comparisons across forward and backward, single and double mediated conditions in the discussion.

***Response:*** Our revised manuscript now includes mini meta-analysis, which provides a cross-experimental comparison of effect sizes for each pair type (pgs. 28; please see our response to Reviewer 3, Comment 3). We thank the reviewer for this suggestion and strongly believe that the inclusion of these additional analyses has strengthened our manuscript.

**Comment 4:** Please see the suggestions from each of the reviewers in their original context. I am fine with adding the pbic at the end of each result, even when significant using NHST, since its so short.

***Response:*** In our revised manuscript, we now include *p*BIC values following each result. Please see our response to Reviewer 1, Minor Comments).

**Reviewer 1**

**Comment 1:** The current study did not provide information on the relatedness among the three types of word pairs (i.e., related, mediated, and unrelated). Given this omission, the findings from Experiment 1 and Experiment 2 that making JOLs enhances mediated pairs may not necessarily indicate enhanced relational processing but could instead be attributed to relatedness processing.

***Response:*** Normative relatedness values for each pair type (FAS/BAS) are now reported in the Appendix (Table A3, pg. 46). In addition to reporting direct relatedness between cue and target in terms of FAS/BAS, this table also displays mean association strength between all steps in the associative pathway for mediated pair types (i.e., FAS from cue 🡪 mediator 🡪 target for single mediated pairs; FAS from cue 🡪, Mediator 🡪 Mediator 🡪 Target for double-mediated pairs).

Finally, as an additional metric, we now report JAMs for both single and double-mediated pairs (pgs. 20 and 23, respectively). Unlike FAS, which provides information regarding normative relatedness, JAMs provide a measure of perceived relatedness (i.e., participants are asked to estimate the number of individuals out of 100 who would respond to the cue with the pair target, which mirrors the process by which FAS is traditionally computed). Based on JAMS, mediated pairs were perceived as being less related relative to traditional forward paired-associates. Moreover, JAMs did not differ between double-mediated and unrelated pairs in Experiment 2A, suggesting that our use of double-mediated pairs sufficiently reduced any potential guessing of the non-presented mediator.  
  
**Comment 2:** The relational processing hypothesis didn't predict that making JOLs would alter the performance of double-mediator pairs. The manipulation of double-mediator pairs may have increased the distance between cue and target, making it less likely for participants to guess the intermediary items. However, this increase must be compared with a baseline, such as single - mediator pairs. Yet, Experiment 2 failed to include such a comparison. I suggest conducting a comparative analysis of the results from Experiment 1 and Experiment 2.

***Response:*** The relational encoding account actually does predict that positive JOL reactivity should occur for double mediated pairs. This should occur whenever the cue/ share a relationship irrespective of whether the relationship is direct or indirect (see pg. 17 of our revised manuscript).

We agree that a comparative analysis of mediated pairs in Experiments 1 and 2 would provide useful information for the reader while providing additional context for interpreting our findings. Based on this suggestion, we now report a set of cross-experimental analyses in our Supplemental Materials. Additionally, based on suggestions from Reviewer 3, we now include a set of cross-experimental meta-analyses, which provide a comparison of effects sizes between pair types (pgs. 28; see our response to Reviewer 3, Comment 3).

**Minor Comments**

**Comment:** The concepts of a priori and posteriori relatedness may be somewhat confusing. Given that "a priori and a posteriori associations are not mutually exclusive, (p.7, line 11-12)" it's important to clarify that posteriori relatedness essentially reflects a type of co-occurrence frequency. To enhance clarity and distinction, I suggest renaming posteriori relatedness to "co-occurrence relatedness." This adjustment would help differentiate between the two types of relatedness and align the terminology more closely with the constructs being discussed.

***Response*:** Thank you for this suggestion. Yes, clarifying the difference between a priori and a posteriori relatedness types would aid the reader and make discussions of our results clearer. In our revised manuscript, we now refer to a priori relatedness as *normative* relatedness, since this type of relatedness is based on free-association norms. Although free-association norms can capture information regarding lexical co-occurrence, these norms can also capture associations which are not directly based on lexical co-occurrence (e.g., *cow* – *milk*). Thus, normative relatedness provides a better description of a priori relatedness. Please see pg. 7 of our revised manuscript.

***Comment*:** I suggest that the Bayes factors (BF) for all statistical results be provided. This would enable readers to more effectively assess the strength of evidence supporting the alternative hypothesis.

***Response:*** In our revised manuscript, we now report *p*BIC values for all comparisons based on the comments from the action editor, regardless of significance. Thank you for this suggestion.

***Comment:*** The relational processing hypothesis overlaps with the cue-strengthening hypothesis. However, what deficiencies of the cue-strengthening hypothesis does the exploration of the relational processing hypothesis address? Additionally, what are the application values of exploring the relational processing hypothesis? Describing the above content will enhance the value and application prospects of this article.

***Response:*** We agree that the relational and cue-strengthening accounts share conceptual overlap. However, as noted in our initial submission (pg. 4), the cue-strengthening hypothesis does not identify the exact cues which JOLs are purported to strengthen and instead simply notes that JOLs strengthen intrinsic cues about stimuli. The relational encoding account provides a more specific mechanism by which JOLs facilitate cued-recall of semantically related word pairs.

From an application standpoint, the relational processing account can potentially inform the design of learning interventions. For example, having learnings make JOLs in contexts where relational information is critical (e.g., thematic learning) may enhance retention. Thus, this account may be particularly informative in learning scenarios where understanding the connections between ideas is more important the recalling specific facts. We now briefly discuss the applied value of this account in the General Discussion (pg. 34) while also noting the need for more research investigating JOL reactivity within applied settings.

Thank you for taking the time to review our manuscript.  
  
**Reviewer 2**  
  
**Comment 1:** I was a bit surprised that time on task was self-paced (particularly during encoding). Given that the work was replicating Maxwell and Huff (2024), I assume this methodological decision was used there, which in turn makes sense here. Nonetheless, I would be interested in knowing if there were differences in time on task across the JOL vs. no-JOL groups and/or the different types of word pairs. Is it possible that differences in encoding time may be part of the explanation? I'm not convinced yes, as the current data are very strong, but I do think for transparency and completeness, the reporting of encoding time -and any potential differences across groups or conditions- is important information to provide to readers.

***Response:*** We elected to use self-paced encoding in the present study to stay consistent with prior work by Maxwell and Huff (2024). We have clarified the rationale behind this decision in the Experiment 1A Procedure (pg. 14).

Based on your suggestions, analyses of encoding latencies as functions of pair type and encoding group for each experiment are now reported in in our Supplemental Materials. Consistent with other studies which have explored JOL reactivity under self-paced encoding conditions (e.g., Maxwell & Huff, 2022; 2024), encoding latencies were higher for participants in the JOL group relative to the No-JOL control group. Additionally, forward associates had lower encoding latencies relative to unrelated and mediated pairs, regardless of encoding group. Encoding latencies for mediated and unrelated pairs, however, did not differ. Additionally, no interactions were detected between Pair Type and Encoding Group.

**Comment 2:** The authors may want to consider streamlining the beginning of the Introduction. The manuscript is incredibly well written, which is perhaps why this section seemed a little overly verbose. More specifically, the recapping of the studies seems like it could be condensed a bit. Particularly because there are mini-discussions throughout Experiments 1A-B/2A-B.

***Response:*** Thank you for this suggestion. We have revised our Introduction for clarity and concision.

We thank you for reviewing our manuscript.  
  
**Reviewer 3**

**Comment 1:** One central issue concerns participants' awareness of the relationships between mediated word pairs (e.g., lion-stripes), particularly in the single-mediated condition. From what I understand, participants were not explicitly informed about the nature of the pairings (related, unrelated, or mediated). As I reviewed the OSF word lists, I noticed that I was spontaneously generating the mediators myself without any prompt. This raises the possibility that single-mediated pairs might inherently invite greater elaboration, independent of JOL solicitation. If so, what appears to be an effect of JOLs might instead reflect additional elaboration opportunities afforded by the stimuli themselves, rather than the activation of pre-existing connections. The ultimate way to test this would be to have differing groups who have awareness of the types of pairs that they will be exposed to , and whether awareness actually causes a difference.

The issue, as I see it, is that the authors assume the effect occurs automatically through spreading activation, without participants necessarily being aware of the connections. While Experiment 2 may make a stronger case for this assumption, I am not fully convinced; particularly in the forward and single-mediated conditions, these connections could well be generated consciously.

***Response:*** Yes, participants across experiments were not informed about the specific relations between each pair type prior to encoding (i.e., participants were not informed that some pairs were direct associates, others mediated, etc.). As noted on pg. 19 of our initial submission, our concerns that participants might just be guessing the mediators in Experiment 1A was the rationale for using backwards mediated pairs (Experiment 1B) and to use forward and backward double mediated pairs (Experiments 2A/B) directly influenced our decision to use double-mediated pairs in Experiments 2A/2B. Because the cue and target in double-mediated pairs are mediated through two concepts, participants would be less likely to guess the specific associative pathway linking the cue and target. Findings from the pilot study reported on pg. 22 of our initial submission are consistent with this account, as JAM ratings (which assess perceived relatedness) did not differ between double-mediated pairs and unrelated pairs, suggesting that participants were not aware of the underlying relationship between double-mediated cues and targets. Thus, our finding that reactivity patterns also extended to double-mediated pairs strongly suggests that JOL reactivity can occur in the absence of observable relatedness cues.

Our revised manuscript includes an additional set of supplemental analyses which compared cued-recall between single and double-mediated experiments. Across experiments, cued-recall of mediated pairs was greater for single-mediated vs. double-mediated pair types. However, given that we did not directly assess whether participants could guess the mediator in single-mediated pair types, it remains unclear whether this benefit reflects elaboration or simply participants identifying the mediator. We now note this possibility as a potential limitation in the General Discussion (pg. 33) while also noting the need for more research in this area.

**Comment 2:** A second important suggestion is to incorporate discussion of the recent study by Chang and Brainerd (2025) in JML. I recognize that this paper may have appeared after the submission of the current manuscript, so the authors might not be aware of it. However, Chang and Brainerd (2025) also emphasize the importance of semantic relatedness and pre-existing connections. How do the present authors' claims align with or diverge from that work?

More broadly, if the observed effects are a consequence of semantic processing in general—potentially unconscious in the present case—can the authors' framework accommodate findings attributable to semantic elaboration of any kind? Moreover, why is it that the related pairs always have higher JOL-reactivity than mediated pairs? Are they explaining it with the shorter distances between cue and target words for related than mediated pairs?

***Response:*** Thank you for this suggestion. This paper had not yet been published at JML when we initially submitted our manuscript for review. We now briefly describe this work in the Introduction (pg. 5) and discuss how our findings potentially fit within an elaboration account in the General Discussion (pg. 32).

Regarding the magnitude of JOLs, related pairs likely have higher JOLs due to the presence of strong perceived relatedness cues (i.e., a posteriori relatedness) in addition to strong normative relatedness (e.g., a priori relatedness). Based on Soderstrom et al.’s (2015) cue-strengthening account, participants use intrinsic cues about the stimuli to inform the magnitude of their JOLs. Because pre-existing relations are a highly salient marker of later remembering (i.e., related pairs are far more likely to be recalled than unrelated pairs), word pairs which appear related at encoding should receive high JOLs. However, as noted throughout the manuscript, mediated pairs lack a direct associate via the norms and should appear unrelated at encoding. However, if participants can guess the mediator, this may inflate their JOLs relative to unrelated pairs. This may explain why participants in Experiments 1A/1B assigned higher JOLs to single-mediated pairs than unrelated pairs. Our finding that double-mediated pairs had lower JOLs relative to single-mediated pairs suggests that participants were less likely to guess the mediators for this pair type.

**Comment 3:** Finally, I believe that the paper could benefit from a single-paper meta-analysis. If they can show that single, double, backward and forward mediations all produce same type of effect size, and this is always higher than unrelated and lower than related pairs, this could support their view further.

***Response:*** Agreed. Our revised manuscript now reports a set of random-effects meta-analyses (pgs. 28) which assessed 1) the overall JOL reactivity effect for all pair types and 2) separate JOL reactivity effects for each pair type (forward, mediated (collapsed across type), and unrelated). Additionally, a forest plot (Figure 3) has been added on pg. 43.

Overall, these analyses revealed a strong reactivity effect on forward pairs (*d* = 0.98), a moderate reactivity effect on mediated pairs (*d* = 0.53), and a null reactivity effect on unrelated pairs (*d* = 0.06). Taken together, mediated pairs typically show a reactivity effect that is larger than unrelated pairs but smaller than forward pairs. Findings from these additional analyses are now discussed on pg. 30 in the General Discussion.

**Minor Comments**

**Comment:** When the authors are presenting the readers with Bayesian statistics, it might be useful to the reader to explain what pbic values stand for.

***Response:*** We have updated our description of *p*BIC values on pg. 16 to provide this information.

**Comment:** If the findings can actually be explained by spreading activation, does that not have a direction either? Please explain.

***Response:*** Given that JOL reactivity was observed for mediated pairs presented in both the forward and backward directions, it is unlikely that any effects of spreading activation would be limited to a single direction. Instead, it is likely that any spreading activation effects are bi-directional in nature. This is also consistent with previous JOL reactivity studies which have found reactivity on backward cue-target word pairs (e.g., Maxwell & Huff, 2022; 2023).

**Comment:** When mediated pairs are used, the effects sizes for all seem to be very similar regardless of the distance from the original cue word. How does the spreading activation account  for this? One could expect that as the distance increases, the helpfulness of the mediators should also decrease.

***Response:*** Yes, while the size of the reactivity effect remained consistent, cued-recall of double-mediated pairs was lower than single-mediated pairs, for both the JOL and No-JOL groups. This is consistent with a spreading-activation account, as we would expect that pairs with a greater associative distance would be recalled at a lower rate relative to pairs with a shorter distance. However, as noted on pg. 33, it is also possible that single-mediated pairs invited greater opportunities for elaboration and/or mediator-guessing. Given that the present study was not specifically designed to measure elaboration, more work is needed to fully explore the extent to which elaboration and spreading activation may each contribute to JOL reactivity within this context.

We thank you for taking the time to review our manuscript.