[TITLE HERE]

Accurately monitoring the progress of one’s learning is paramount for improving the learning process when studying new information. Effective monitoring allows individuals to adjust their encoding strategies to maximize later retention (Nelson & Narens, 1990). Metamemory judgments, or having individuals judge or estimate the effectiveness their memorial abilities can be used to obtain information about the and individual’s knowledge of learning process. A common method used to gauge metamemory knowledge is the Judgment of Learning (JOL) task. In the standard JOL task, individuals study a set of cue-target word pairs and are asked to estimate the likelihood that they will be able to recall the target word when only provided with the cue word on a subsequent memory test. These estimates can be elicited using several types of measurement scales (e.g., Likert Scales or binary “yes-no” responses; Hanczakowski, Zawadzka, Pasek, & Higham, 2013), however, JOLs are typically elicited using a continuous 0 to 100 scale representing the percent likelihood of the target item being successfully recalled at test (e.g., 100% = definitely would remember; 0% = definitely would not remember). The use of a 100-point scale is beneficial as it allows for an easy comparison between predicted target recall (via JOLs) and the proportion of targets that are correctly recalled at test.

Although JOL ratings can be accurate and predictive (i.e., well-calibrated) with subsequent recall, may factors can affect the efficacy of JOLs on later recall. These include perceived ease in identical cue-target word pairs (Castel, McCabe, & Roediger, 2007), increased in time spent studying word pairs (Koriat & Ma’ayan, 2005), and the direction and magnitude of associative relationships between the cue-target study pairs (Koriat & Bjork, 2005; Maxwell & Huff, in press). The present study further examines factors that affect the accuracy of JOLs by examining the associative direction between cue-target pairs (i.e., probability that the cue item elicits the target at test or vice versa). Additionally, we also examine whether encoding tasks that emphasize the shared or distinctive characteristics of the word pairs through relational and item-specific encoding tasks, respectively, can improve the relationship between JOLs and correct recall relative to a control group.

Interest in the relationship between memory predictions and accuracy is not a novel area of exploration. In an early example, Arbuckle and Cuddy (1969) asked participants to study letter pairs and report whether they would or would not remember the pair, followed by a memory test of the pair with a postdiction that they were initial correct or incorrect regarding their initial prediction. Overall, this study found that participants, on average, were over 60% right in their predictions of their recall. The authors concluded that participants had insight into how difficult each pair would be to remember and adjusted their predictions accordingly, based on the association between participants predictions and subsequent recall.

More recently, research conducted by Koriat and Bjork (2005) supports the notion that both the associative strength and direction of cue-target word pairs affects correspondence between JOL ratings at study and subsequent correct recall. Specifically, the authors delineated between types two types of associations thought to influence the relationship between JOLs and recall. First, *a priori* associations refer to associations in the forward direction (e.g., credit-card). The strength of these pair types is rooted in the likelihood that the cue word will elicit the target word at test. A priori/forward association strength can be readily assessed through the use of free association norms (e.g., The University of South Florida Free Association Norms; Nelson, McEvoy, & Schreiber, 2004; The Small World of Words Project; De Deyne, Navarro, Perfors, Brysbaert, & Storms, 2019). These norms are generated via free association tasks in which participants are provided with a cue word and are asked to respond with the first target word that comes to mind. These norms can then be used to compute the probability of responding to word A with word B (i.e., forward associative strength, FAS). Second, *a posteriori* associations refer to the perceived relatedness between pairs that are only apparent to participants when words are presented together. These pairs can refer to weakly associated pairs (e.g., article-newspaper) or strong associates that in which the pair order has been flipped (i.e., backward pairs, card-credit). Similar to a priori pairs, free association norms can be useful for indexing the backward associative strength (BAS) between pairs (i.e., the probability of responding to word B with word A in an A-B item pairs; see Nelson, McEvoy, & Dennis, 2000 for a review). Thus, a posteriori pairs could have either weak levels of FAS or strong levels of BAS.

To test the correspondence between JOLs and recall for a priori and a posteriori pairs, Koriat & Bjork (2005) conducted three experiments in which participants were presented with unrelated and a priori study pairs (e.g., strong forward associates; Experiment 1), a priori and a posteriori pairs (e.g., backward associates; Experiment 2), and unrelated pairs, a priori pairs, and a set of semantically related a posteriori pairs that shared no association based on norms (Experiment 3). Across each experiment, an *illusion of competence* was found for a posteriori pairs in which participants’ JOLs exceeded subsequent recall rates. In particular, this effect was particularly robust the backward pairs presented in their second experiment, as the target words within this pair type do not readily converge upon the cue. Thus, although participants predict that backward pairs as highly likely to be recalled, recall accuracy is typically much lower than predicted.

The illusion of competence pattern found with a posteriori and backward pairs has similarly been found by Castel et al. (2007) who reported that the illusion of competence also occur when participants study identical cue-target pairs. Participants studied a set of strongly and weakly related forward associates, unrelated items, and identical cue-target word pairs and provided JOL ratings. Overall, an illusion of competence emerged for identical word pairs in which JOLs exceeded subsequent recall rates. One explanation for this finding is that participants perceived the identical pairs to be easier relative to the other pairs and thus spent less time studying them or because the participants did not encode the identical pairs as deeply because they thought they would be easier to recall (Castel et al., 2007). [RT STUFF FROM CASTEL PAPER HERE]

More recently, Maxwell and Huff (in press), further investigated the correspondence between JOLs and recall rates by looking at symmetrical associates (e.g., on-off). Symmetrical pairs are different from forward and backward pairs in that the associative strength between the cue and target word is the same regardless of direction (i.e., salt-pepper would have the same associative strength as pepper-salt), whereas forward and backward cue-target pairs have a stronger strength depending on the direction of the pair (i.e. tuna-fish (F) has a stronger associative strength than fish-tuna (B)). Furthermore, these pa Across four experiments, a strong illusion of competence pattern was found for backward pairs and, additionally, the illusion of competence was shown to extend to symmetrical associates, indicating that… [EXPAND]. Furthermore, Maxwell and Huff found that the illusion of competence was not contingent upon the timing of when JOLs were provided at study, as similar illusion of competence patterns were found when JOLs were provided under experimenter-paced encoding durations and when JOLs were provided after a delay—two manipulations that have been shown to enhance the calibration between JOLs and later recall (Hertzog, Dixon, Hultsch, & MacDonald, 2003; Rhodes & Tauber, 2011). Finally, Maxwell and Huff employed the use of calibration plots in which JOL ratings were plotted against their corresponding recall accuracy Nelson & Dunlosky, 1991), allowing the authors to pinpoint the JOL rating at which the illusion of competence emerged for each pair type. [SENTENCE HERE]

[NEW PARAGRAPH HERE]

**Item-Specific/Relational Framework**

Memory researchers have long known that certain study tasks are more successful at improving retention than others. Several tasks have been identified, the levels-of-processing framework classifies tasks that promote elaborative processing of studied items that typically promotes memory as “deep” tasks, while less successful tasks that focus on surface or perceptual features of study items as “shallow” tasks (Craik & Lockhart, 1972; Craik, 2002). Several deep tasks have been identified, including generation (Slamecka & Graf, 1978), production (MacLeod, Gopie, Hourihan, Neary, & Ozubko, 2010), and survival processing (Nairne, Thompson, & Pandeirada, 2007), however deep tasks can be bifurcated further based on a tasks propensity to encourage the processing of item-specific or relational features. According to the item-specific/relational processing framework (Hunt & Einstein, 1980; Einstein & Hunt, 1981). According to this framework, encoding tasks differ in the likelihood that they can encourage the processing unique features of study items through item-specific processing, or they can encourage the processing of shared characteristics of study items through relational processing.

Given the benefits of item-specific and relational processing on memory, the present study tested whether these encoding strategies can be used to reduce the illusion of competence found for backward and symmetrical related pairs and unrelated pairs. Specifically, Experiment 1 compares JOLs and cued-recall performance for each of the aforementioned encoding strategies to a standard read-only JOL control group who receives no explicit encoding instructions. Next, Experiment 2 tests whether combining these encoding manipulations with an explicit warning about the deceptive nature of backward, symmetrical, and unrelated study pairs further reduces the illusion of competence. Finally, across both experiments, we follow the analyses used by Maxwell & Huff (in press) by plotting participants JOL ratings against their recall rates using a series of calibration plots to gauge whether participants over/under predict subsequent recall.

**Experiment 1: Item-Specific vs Relational Encoding**

The goals of Experiment 1 were twofold. First, this experiment sought to replicate the illusion of competence for backward, symmetrical, and unrelated pairs for participants completing the silent reading task. Next, it tested whether the encoding manipulations modeled after the Item-Specific/Relational framework (Hunt & Einstein, 1981) could reduce the illusion of competence by either lowering JOL ratings, increasing correct recall, or both. Overall, it was expected that having participants engage in these additional processing tasks at encoding would reduce the illusion of competence by improving correct recall relative to the control group. Additionally, because relational encoding encourages participants to create an association instead of relying on the weak cues between pairs low in FAS, it was expected that this encoding manipulation would be particularly beneficial for improving recall of unrelated pairs. Finally, because item-specific processing has been shown to be more beneficial to memory when pairs are related (Huff & Bodner, 2014), it was expected that this encoding strategy would be most beneficial for reducing the illusion of competence for backward and symmetrical pairs.

**Method**

[We’ll paste the methods stuff in here]