THESIS

# RECOGNITION WITHOUT IDENTIFICATION (RWI) AND THE FEELING OF KNOWING (FOK): A COMPARISON OF RETROSPECTIVE AND PROSPECTIVE-BASED FAMILIARITY JUDGMENTS

Submitted by

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WE HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER OUR SUPERVISION BY JASON S. NOMI ENTITLED RECOGNITION WITHOUT IDENTIFICATION (RWI) AND THE FEELING OF KNOWING (FOK): A COMPARISON OF RETROSPECTIVE AND PROSPECTIVE-BASED FAMILIARITY JUDGMENTS BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE.

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ABSTRACT OF THESIS

RECOGNITION WITHOUT IDENTIFICATION (RWI) AND THE FEELING OF KNOWING (FOK): A COMPARISON OF RETROSPECTIVE AND PROSPECTIVE-BASED FAMILIARITY JUDGMENTS

Recognition without identification (RWI) and the feeling of knowing (FOK) are two memory paradigms that attempt to tap awareness of memory states in the absence of identification of a target. Although both RWI and FOKs have been described using the example of recognizing a face as familiar without recalling who that person is, no empirical evidence has yet demonstrated that they are based on a common underlying mechanism. The presented studies attempted to directly compare RWI and FOK judgments by utilizing a hybrid paradigm containing commonly used RWI and FOK methodologies that differed by a single manipulation of instruction type. The data demonstrated that participants gave significantly different patterns of ratings in the RWI condition than the FOK condition, suggesting different underlying mechanisms of RWI and FOK judgments.

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# Chapter I:
# Introduction

*The Feeling of Recognition*

An often cited example of the feeling of recognition is that of realizing that a person has been seen before, despite the inability to identify where or when that person was previously seen. For example, imagine getting onto the city bus and seeing the butcher from the local supermarket. Upon seeing the butcher on the bus, a feeling of familiarity may arise as he is not easily identified outside the context of the supermarket. Despite not being able to identify him, he is strangely familiar. This experience is often referred to as the "the butcher on the bus" phenomenon and has been a popular example of a familiarity-based recognition in the real world (Mandler, 1980; Yovel & Paller, 2004). This example of a real world familiarity process has often been used to describe two different laboratory phenomena: recognition without identification (RWI) and the feeling of knowing (FOK). Whereas recognition without identification (RWI) is the finding that participants can discriminate between previously presented items and foils at levels above chance despite being unable to explicitly identify (i.e., retrieve) those items (Cleary, 2006), the feeling of knowing (FOK) is the finding that participants are generally able to predict at above-chance levels whether or not they would recognize an unidentifiable (i.e., unretrievable) target if they were to see it in the future (Koriat, 2007).

Both RWI and FOK have been described in similar terms as the butcher on the bus phenomenon. For example, Cleary and Specker (2007) cited numerous variations of the butcher on the bus phenomenon from familiarity based recognition studies as examples describing RWI. Koriat described the FOK phenomenon in the following way: "The FOK phenomenon is best illustrated by the many everyday situations in which people try to recall the name of a person but fail to find it" (Koriat, 1995, p. 311). Given that several researchers have described both RWI and FOKs using the same real-world example (Butterfield, Nelson, & Peck, 1988; Cleary & Specker, 2007; Koriat, 1995; Rajaram, 1993), and that both RWI and FOK are mainly examined when full recollection fails, it is plausible that both phenomena share a common underlying mechanism.

The presented studies examined this possibility by comparing the conventional RWI and FOK paradigms in a situation where the only difference between the two conditions is a single between-subjects manipulation of instruction type. Whereas studies of RWI involve tapping participants' knowledge of past experiences through a retrospectively-based judgment (i.e., was this item previously presented?), FOK studies attempt to tap participants' knowledge of future experiences through a prospectively-based judgment (i.e., will you recognize the item if you see it?). Therefore, the single between-subjects manipulation of instruction type for the RWI condition essentially was, "was the target presented earlier", while the FOK condition essentially was, "will you recognize the target if you see it". Should the manipulation of instruction type lead to identical rating patterns for both RWI and FOK tasks, it would suggest that RWI and FOK paradigms tap a common underlying mechanism. However, if different overall patterns emerge, then it would stand to reason that prospective- and retrospective-based familiarity judgments are based on different underlying mechanisms.

*Familiarity-based Recognition*

Dual process theories of recognition propose that an item can be recognized in two ways: recollection or familiarity. Recollection-based recognition occurs when contextual details of the prior experience are retrieved whereas familiarity-based recognition is proposed to occur when an item is recognized as being previously experienced, but no contextual details are retrieved (Yonelinas, 2002). In the above example, recollection would entail recalling that the person on the bus is the butcher from the local supermarket. In contrast, familiarity would involve recognizing him based on a feeling or hunch, despite not being able to recall who is he is.

Numerous experimental paradigms have found dissociations between recollection and familiarity (see Yonelinas, 2002 for a thorough review), and it is generally accepted that recollection and familiarity are different cognitive processes (see Wixted, 2007 for an objection). Several paradigms have been used to separate recollection and familiarity-based processes; among them are: remember/know (Tulving, 1985), process dissociation (Jacoby, 1991), and the focus in this paper, the recognition without identification paradigm (RWI: Peynircioglu, 1990; Cleary & Greene, 2001; Cleary & Greene, 2005).

*Recognition without Identification (RWI)*

Recognition without identification (RWI) is the finding that participants are able to make old/new discriminations among test items in the absence of explicit identification of those items. That is, although participants lack the ability to identify the target item, they are still able to determine at levels above chance whether or not that item was previously presented. Because the analysis focuses only on those items that are unidentified, recognition without identification (RWI) is thought to reflect a form of familiarity-based recognition, and several studies support this assertion (e.g., Arndt, Lee & Flora, 2008; Cleary, 2004, 2006; Cleary & Greene, 2001, 2005; Cleary & Reyes, 2009; Kostic & Cleary, 2009).

Peynirgioclu (1990) elicited the first known instance of laboratory based RWI by having participants remember a study list of words. At test, participants were presented with word fragments; half of the fragments were from studied items while half were not. If participants could not complete the word fragment, they were asked to rate the likelihood that the word appeared on the study list. Data analysis of the word fragments that were not completed demonstrated that participants gave higher ratings to studied, as compared to unstudied fragments. That is, they could recognize an item as being old, despite not being able to explicitly identify the word fragment.

Cleary and Greene (2001) attempted to determine if RWI reflected a form of familiarity based recognition. Support for this would occur if RWI was present in recognition memory tasks thought to reflect familiarity while absent in tasks thought to reflect recollection. Therefore, RWI should occur in item recognition tasks and judgments of presentation frequency, that are thought to reflect familiarity. In contrast, it should not occur in associative recognition or list discrimination tasks, that are thought to reflect recognition. This is in fact what Cleary and Greene found. Item recognition and judgments of presentation frequency elicited RWI while associate recognition and list discrimination did not. This was viewed as support that RWI reflected a form of familiarity-based recognition.

RWI has since been extended to face recognition (Cleary & Specker, 2007), scene recognition (Cleary & Reyes, 2009; Cleary, Ryals, & Nomi, 2009), picture recognition

(Langley, Cleary, Kostic, & Woods, 2007), geon recognition (Cleary, Langley, & Seiler, 2004), auditory phoneme recognition (Cleary, Winfield, & Kostic, 2007), and music recognition (Kostic & Cleary, 2009). Further, RWI has been shown to rely on perceptual information (Cleary, Langley, & Seiler, 2004), auditory information (Cleary, Winfield, & Kostic, 2007), orthographic, phonological, and semantic information (Cleary, 2004), and existing semantic knowledge representations (Cleary, 2006; Cleary & Specker, 2007; Cleary & Reyes, 2009).

Of particular relevance to the present studies are those RWI paradigms that appear to involve participants' existing semantic knowledge representations. For example, Cleary (2006) presented participants with a list of answers to general knowledge questions at study. At test, participants were presented with a list of general knowledge questions; half had their answers presented at study, half did not. When participants could not retrieve an answer, they were asked to rate the likelihood that the answer was presented during study. For questions that participants could not answer, Cleary found that participants gave higher ratings for questions whose answers were presented at study than for those that were not presented. Because the answers to the questions were not presented together within the experiment, the connection between the answers and the questions must have been present in participants' semantic knowledge stores prior to the experiment. Further, because the study phase involved presentation of only the target, and the test phase involved presentation of only the cue, the discrimination shown must have involved pre-experimental semantic knowledge. Thus, this particular form of RWI involves pre-experimental knowledge (as opposed to experiment-specific information).

Cleary and Specker (2007) presented participants with a list of famous or well known names at study. At test, participants were presented with images of famous or well known people; half had their names presented at study, half did not. When participants could not identify the person in the image, they were asked to rate the probability that the person's name appeared at study. The results demonstrated that although participants could not name the person in the image, they still gave higher ratings to those people who had their name studied than those that did not. Just as with the general knowledge question results of Cleary (2006), these judgments had to have been based on pre-existing semantic knowledge. However in this case, it was semantic knowledge of faces and their referent names.

The current study is based on yet another RWI paradigm that involved participants pre-existing semantic knowledge. Cleary and Reyes (2009) presented participants with a list of well known or famous places (The Alamo, Stonehenge, etc.) at study. At test, participants were presented with images of famous places; half had their names presented at study, half did not. When participants could not name the scene at test, they were asked to rate the probability that the scenes name was presented at study. Ratings for unidentified scenes indicated that even in the absence of identification participants gave higher ratings to those scenes that had their names presented at study than those that had not. Again, because no perceptual overlap between study (names) and test (images) items existed, pre-experimental knowledge of scenes and their names was involved.

*Feeling of Knowing (FOK)*

The methodologies used in FOK studies generally differ from those used to study familiarity-based recognition from a dual-process perspective. In the first known FOK study, Hart (1965) asked participants to answer general information questions (e.g., What is the largest planet in the solar system? [Jupiter], how many sides in a hexagon? [6], etc.). When participants failed to recall an answer, they rated the probability that they felt they would be able to identify the answer in a future forced-choice recognition test that was later administered to them. By comparing participant's predictions with their actual performance on the recognition test, Hart provided a method for an objective measure of performance. Although the preferred method of objective measurement has changed (Costermans, Lories, & Ansay, 1992; Wright, 1996), numerous studies have followed on Hart's seminal work and have produced a sizable literature of FOK studies (for a review see Koriat, 2007).

Much like the aforementioned studies of the RWI effect (Cleary, 2006; Cleary & Reyes, 2009; Cleary & Specker, 2007), studies exploring FOKs have relied on the pre-existing knowledge base of participants. Because Hart's participants were required to make FOK judgments after being presented only with the question, they were forced to use their pre-existing knowledge about the possibility of answering when making their FOKs. The use of participants' pre-existing semantic memory base of general knowledge questions to explore FOKs is a common methodology used by metacognitive researchers (Koriat, 1995; Koriat, & Levy-Sadot, 2001; Litman, Hutchins, & Russon, 2005; Singer, & Tiede, 2008; Widner Jr., & Smith, 1996).

Other examples of FOK studies are as follows. Gruneberg and Monks (1974) presented participants with the names of countries and asked them for the name of the capitol. When participants failed to correctly recall the capitol, they were asked to make an FOK indicating how confident they were that they knew the capitol name. Participants were then cued with the first and second letters of the capital. The results indicated that FOKs predicted if the participant would later recall the word after being cued with the first and second letters of the target.

Another paradigm used to tap participants' pre-existing knowledge base was employed by Izaute et. al. (2002). Participants were presented with the descriptions of common (Difficulty falling asleep: insomnia) names and proper (First man on the moon: Armstrong) names, then were asked to make a FOK assessing the probability that they would recognize the name if they saw it. The results indicated that participants were more accurate when assessing their pre-existing knowledge of proper names rather than common names.

Finally, Yaniv and Meyer (1987) attained FOKs after participants failed to recall a rare target word after being presented with only its definition. After the participants provided their FOK judgments, they were presented with a lexical decision task and were asked to decide if target, control, filler, or non-words were from the English language or not. The results indicated that participants' FOK ratings were negatively correlated with reaction times of target words. That is, participants reacted faster to target words that had their definitions previously presented and elicited high FOK ratings of 4 or 5 on a scale of 1-5, despite not being recalled.

*Relating RWI and the FOK phenomenon*

Though they are different methodologies from different domains of research, there are numerous similarities between RWI and FOKs. As previously mentioned, the RWI and FOK literature both use similar descriptions of the "butcher on the bus" phenomenon as real-world examples of their respective phenomena. Also, many RWI and FOK paradigms are based on the premise that participants are able to tap into existing knowledge representations even in the absence of identification of the targets. Further, in both RWI and ROK paradigms participants are asked to make judgments in the absence of identification of the target. Finally, although participants rarely perform perfectly in RWI and FOK studies, with small and medium effect sizes of old-new discrimination in RWI studies and target recognition in FOK studies, performance is consistently higher than chance.

The main difference between RWI and FOK paradigms is that they rely on different types of judgments - retrospective and prospective judgments, respectively. Prospective judgments are concerned with an assessment of future performance whereas retrospective judgments are concerned with judgments of past experiences. The RWI paradigms mentioned earlier rely on retrospective judgments; participants were asked to make a judgment about how probable it was that a given unidentified target was presented earlier within the context of the experiment. In contrast, FOK paradigms rely on prospective judgments; participants were asked to make a judgment about the probability that they will recognize an unidentified target in the future.

The proposed research is expected to make a contribution to the dual-process recognition literature. There has been a recent interest in applying theoretical approaches to metacognitive phenomena (i.e., TOT states) to ongoing controversies over dual-process theories of recognition memory (e.g., Wixted, 2007). Specifically, it has been argued that partial recollection, because it has been shown to contribute to such metacognitive phenemona as TOT states, may actually contribute to judgments that occur in the absence of full recollection in dual-process paradigms. That is, list-learning tasks aimed at studying familiarity may actually be tapping partial recollection instead of familiarity. However, the extent to which theories of such metacognitive phenomena are applicable to theories of familiarity-based recognition in list-learning paradigms has not been empirically examined. Given that FOK judgments are another type of metacognitive phenomenon thought to involve partial recollection (e.g., Koriat, 1995), attempting to directly compare two types of judgments (familiarity-based recognition judgments and FOK judgments) in a within-experiment comparison will help to determine if applying metacognition theories of the FOK phenomenon to dual-process theories of recognition memory is appropriate. Specifically, if the two elicit similar patterns of ratings in response to experimental variables (such as the study-status of an unidentified item), then it would suggest that they may, in fact, be tapping the same underlying construct and thus, it may be appropriate to apply a theoretical explanation of one (i.e., partial recollection) to a theoretical explanation of the other. However, if the two elicit different patterns of ratings in response to experimental variables, it would suggest that a theory of one may not apply to a theory of the other.

*RWI, FOKs, and TOTs*

Previous work within the recognition and metamemory literatures has compared tip-of-the-tongue (TOT) states with RWI and FOKs respectively. Recognition memory researchers have shown that although both RWI and TOT states seem subjectively similar, they are not identical (Cleary, 2006; Cleary & Reyes, 2009; Cleary & Specker, 2007). Meta-memory researchers have shown that although FOKs and TOTs may appear subjectively similar, they are affected differently by experimental manipulations (Maril, Simons, Weaver, & Schacter, 2005; Schwartz, 2008). A quick review of some differences between RWI and TOTs is followed by differences between FOK and TOTs.

Cleary (2006), Cleary and Reyes (2009), and Cleary and Specker (2007) noted that the subjective states that drive RWI may be similar to those that drive reported TOT states. Across these studies, it was shown that the TOT phenomenon and the RWI phenomenon may be based on similar mechanisms, but are not identical. First, in the absence of identification of the target, recognition ratings are consistently higher during reported TOT states than during reported non-TOT states, suggesting that the feeling of being in a TOT state and the feeling of familiarity that can occur in list-learning paradigms may feel subjectively similar to participants. Second, studying a target word does not result in an increase in the likelihood of a TOT for that word. If anything, there is a consistent trend in the opposite direction; there is a slightly lower likelihood of a reported TOT for a target that has been studied. Third, the RWI effect often persists even among reported non-TOT states (Cleary, 2006; Cleary & Reyes, 2009). Thus, although the two phenomena may feel subjectively similar, RWI and TOT are not based on identical underlying mechanisms.

Comparing FOKs and TOTs, Schwartz (2008) demonstrated that adding a working memory task (remembering 4 digits) during attempted retrieval of answers to general knowledge questions decreased TOTs while increasing FOKs as compared to when participants simply answered general knowledge questions. Increasing working memory load by having participants remember 6 digits when retrieving answers decreased TOTs but did not affect FOKs. Schwartz concluded that because TOTs and FOKs were affected differently by working memory load, they are similar but not identical.

Maril, Simons, Weaver, and Schacter (2005) asked participants to respond with one of four answers when presented with general knowledge questions during an fMRI scan: know, don't know, TOT state, or FOK state. Although TOT and FOK states both activated areas in the parietal cortex, differential activation patterns for TOTs and FOKs were found in other cortical areas such as the pre-frontal cortex. The authors stated that this suggested a qualitative difference rather than a quantitative difference. That is, although a TOT may feel like a strong FOK, the cortical areas involved suggest that they are different in quality as well.

In sum, researchers of recognition memory and metamemory have demonstrated that even though RWI and FOKs may feel subjectively similar to TOTs, they are not identical and are influenced differently by experimental manipulations. Therefore, despite the previously mentioned similarities that exist between RWI and FOKs, there is also reason to suspect that the two may not be based on the same underlying mechanism. The present studies sought to examine this possibility.

*The Present Studies*

The present studies used a variation of the previously described recognition without scene identification paradigm utilized by Cleary and Reyes (2009) to explore the difference between retrospective and prospective judgments of familiarity in cases where items go unidentified. Participants were presented with a list of names at study. At test, participants viewed a series of images; half had their names presented at study, half did not. A single between-subjects manipulation across three experiments consisted of either a test question asking a participant to judge the probability that a test image had its name presented earlier or to judge the probability that they will recognize the images name if presented with it later. The pilot experiment is presented before the two experiments conducted for my Master's thesis are discussed.

# Chapter II:
## Pilot Experiment

Participants were presented with the names of 40 well-known scenes of various places (The Alamo, Stonehenge, etc.) during study. At test, participants were presented with 80 images of scenes; half represented studied names while the other half did not. All variables were held constant except for a single between-subjects manipulation of instruction type. In the RWI condition, participants were asked to rate the probability that the presented test image had its corresponding name presented at study; a retrospective judgment. In the FOK condition, participants were asked to rate the probability that they will recognize the presented test image's name if they see it in the future; a prospective judgment. The data under primary consideration will be those ratings that participants gave to unidentified items, and should represent only those judgments based on the absence of recollection. That is, the data should allow for a comparison between retrospectively and prospective based familiarity judgments. Support for a single underlying mechanism of both RWI and FOK judgments will arise if the same overall pattern is shown among the ratings given in both cases.

## Methods

### *Participants*

One hundred Colorado State introductory psychology students participated for course credit: 48 in the RWI condition and 52 in the FOK condition.

*Materials*

Stimuli were presented on a desktop Dell computer using the program E-prime and consisted of 80 names of famous scenes, landmarks, and buildings along with their pictorial referents. Two sets of stimuli were created: 40 names and their pictorial referents constituted one set of items, then, a second set was constructed consisting of 40 plausible alternatives and their pictorial referents. For example, an item (an item refers to a name and its pictorial referent) from the first set of 40 was the "Great Wall of China" and its plausible alternative in the second set of 40 was "Berlin Wall".

Two sets of 40 images that were similar to each other were needed to account for possible confounds when the final recognition test is added at the end of future experiments. A final recognition test is typically administered after FOKs are acquired in the test portion that typically consists of presenting a question along with possible answers to choose from. The participant is then asked to choose the target. Typically, higher FOK judgments predict better recognition memory performance of currently unidentified targets than lower FOK judgments. However, a concern with final recognition tests is that targets or foils may be identified by their plausibility or implausibility. For example, if the picture of the "Great Wall of China" was presented in the final recognition test, and a possible foil name for that picture was presented as "Liberty Bell", participants may correctly reject the foil on the basis that the description "bell" has nothing to do with a picture of a wall. Therefore, each item in an FOK paradigm should have a plausible alternative in order to ensure that participants cannot use the plausibility or implausibility of a name to correctly reject foils, and these stimuli need to be counterbalanced across studied and non-studied status.

The planned forced-choice yes/no task for Experiment 1 consisted of presenting participants with a picture and a name; half the names were correct, half were not. Thus, considerations were made when choosing stimuli for the pilot experiment to avoid future confounds in follow up experiments. In order to ensure that targets and foils were equally represented across all participants, similar items were presented in both studied and unstudied categories. Some stimuli were taken from Cleary and Reyes (2009) while others were acquired from the internet through the use of websites that contained information on "famous places". For counterbalancing purposes, 40 items represented the "studied" category for half of the participants while the other set of 40 represented studied items for the other half of participants in each condition (RWI and FOK). All 80 items were then presented at test for all participants; 40 from study and 40 foils.

*Design and Procedure*

Before the experiment, participants were instructed that they would be presented with a list of names and that they should try to remember those names for a later memory test. Participants were then presented with 40 famous names (Sistine Chapel, Alamo, etc.) one a time in the upper left hand corner for two seconds each with a one second inter-stimulus interval. After the study list was presented, instructions for the test were explained.

Participants were informed that they would be presented with 80 images of well-known scenes and that they would be presented with four questions for each scene. First, they would be asked if they could name the scene. Second, they would be asked to make a rating on a scale of 1 - 10. In the RWI condition, participants were asked to rate the probability that the image's name appeared on the study list on a scale of 1 (definitely not studied) to 10 (definitely studied). In the FOK condition, participants were asked to rate the probability that they would recognize the name if they saw it using the same scale of 1 (not likely to recognize) to 10 (very likely to recognize). Third, after the participants gave a rating, they were given a second chance to identify the scene. A second chance was given in order to avoid the possibility that participants might recall the scene name before giving the rating, but after their original chance to identify the scene had already passed. This was done in order to ensure that items get correctly labeled as identified and unidentified. Because the analysis of RWI and FOKs depends on unidentified items, a stringent criterion for acceptable answers was instantiated. That is, any misspelled words or instances of partial identification disqualified the word from being included in the final analysis. Fourth, participants were asked to type in whatever partial information that they could recall about the name of the image, such as number of syllables, first letter of the word, a similar sounding word, etc. Partial information was recorded to ensure that the participant was basing his or her rating on a lack of access of articulable information (articulable information in this case refers to any type of verbal information that corresponds to a specific test item) about the target in question.

*Results*

Before discussing the data of primary interest, it is important to first consider the identification rates and partial identification rates among studied and unstudied items in the RWI and FOK conditions. A 2 x 2 Study-Status (studied vs. non-studied) x Condition (RWI vs. FOK) mixed-model ANOVA performed on identification rates (Table 1) produced a main effect of study status, $F\ (1, 98) = 253.52$, $MSE = .041$, $p <$

.001, $\eta_p^2$ = .721 such that identification rates were higher overall for studied items than for non-studied items. No other significant effects resulted from the 2 x 2 ANOVA (*F*'s < 1.0).

Partial identification rates (rates of reporting partial information about the target scene name in the absence of complete identification of the target scene) were computed for studied and non studied items in both conditions (Table 2). A 2 x 2 Study-Status (Studied vs. Non-studied) x Condition (RWI vs. FOK) mixed-model ANOVA produced a main effect of study status, $F$ (1, 98) = 10.91, *MSE* = .002, $p$ = .001, $\eta_p^2$ = .10, such that participants were more likely to give partial information for unstudied items. A Study Status x Condition interaction approaching significance was also found, $F$ (1, 98) = 3.84, *MSE* = .005, $p$ = .053, $\eta_p^2$ = .038, such that participants were more likely to give answers with partial information for unstudied items in the FOK condition. No other effects were significant (*F*'s < 1.0).

The data of primary interest were the ratings given to those test items that could not be identified (Table 3). A 2 x 2 Study-Status (Studied vs. Non-studied) x Condition (RWI vs. FOK) mixed-model ANOVA produced a significant Study-Status x Condition interaction, $F$ (1, 98) = 8.215, *MSE* = 3.96, $p$ = .005, $\eta_p^2$ = .077, such that overall mean ratings were higher for unidentified unstudied items in the FOK condition, $t$ (51) = -2.97, *SEM* = .15, $p$ = .005. No other significant results were found, (*F*'s < 1.0).

**Pilot Experiment Discussion**

The primary results of interest, ratings given to unidentified test items, preliminarily suggest that a difference does exist between retrospective and prospective based familiarity judgments. However, two main concerns need to be addressed before further speculation on the mechanisms behind RWI and FOK judgments can be explored. First, the RWI effect, which is the typical finding that unidentified studied items receive significantly higher ratings than unidentified unstudied items, was not significant. Second, FOK judgments are typically examined with respect to how well they predict future performance on a recognition test. The proposed experiment will attempt to replicate the overall pattern found in the pilot experiment while also addressing these two concerns.

With regard to the former concern, the RWI effect may not have been found for several reasons. First, Cleary and Greene (2000) demonstrated that although presentation of a 60/120 study/test block was able to elicit an RWI effect, it was smaller than the RWI effect found with four 15/30 test blocks. Therefore the single large study test block utilized in the current experiment may have contributed to the lack of a significant RWI effect. Second, the pool of stimuli used in the current pilot experiment was different from the pool of stimuli used in Cleary and Reyes (2009). Third, each famous scene in the current study had a highly plausible distracter inserted into the stimulus pool in order to account for possible confounds when the final recognition test is administered.

As previously mentioned, the need to account for plausible distracters is necessary in the FOK condition because the final recognition tests used to assess FOK accuracy typically rely on the presentation of targets and foils with the question. If the distracters are not plausible answers, then participants could base their final recognition judgments on the plausibility or implausibility of the foil. However, accounting for this possible confound in the FOK condition raises another issue with regard to the RWI condition. Because highly plausible distracters are being used as test cues, stimuli corresponding to the highly plausible distracters had to be used in the ratings phase of the experiment for counterbalancing purposes. The presence of highly plausible distracters in the rating phase likely meant that the ratings for items in the unstudied RWI category are inflated. This is because every item in the studied condition has their name presented at study, along with the pictorial referent as a cue at test, yet there are two plausible pictorial referents for each studied name presented at test; one that represents the studied name and one that is a plausible image of a studied name. For example, if the words "templar tombs'" is presented at study, there will be two plausible pictorial referents shown at test: the image of the templar's tomb, and the image of the plausible distracter, in this case the image is of the "terracotta army". In short, ratings for the distracters may be higher than is typical in RWI studies, and this may be lowering the overall old-new discrimination in the present study relative to prior studies.

The latter concern, that FOK judgments are typically measured by comparing participants' FOKs during test and their actual performance on a later recognition test, will be addressed in Experiment 1. Because the pilot study did not include a recognition test after the study/test block was presented, the typical measurement of the predictive ability of FOKs was not acquired. In order to proceed with further investigating the possibility that RWI and FOKs measure different underlying processes, Experiment 1 aimed to address the aforementioned concerns. Specifically, Experiment 1 contained changes that aimed at both acquiring a significant RWI effect and exploring the predictive power of FOKs.

## Chapter III:
## Experiment 1

Two changes were made to the experimental paradigm of the pilot study in order to address the concerns listed above. First, more items from the stimuli pool from Cleary and Reyes (2009) were utilized in order to address the concern that the use of a different stimuli pool resulted in the lack of a RWI effect. Second, in order to explore the predictive power of FOKs, a final surprise forced choice yes/no recognition test was administered after participants completed a single study/test block.

Finally, there does not seem to be a way to address the problems of list length and plausible distracters without introducing additional confounds. Changing the single study/block presentation to a multiple study/block paradigm would mean that participants would become aware of the type of judgments that they will be asked to use (encoding is held constant at the moment as the type of judgment the participant makes is not revealed until after the study phase), thus encoding strategies could differ after the first study/test block. As previously mentioned, the need for plausible distracters in the final recognition test is seemingly unavoidable due to the possibility that participants will utilize a strategy of simply selecting the more familiar targets, or discounting the target on the basis of its unfamiliarity. Although this makes the acquisition of an RWI effect much more difficult, addressing these possible RWI confounds seems to lead to larger ones. The hope in the present study is that with more power, the RWI effect will be significant even if it is smaller than the typical RWI effect. The means in the pilot experiment were in the direction of an effect; therefore, with enough power, it is likely that the effect will be found.

## Methods

### *Participants*

Seventy-one Colorado State introductory psychology students participated for course credit: 34 in the RWI condition and 37 in the FOK condition.

### *Materials*

Seventy-seven names of famous scenes, landmarks, and buildings along with their pictorial representations taken from the pool of stimuli used by Cleary and Reyes (2009) were presented on a desktop Dell computer using the program E-prime. Three additional scenes from the pilot experiment were also used.

### *Design and Procedure*

Experiment 1 replicated the methodology from the pilot experiment with one addition: after participants completed a single study/test block, a final forced choice yes/no recognition test was administered. The recognition test entailed the presentation of 40 images of well known places. Half of the images had their names studied and were presented at test while the other half were taken from foils presented at test. Each image was presented with a possible answer placed on the screen. Participants were asked to type in "y" for "yes" or "n" for "no" to state whether or not the presented answer correctly identified the presented image. Half of the presented answers correctly identify the image while half did not.

### *Results*

As before, identification and partial identification rates are presented before the primary results of interest, ratings given to unidentified items, are discussed. A 2 x 2 Study-Status (Studied vs. Non-studied) x Condition (RWI vs. FOK) mixed-model ANOVA performed on overall mean identification rates (Table 1) produced a main effect of study status, $F$ (1, 70) = 79.43, $MSE$ = .006, $p < .001$, $\eta_p^2 = .532$, such that identification rates were higher overall for test images that had their names presented than those that did not. No other significant effects resulted from the 2 x 2 ANOVA ($F$'s < 1.0).

As in the pilot experiment, partial identification rates (rates of reporting partial information about the target scene name in the absence of complete identification of the target scene) were computed for studied and non studied items in both conditions (Table 2). A 2 x 2 Study-Status (Studied vs. Non-studied) x Condition (RWI vs. FOK) mixed-model ANOVA produced a main effect of Study Status, $F$ (1, 70) = 4.22, $MSE$ = .001, $p$ = .044, $\eta_p^2 = .057$, indicating that participants were more likely to give partial information in the non-studied rather than studied category. No other effects were significant ($F$'s < 1.0). A paired sample t-test performed on partial identification rates for studied and unstudied items in the RWI category was marginally significant, $t$ (33) = -1.86, $SEM$ = .008, $p$ = .07, such that partial information was more likely to be given in the unstudied category, while a paired sample t-test performed on studied and unstudied items in the FOK was not ($p$ = .281).

The main results of interest were ratings given to unidentified test items (Table 3). A 2 x 2 Study-Status (Studied vs. Non-studied) x Condition (RWI vs. FOK) mixed-model ANOVA demonstrated a Study Status x Condition interaction, $F$ (1, 69) = 6.98, $MSE$ = .35, $p$ = .01, $\eta_p^2 = .092$, such that ratings were higher in the unstudied category in the

FOK condition while ratings were higher in the studied category in the RWI condition. A main effect of Study Status that was primarily carried by ratings in the unstudied FOK condition was also significant, $F$ (1, 69) = 6.56, $MSE$ = .345, $p$ = .013, $\eta_p^2$ = .087, such that items in the unstudied category were higher than those in the studied category. In the FOK condition, a paired sample t-test between the studied and unstudied categories was significant, $t$ (36) = -3.45, $SEM$ = .15, $p$ = .001, such that ratings were higher for items in the unstudied category while a paired sample t-test between the studied and unstudied RWI categories was not, (p = .9).

## Additional Results

*Metamemory measures*

Gamma correlations (Table 4) for unidentified test items were subjected to a 2 x 2 Study-Status (Studied vs. Non-studied) x Condition (RWI vs. FOK) mixed-model ANOVA that demonstrated a Study-Status x Condition interaction, $F$ (1, 65) = 26.97, $MSE$ = .011, $p$ < .001, $\eta_p^2$ = .293, such that the difference between gammas in the RWI condition was larger than in the FOK condition. A main effect of Condition that was primarily carried by the RWI condition was also significant, $F$ (1, 65) = 6.37, $MSE$ = .011, $p$ = .014, $\eta_p^2$ = .089, such that gammas for studied items were higher than unstudied items. No other interactions occurred (F < 1). A paired sample t-test between studied and non-studied gammas in the RWI condition was significant, $t$ (30) = 6.17, $SEM$ = .023, $p$ < .001, such that gammas in the studied condition were higher than gammas in the unstudied condition. A paired sample t-test between studied and non-studied gammas in the FOK condition was approaching significance, $t$ (35) = -1.77, $SEM$ = .027, $p$ = .086, such that gammas for the unstudied condition were higher than gammas in the studied condition. Gamma correlations were also computed by collapsing studied and unstudied items together for the RWI and FOK condition (Table 4), and subjected to a paired samples t-test that was significant, $t$ (33) = 14.30, $SEM$ = .019, $p$ < .001, such that collapsed studied/unstudied gammas for the RWI condition were higher than collapsed studied/unstudied gammas in the FOK condition.

The meta-memory measure G* (Table 5; Benjamin & Diaz, 2008; Masson & Rotello, 2009) for unidentified test items was subjected to a 2 x 2 Study Status (Studied vs. Non-studied) x Condition (RWI vs. FOK) mixed-model ANOVA that produced a significant main effect of Study Status, $F$ (1, 54) = 10.28, $MSE$ = .017, $p$ = .002, $\eta_p^2$ = .16, such that G* was higher for studied items than unstudied items. No other main effects or interactions occurred ($F$ < 1). A paired sample t-test between studied and unstudied G* for the RWI condition was approaching significance, $t$ (26) = 1.72, $SEM$ = .037, $p$ = .097, such that G* was higher for studied items while a paired samples t-test between studied and unstudied G* for the FOK condition was not significant ($p$ = .23). G* was also collapsed across studied and unstudied items for the RWI condition and the FOK condition (Table 5) and subjected to a paired samples t-test that was significant, $t$ (28) = -3.97, $SEM$ = .015, $p$ < .001, such that collapsed G* for the FOK condition was higher than the RWI condition.

The meta-memory measure R* (Table 6; Benjamin & Diaz, 2008) for unidentified test items was subjected to a 2 x 2 Study Status (Studied vs. Non-studied) x Condition (RWI vs. FOK) mixed model ANOVA that produced a Study Status x Condition interaction, $F$ (1, 65) = 13.26, $MSE$ = .007, $p$ = .001, $\eta_p^2$ = .17, such that R* was higher for studied items in the RWI condition while R* was higher for unstudied items in the

FOK condition. A paired sample t-test between studied and unstudied items in the RWI condition was significant, $t$ (30) = 3.03, $SEM$ = .024, $p$ = .005, such that R* was higher for studied items while a paired sample t-test between studied and unstudied items in the FOK condition was marginally significant, $t$ (35) = -1.89, $SEM$ = .017, $p$ = .067, such that R* was higher for unstudied items. R* was also collapsed across studied and unstudied items for the RWI and FOK conditions (Table 6) and subjected to a paired sample t-test that was significant, $t$ (34) = 4.60, $SEM$ = .01, $p < .001$, such that R* was higher for the RWI condition than the FOK condition.

The metamemory measure D_a (Table 7; Benjamin & Diaz, 2008; Masson & Rotello, 2009) for unidentified test items was subjected to a 2 x 2 Study Status (studied vs. unstudied) x Condition (RWI vs. FOK) mixed model ANOVA that produced a significant Study Status x Condition interaction, $F$ (1, 10) = 20.63, $MSE$ = .036, $p$ = .001, $\eta_p^2 = .674$, such that the difference between studied and unstudied D_a in the RWI condition was greater than the difference between studied and unstudied in the FOK condition. A paired sample t-test between the studied and unstudied items in the RWI condition was significant, $t$ (8) = -4.37, $SEM$ = .06, $p$ = .002, such that ratings in the unstudied category were higher than the studied category while a paired sample t-test between studied and unstudied items in the FOK condition was not significant ($p$ = .15). D_a was also collapsed across studied and unstudied items for the RWI and FOK conditions (Table 7) and subjected to a paired sample t-test that was significant, $t$ (16) = -4.87, $SEM$ = .07, $p < .001$, such that D_a was higher for the FOK condition.

*Norming Data*

In order to examine how the baseline familiarity of each image impacted the current results a norming study was conducted on 50 CSU students participating for credit in an introductory psychology class. Half of the students rated 40 images while the other half rated another set of 40 images. Each participant was presented with an image in the center of the screen and then were asked to "rate the familiarity of the image on a scale of 1 – 10".

The images were then divided according to two criteria: a median split between the 40 images with the highest mean familiarity ratings and the 40 with the lowest mean familiarity ratings and a quartile split creating four categories of familiarity – 1 - lowest, to 4 – the highest (see table 8 & 9). Unidentified test items were divided according to the median and quartile divisions acquired from the norming study and divided into old and new categories to acquire the mean ratings for each item in each condition.

Accordingly, an items analysis consisting of a 2 x 2 x 2 Study Status (Old vs. New) x Condition (FOK vs. RWI) x Familiarity (High vs. Low) mixed model ANOVA produced a main effect of Familiarity, $F$ (1, 64) = 166.04, $MSE$ = .83, $p < .001$, $\eta_p^2$ = .722, such that items higher in familiarity received higher ratings than less familiar items (Figure 1). A main effect of Condition was also produced, $F$ (1, 64) = 4.58, $MSE$ = 3.54, $p = .036$, $\eta_p^2$ = .067, such that ratings in the FOK condition were significantly higher than those in the RWI condition. A two-way Study Status x Condition interaction was significant, $F$ (1, 64) = 5.44, $MSE$ = 1.47, $p = .023$, $\eta_p^2$ = .078, such that ratings for unstudied items in the FOK condition were higher than studied items while ratings for studied items in the RWI condition were higher than unstudied items. A two-way

Familiarity x Study Status interaction was significant, $F$ (1, 64) = 1.96, $MSE$ = .83, $p$ = .030, $\eta_p^2$ = .03, such that old-new ratings differences were larger among high familiarity items than among low familiarity items. Finally, a three-way Study Status x Condition x Familiarity interaction was marginally significant, $F$ (1, 64) = 3.04, $MSE$ = .83, $p$ = .06, $\eta_p^2$ = .054, such that the old-new reversal pattern across the FOK and RWI conditions was larger among high familiarity items than among low familiarity items.

The quartile items analysis consisted of a 2 x 2 x 4 Study Status (Old vs. New) x Condition (RWI vs. FOK) x Familiarity (Lowest, Mid-low, Mid-high, Highest) mixed model ANOVA that produced a main effect of familiarity, $F$ (3, 27) = 57.99, $MSE$ = .93, $p < .001$, $\eta_p^2$ = .785, such that more familiar items received higher ratings than less familiar items (Figure 2). A two way Familiarity x Condition interaction was significant, $F$ (3, 27) = 3.88, $MSE$ = .94, $p$ = .02, $\eta_p^2$ = .301, such that items classified as more familiar in the FOK condition received higher ratings than those in the high familiar RWI condition. Finally, a two-way Study Status x Condition interaction was significant, $F$ (1, 29) = 5.41, $MSE$ = 1.87, $p$ = .027, $\eta_p^2$ = .157, such that ratings for unstudied items in the FOK condition were higher than studied items while ratings for studied items in the RIW condition were higher than unstudied items.

**Experiment 1 Discussion**

The replication of the Study-Status x Condition interaction for ratings given to unidentified test items from the pilot experiment, and the appearance of a Study-Status x Condition interaction for gamma correlations, add further support to the notion that retrospective (RWI) and prospective (FOK) judgments of familiarity are based on different underlying mechanisms. If retrospective and prospective judgments were based on similar underlying mechanisms, the ratings and gamma correlations in the RWI and FOK condition should followed the same pattern.

However, there was still a lack of an RWI effect. The increase in the number of stimuli used from Cleary and Reyes (2009) did not lead to the emergence of an RWI effect as hoped. Therefore, the issues of list length and plausible distracters were examined in Experiment 2. In order to preserve as much similarity as possible between different experiments, Experiment 2 attempted to examine if the use of plausible distracters was responsible for the lack of an RWI effect. As previously mentioned, because RWI paradigms require balanced presentation of studied and non-studied items and FOK paradigms require the use of plausible foil targets for final recognition test questions, ratings given to unidentified test items in the RWI unstudied condition may be inflated by false alarms to the plausible distracters. This is due to the possibility that participants mistakenly identify unstudied items as studied because they closely resemble each other. Thus, old-new discrimination may be diminished, eliminating the RWI effect.

In order to directly examine the hypothesis that the presence of plausible distracters led to the diminished RWI effect, a change of stimuli was needed. Thus, in Experiment 2, the pool of stimuli no longer contained two sets of 40 images that were similar to each other. Instead, one large pool of stimuli consisting of 80 images taken from Cleary and Reyes (2009) would be utilized in Experiment 2. This situation also allowed us to determine that the FOK ratings pattern found in Experiment 1 (whereby ratings were higher for unstudied than for studied items in the absence of identification) could be found in a situation where the typical RWI effect was found.

## Chapter IV:
## Experiment 2

The purpose of Experiment 2 was to determine is the use of plausible distracters is responsible for the lack of an RWI effect. To this end, the surprise final recognition test was eliminated and the pool of stimuli was changed so that each name from study no longer had two plausible images presented at test (the image representing the name and a plausible distracter). Rather, the foils were chosen so as not to be so highly similar to images representing studied names. For example, previously, if the name "St. Lois Arch" was presented at study, the image of the both the St. Lois Arch as the target and the image of the Arch de Triomphe as a foil would be presented. However, in Experiment 2, the presentation of the name "St. Lois Arch" at study would be represented by the image of the St. Lois Arch and the image of a building as a possible foil. Although this eliminates the possibility of computing gamma correlations, it does allow the hypothesis that plausible distracters diminished the RWI effect to be examined.

### Methods

*Participants*

One-hundred twenty three introductory psychology students from Colorado State University participated for course credit: 62 in the RWI condition and 61 in the FOK condition.

*Materials*

Eighty images were taken from the stimuli set of Cleary and Reyes (2009) and were presented on a desktop computer using the program E-Prime.

*Design and Procedure*

The same design and procedure was repeated from the pilot study.

*Results*

As before, full and partial identification rates are reported before the main results of interest. A 2 x 2 Study Status (Studied vs. Non-studied) x Condition (RWI vs. FOK) mixed model ANOVA conducted on overall identification rates (Table 1) demonstrated a main effect of Study Status, $F(1, 121) = 193.14$, $MSE = .008$, $p < .001$, $\eta_p^2 = .615$, such that participants were significantly more likely to identify test items when the name was presented at study than for test items that did not have their name presented at study. No other main effects or interactions were found ($F < 1$).

A 2 x2 Study Status (Studied vs. Non-studied) x Condition (RWI vs. FOK) mixed model ANOVA conducted on partial identification rates (Table 1) demonstrated a main effect of Study Status, $F(1, 121) = 7.75$, $MSE = .002$, $p = .006$, $\eta_p^2 = .06$, such that partial identification for items in the unstudied condition were higher than those in the studied condition. No other main effects or interactions occurred ($F < 1$). A paired sample t-test conducted on partially identified studied and unstudied items in the FOK condition was significant, $t(60) = -2.78$, $SEM = .007$, $p = .007$, such that more items were partially identified in the unstudied condition, while a paired sample t-test conducted on studied and unstudied partial identification rates in the RWI condition was not ($p = .18$)

The main results of interest were the ratings given to unidentified test items (Table 3). A 2 x 2 Study-Status (Studied vs. Non-studied) x Condition (RWI vs. FOK) mixed-model ANOVA demonstrated a Study Status x Condition interaction, $F(1, 121) =$

11.36, $MSE = .40$, $p < .001$, $\eta_p^2 = .192$, such that ratings in the RWI condition were higher in the studied than the unstudied categories while ratings in the FOK condition were higher for unstudied than studied items. A paired-sample t-test between items in the studied and unstudied categories in the RWI condition was significant, $t\,(61) = 5.67$, $SEM = .09$, $p < .001$, such that ratings were higher for unidentified test items in the studied condition. A paired sample t-test between items in the studied and unstudied categories in the FOK condition was significant, $t\,(60) = -2.55$, $SEM = .13$, $p < .05$, such that ratings were higher for unidentified test items in the unstudied condition.

**Experiment 2 Discussion**

The presence of an RWI effect found in Experiment 2 supports the hypothesis that the presence of plausible distracters was the reason that an RWI effect did not emerge in the pilot study or in Experiment 1. Because a final surprise recognition test could not be administered at the end of Experiment 2, it is unclear how the gamma correlations from Experiment 1 would be affected by the use of this different stimuli pool. However, the finding of an RWI effect in Experiment 2 does alleviate some of the concerns over the lack of an RWI effect in the pilot experiment and Experiment 1.

Further, the finding of an RWI effect in Experiment 2 may lend support to fact that the distracters used in the pilot experiment and Experiment 1 were in fact plausible distracters. That is, the chosen foils were similar enough to inflate RWI ratings in the unstudied condition, thus eliminating the RWI effect in the pilot experiment and Experiment 1. The fact that ratings were higher for unstudied items than studied items in the FOK condition across all three experiments lends further support to the notion that RWI and FOK judgments are based on different underlying mechanisms, as does the fact that the use of similar distracters only seemed to influence ratings in the RWI condition.

# Chapter V:
## General Discussion

The present study demonstrates that different underlying mechanisms influence retrospective (RWI) and prospective (FOK) judgments given to unidentified test items. Participants who judged the likelihood that an unidentified test image's name was presented at study (retrospective RWI condition), gave significantly different ratings than those participants judging the likelihood that they would recognize an unidentified test image's name in the future (prospective FOK condition) across all three experiments. In the pilot experiment and Experiment 1, there was a significant study status x condition interaction such that ratings in the unstudied FOK condition were significantly higher than all other conditions. In experiment 2, the standard RWI effect emerged, such that mean ratings given to test images that had their names presented at study received significantly higher ratings than mean ratings given to test images that did not have their names presented at study. The ratings were reversed in the FOK condition such that test images that did not have their names presented at study garnered significantly higher ratings than test images that did have their names presented at study. Finally, all metamemory measures from Experiment 1 produced some type of significant difference between the RWI and FOK conditions.

Therefore, although RWI and FOK researchers have been using the real-world example of the "butcher on the bus" in order to describe RWI and FOK experiences, the current experiments suggest that they are based on different underlying mechanisms. The present findings are similar to other sets of data demonstrating that although TOT and FOK states (Maril, Simons, Weaver, & Schacter, 2005; Schwartz, 2008), and RWI and TOT states (Cleary, 2006; Cleary & Reyes, 2009; Cleary & Specker, 2007) are subjectively similar and closely related to each other respectively, they are influenced by different underlying mechanisms. A review of possible mechanisms behind FOK and RWI judgments will be necessary before discussing possible mechanisms of influence in the present experiments.

***Possible underlying mechanisms of FOKs***

The first explanation for FOKs was a direct access account provided by Hart (1965) who proposed FOKs were based on participant's direct access to their memory trace. That is, participants could determine the probability of future recognition by directly tapping into their memory store in the absence of recall and assess the probability of future recognition. Recently, direct access accounts have been abandoned in favor of inferential accounts that propose that FOKs are based on participants' use of available cues when making FOK judgments (Koriat & Levy-Sadot, 2001). The two dominant inferential accounts that have garnered support are the cue-familiarity account and the accessibility account of FOKs (Koriat, 1995; Koriat, 2007).

*Cue-familiarity account of FOKs*

The cue-familiarity account posits that FOKs are based on the familiarity of the pointer or cue rather than the target itself (Metcalfe, 1993; Metcalfe, Schwartz, & Joaquim, 1993; Reder, 1987; Schwartz & Metcalfe, 1992). That is, participants assess the likelihood of future recall of an unidentified target based on the initial assessment of a cue's familiarity. Support for the cue-familiarity hypothesis comes from studies that manipulate the familiarity of the cue and target independently. For example, Reder and Ritter (1992) had participants make FOK judgments quickly after the presentation of an arithmetic problem. Before participants had enough time to calculate an answer, they were asked to make an FOK predicting the likelihood that they would be able to produce the answer simply by looking at the numbers involved. For example, presenting the problem 27 x 32 during study increased FOK judgments for math problems that contained those numbers at test in different equations, such as 27 x 17 and 27 + 32, even though those equations had not been seen before in the context of the experiment. The authors argued that this presented evidence that participants could base their FOKs on an initial assessment of cue-familiarity.

Further support for the cue-familiarity hypothesis came from Schwartz and Metcalfe (1992) who had participants either generate or read word pairs at study. Half of the cues had previously been primed using a previous pleasantness rating task. They found that generating targets increased recall rates but did not affect FOKs while the pleasantness rating task increased FOKs but had no effect on recall. The authors concluded that the data supported the cue-familiarity hypothesis as increasing cue familiarity through presentation in the rating task increased FOK's but increasing familiarity of the targets through generation did not.

Finally, studies that assess the feeling of "not knowing" also suggest that cue-familiarity influences FOK judgments (Liu, Su, Xu, & Chan, 2007; Glucksberg & McCloskey, 1981; Klin, Guzman, & Levine, 1997). For example, Glucksberg & McCloskey (1981) recorded responses of "don't know", "true", and "false" from participants presented with general knowledge questions. They found that participants were fastest to answer "don't know" to a general knowledge question compared to "true" or "false" responses. That is, participants were quickest to judge the *unfamiliarity* of the general knowledge question, and that having some familiarity with the question led to longer response times and "true" and "false" responses. The authors argued that an initial assessment of cue-familiarity was responsible for "don't know" responses.

*Accessibility account of FOKs*

The accessibility account posits that attempts to retrieve target information will generate clues or activate target information that will influence FOKs. Clues or target information may consist of target fragments, semantic information, or episodic information that will enhance the subjective feeling that the target is stored in memory and can be accessed. An important premise of the accessibility account is that participants have no access to the correctness of the partial information that is generated. However, as long as whatever information comes to mind is correct (i.e., experimenters do not purposefully mislead participants with false partial information), that information should be a valid predictor of FOKs.

Support for the accessibility account was provided by Koriat (1993) who presented participants with strings of nonsense letters to remember. When participants later failed to recall a nonsense string of letters, they were asked to make an FOK judgment predicting the likelihood that they would recognize the correct string among foils in a later recognition test. Koriat found that FOK judgments were positively correlated with the number of letters recalled and future recognition performance, regardless of their correctness. That is, the more access participants had (or believed they had) to the target string of letters, the greater their FOKs and recognition performance.

Koriat (1995) found further support for the accessibility account by presenting participants with general knowledge questions that were classified according to high or low accessibility. High accessibility questions were those questions that were more likely to be answered by participants than low accessibility questions, regardless of their correctness. Koriat found that among participants who failed to give an answer to the questions gave higher FOKs to questions classified as high accessibility than to those classified as low accessibility. Based on the assumption that questions rated as being highly accessible lead to more generation of partial target clues, support was found for the accessibility account.

Finally, evidence for the accessibility account arises from examining at FOK judgments according to commission and omission errors. Commission errors occur when a participant gives a wrong answer to a question while omission errors occur when there is a failure to answer. Consistent with the view that FOKs are based on access to partial information regardless of its correctness, commission errors correspond with higher FOKs than omission errors (Koriat, 1993; Krinsky & Nelson, 1985).

*Two-Stage account of FOKs*

Koriat and Levy-Sadot (2001) proposed a two stage process in where cue familiarity is initially used to formulate FOK judgments. However, after the initial assessment of cue familiarity, participants switch strategies by formulating FOKs on the basis of target accessibility. As stated before, an important caveat of the accessibility account is that an FOK is formulated on the basis of the information available regardless of the correctness of that information. Therefore, as long as subjects are given sufficient time, their judgments should be based on the strength or amount of information accessed rather than the familiarity of the cue. Further evidence for the two stage model of FOKs was provided by Benjamin (2005), who found that attempted target retrieval played a larger role in influencing FOKs when participants were allowed to proceed as they chose. However, when pressured to make a FOK in a time constraint condition, cue-familiarity had a larger influence than target retrievability.

***Possible mechanisms of RWI***

As one possible explanation for the RWI effect, Cleary (2006) proposed that describing familiarity judgments within the context of baseline activation and current activation could explain why familiarity ratings are higher for novel test cues when targets are presented at study. In Reder's SAC model (Reder, 1987; Reder et. al., 2000), baseline activation can be represented as the pre-experimental familiarity of a particular item. It can be based on variables such as word frequency (the more times a word is encountered in real life, the more familiar it is) or semantic fan size (the amount of neighboring concepts that are associated with a word) while current activation includes any increase in an items familiarity due to experimental presentations (i.e., presenting a word at study).

For example, in the current study (as well as in Cleary and Reyes, 2009) presentation during study of the word "Alamo" increased activation of the participants pre-experimental semantic network that includes the image of "The Alamo" and the node connecting the word with its pictorial referent. When the image of the Alamo was presented at test, the increased activation of the semantic network from the study presentation of the name "Alamo" increased the activation level of the test cue. This would explain why RWI ratings for images that had their names studied received higher ratings than images that did not. Therefore, participants in the RWI condition may have utilized the activation level of the semantic network associated with the cue or target when making their RWI judgments.

This account of RWI can be interpreted within the framework of either the cue-familiarity or accessibility accounts of FOKs. The cue-familiarity account of FOKs would be identical to the described RWI explanation given above while the accessibility account would assume that participants are directly accessing the target or intermediate node and assessing its level of familiarity. Interpreted within Reder's SAC model, access of target information may include the intermediate node or the activation level of the targets semantic network, where both should have increased in familiarity with the presentation of the study list. The main difference between the RWI account and the FOK accounts is that the RWI account does not differentiate between cue-familiarity and target-accessibility.

***Application of RWI and FOK mechanisms to the present study***

A plausible explanation of the current experiments should account for the differences between studied and unstudied unidentified test items within and across the RWI and FOK conditions. The differences across conditions will necessarily entail two separate explanations: one for the RWI condition and one for the FOK condition. Those accounts used to explain RWI and FOK judgments should then be used to explain the differences in ratings for the studied and unstudied categories.

As stated before, Cleary (2006) proposed a possible mechanism behind RWI judgments using the Reder's SAC model that could be interpreted within either the cue-familiarity or accessibility accounts of FOKs. Therefore, the cue-familiarity account of

FOKs will be used to explain the pattern of ratings in the RWI condition. Because RWI in this case relies on a pre-existing semantic knowledge base, presentation of a place's name at study could theoretically initiate activation throughout the semantic network associated with that famous place, including its pictorial referent, semantic neighbors, and whatever else information is contained within that semantic network.

For example, in the current study (as well as in Cleary and Reyes, 2009) presentation during study of the word "Alamo" increased activation of the participants pre-experimental semantic network that includes the image of "Alamo" and the node connecting the word with its pictorial referent. When the image of the Alamo was presented at test, the increased activation of the semantic network from the study presentation of the name "Alamo" increased the activation level of the test cue. Therefore, because unidentified test items that did not have their name presented at study did not receive this increase in activation, those items would get lower ratings than test items that did have their name presented at study. This would account for the higher ratings given to studied items in the RWI condition.

Based on the assumption that different patterns of ratings in the RWI and FOK condition arise from different underlying mechanisms, the use of the cue-familiarity account to explain the RWI data should not be used to explain the FOK data. If subjects were using the familiarity of the cue when making FOK judgments, the items in the studied category should have received higher ratings and the data should have mirrored the RWI condition. Therefore, the accessibility account will be used to explain the pattern of ratings in the FOK condition.

The accessibility account may explain the FOK data, but *only* when item selection is considered. Item selection in this case would be that "easy-to-identify" items in the studied category should be more likely to be identified than those in the unstudied category due to priming. This left more "easy-to-identify" items in the unstudied FOK category as the priming influence of the study list should have pushed the activation level of easier items over the threshold, thus making them retrieved. FOKs have been shown to increase for items with larger semantic networks, but only in situations that do not involve presentation of the target (Koriat & Levy-Sadot, 2001). When FOKs are acquired in list or paired associated learning, target presentation decreases FOKs. Because the current study did not entail target presentation for items in the unstudied FOK condition, and considering the effect of priming in the studied condition, the finding that ratings were higher for the unstudied FOK category is in accord with previous findings in the FOK literature.

Further evidence for an explanation of the current FOK data based on the accessibility account and item selection comes from Koriat (1995) who demonstrated that more difficult-to-answer items elicit lower FOKs than easier-to-answer items. The difficulty of the questions was determined by the number of participants that gave an answer for that particular question, regardless of it being correct. The FOK ratings of participants who did not provide an answer were higher for questions classified as "easier". Thus, Koriat and Levy-Sadot (2001) proposed that FOKs are positively correlated with the amount of partial information that comes to mind (regardless of correctness), and as long as that information is mostly correct, FOKs will be predictive of future recognition performance.

The accessibility account of the FOK data does not rule out the use of cue-familiarity, rather, as Koriat and Levy-Sadot (2001) proposed, accessibility actually *depends* on cue-familiarity. In their two stage model of FOKs, if the cue familiarity is high enough, participants will then engage in a search for the target. Searching for the target then leads to either access of the target, or access of pertinent information that may give clues about an unidentified item. Consistent with this line of reasoning, Benjamin (2005) found that attempted target retrieval played a larger role in influencing FOKs when participants were allowed to proceed as they chose. However, when pressured to make a FOK in a time constraint condition, cue-familiarity had a larger influence than target retrievability. The current studies did not have a time constraint for making FOK judgments, therefore, participants may have been more likely to search and then access their semantic knowledge store.

The identification rates for RWI and FOK conditions were not significantly different in the studied or unstudied conditions across all experiments. Therefore, if priming led to higher identification rates for certain items, this would have occurred equally across RWI and FOK conditions, leaving equal amounts of difficult items not being identified in the studied category for both conditions. Also, counterbalancing of items across subjects ensured equal presentation of stimuli as studied and non-studied items and further lessons the probability that item selection is responsible for the difference in ratings between the RWI and FOK conditions. That is, participants were equally likely to have only difficult items left in the studied category for the RWI and FOK conditions. Thus, the difference in ratings between the RWI and FOK conditions is not likely to be due to item difficulty. Instead, it likely reflects different underlying mechanisms of RWI and FOK judgments.

It should also be noted that Koriat's (1993) accessibility account could also be used to explain the data for the RWI condition. An accessibility account of the RWI condition would assume that participants were able to access the nodes connecting the target to the cue, or also the node of the cue itself, where both should have increased activation in the studied condition relative to the unstudied condition. However, while the accessibility and cue-utilization account are both plausible explanations for the RWI condition, it seems that only the accessibility account plausibly explains the FOK account. Further, it would make sense that if the accessibility account does explain the pattern of ratings in the FOK condition, then it would be unlikely that an accessibility account would explain the pattern of ratings in the RWI condition, as opposite patterns were shown between the RWI and FOK conditions. Therefore, the accessibility account alone cannot explain the full pattern of results reported here.

*Two-stage account of the current experiments*

If different variables were influencing RWI and FOK judgments, an important question then is, "*why* are participants basing their RWI and FOK judgments on different influences?" A possible explanation could be that because participants in the RWI condition were concerned with making a decision about prior presentation of the target, they may simply have used the familiarity of the cue. In the FOK condition, because subjects were concerned about whether or not they could recognize the answer if it was presented to them, they may have been more likely to attempt to assess their semantic store and use that information as a basis for their FOK judgment.

This account would fit nicely into Koriat and Levy-Sadot's (2001) two stage account of FOKs where cue-familiarity drives accessibility. In the RWI condition, participants may have been concerned mainly with cue-familiarity. That is, they were simply concerned with whether or not the test cue had its name presented at study. Therefore, cue-familiarity would have been sufficient for discriminating between test cues that had their targets previously presented from test cues that did not. However, in the FOK condition, participants may have been more concerned with acquiring the target from their semantic knowledge base. That is, they were concerned with the ability to answer the question in order to recognize the answer in the future. Therefore, they may have been more likely to continue on to the second stage of accessing their semantic knowledge store when making FOK judgments.

Consistent with this line of reasoning is the fact that there were significantly more instances where partial information was recalled in the unstudied FOK condition than the studied FOK condition in the pilot experiment and Experiment 2. The means for Experiment 1 were also in the same direction for the FOK condition (unstudied > studied) although the differences were not statistically significant. A possible explanation that fits with the proposed two-stage explanation entails that because participants making FOK judgments may have been more likely to search their semantic memory store for information, rather than use the familiarity of the cue, they would have been more likely to recall partial information. Participants in the RWI condition, who may have been more likely to rely on cue-familiarity may not have continued on to the second stage and attempt to access their semantic knowledge store, leaving them to base their judgments on cue familiarity.

### *Implications for Dual process theories*

If the interpretation of the data is correct (that participants are solely using the familiarity of the cue as a basis for their retrospective judgments), then an implication is that list-learning paradigms may in fact successfully tap familiarity processes when full recollection fails. Recently, there has been some disagreement in the literature regarding whether existing dual process methods actually tap familiarity or just differing degrees of recollection (e.g., Wais, Mickes & Wixted, 2008; Wixted, 2007). The basic idea is that, in the absence of full recollection, methods of separating familiarity from recollection may actually only be separating partial from full recollection. If we are correct that participants only search for further information when giving prospective judgments in the absence of full recollection, but stop at cue familiarity when giving retrospective judgments, then this suggests that standard dual-process list-learning paradigms, because they involve retrospective judgments, likely do tap familiarity.

### *Limitations*

Although the present explanation relies on the accessibility account proposed by Koriat (1993), the removal of items that were partially identified is an experimental procedure that has not seem to be addressed in theoretical explanations of the accessibility account. Koriat describes partial information as information that can be articulated, such as letter information, regardless of its correctness. However, there seems to be no cases in the FOK literature where partially recalled information is treated as a completely recalled answer. As this is the common methodology in RWI paradigms, and also the methodology applied here, it would imply that subjects were basing their FOK judgments on information that could not be articulated.

Finally, it would be interesting to examine how RWI and FOK judgments differ when using different types of stimuli such as faces, general knowledge questions, and other types of stimuli while also manipulating the use of participants' semantic or episodic memory stores. For example, examining how RWI and FOK judgments are affected when using famous faces and novel faces paired with names. Should more data continue to demonstrate a difference between RWI and FOK judgments, the case for generalizing the findings of this experiment will be even stronger.

## References

Arndt, J., Lee, K., & Flora, D.B. (2008). Recognition without identification for words pseudowords, and nonwords. *Journal of Memory and Language*, 59 (3), 346-360.

Benjamin, A.S. (2005). Response speeding mediates the contributions of cue familiarity and target retrievability to metamnemonic judgments. *Psychonomic Bulletin & Review*, 12 (5), 874-879.

Benjamin, A.S., & Diaz, M. (2008). Measurement of relative metamnemonic accuracy. In J. Dunlosky & R. A. Bjork (Eds.), *Handbook of memory and metamemory* (pp. 73 - 94). New York: Psychology Press.

Butterfield, E.C., Nelson, T.O., & Peck, V. (1988). Developmental aspects of the feeling of knowing. *Developmental Psychology*, 24, 654-663.

Cleary, A.M., (2004). Orthography, phonology, and meaning: Word features that give rise to feelings of familiarity in recognition. *Psychonomic Bulleting & Review*, 11, 446-451.

Cleary, A.M. (2006). Relating familiarity-based recognition and the tip-of-the-tongue phenomenon: Detecting a word's recency in the absence of access to the word. *Memory & Cognition*, 34, 804-816.

Cleary, A.M., & Greene, R.L. (2000). Recognition without identification. *Journal of Experimental Psychology: Learning, Memory, and Cognition,* 26, 1063-1069.

Cleary, A.M., & Greene, R.L. (2001). Memory for unidentified items: Evidence for the use of letter information in familiarity processes. *Memory & Cognition*, 29 (3), 540-545.

Cleary, A.M., & Greene, R.L. (2005). Recognition without perceptual identification: A measure of familiarity? *The Quarterly Journal of Experimental Psychology*, 58A (6), 1143-1152.

Cleary, A.M., Langley, M.M., & Seiler, K.R. (2004). Recognition without picture identification: Geons as components of the pictorial memory trace. *Psychonomic Bulletin & Review*, 11 (5), 903-908.

Cleary, A.M., & Specker, L.E. (2007). Recognition without face identification. *Memory*

*& Cognition*, 35, 1610-1619.

Cleary, A.M., & Reyes, N.L. (2009). Scene recognition without identification. *Acta Psychologia*, 131 (1), 53-62.

Cleary, A.M., Ryals, A.J., & Nomi, J. (2009). Can déjà vu result from similarity to a prior experience? Support for the similarity hypothesis of déjà vu. *Psychonomic Bulletin & Review*, 16 (6), 1082-1088

Cleary, A.M., Winfield, M.M., & Kostic, B. (2007). Auditory recognition without identification. *Memory & Cognition*, 35 (8), 1869-1877.

Costermans, J., Lories, G., & Ansay, C. (1992). Confidence level and feeling of knowing in question answering: the weight of inferential processes. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 18 (1), 142-150.

Glucksberg, S., & McCloskey, M. (1981). Decisions about ignorance: Knowing that you don't know. *Journal of Experimental Psychology: Human Learning and Memory*, 7 (5), 311-325.

Hart, J.T. (1965). Memory and the feeling-of-knowing experience. *Journal of Educational psychology,* 56 (4), 208-216.

Izaute, M., Chambres, P., & Larochelle, S. (2002). Feeling-of-knowing for proper names. *Canadian Journal of Experimental Psychology*, 56 (4), 263-272.

Jacoby, L.L. (1991). A process dissociation framework: separating automatic from intentional use of memory. *Journal of Memory and Language*, 30, 513-514.

Langley, M.M., Cleary, A.M., Woods, J., & Kostic, B. (2008). Picture recognition without picture identification: A method for assessing the role of perceptual information in familiarity based picture recognition. *Acta Psychologica*, 127, 103-113.

Litman, J.A., Hutchings, T.L., & Russon, R.K. (2005). Epistemic curiosity, feeling-of-knowing, and exploratory behavior. *Cognition and Emotion*, 19 (4), 559-582.

Liu, Y., Su, Y., Xu, G., & Chan, R.C.K. (2007). Two dissociable aspects of feeling-of-knowing: Knowing that you know and knowing that you do not know. *The Quarterly Journal of Experimental Psychology*, 60 (5), 672-680.

Klin, C.M., Guzman, A.E., & Levine, W.H. (1997). Knowing that you don't know: Metamemory and discourse processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 23 (6), 1376-1393.

Koriat, A. (1993). How do we know that we know? The accessibility model of the feeling of knowing. *Psychological Review*, 100, 609-639.

Koriat, A. (1995). Dissociating knowing and the feeling of knowing: further evidence for the accessibility model. *Journal of Experimental Psychology: General*, 124 (3), 311-333.

Koriat, A. (2007). *Metacognition and Consciousness*. In: Cambridge handbook of consciousness. Cambridge University Press, New York, USA.

Koriat, A., & Levy-Sadot, R. (2001). The combined contributions of the cue-familiarity and accessibility heuristics to feelings of knowing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 27 (1), 34-53.

Kostic, B.K., & Cleary A.M. (2009). Song recognition without identification: when people cannot "name that tune" but can recognize it as familiar. *Journal of Experimental Psychology: General*, 138 (1), 146-159.

Krinsky, R., & Nelson, T.O. (1985). The feeling of knowing for different types of retrieval failure. *Acta Psychologia*, 58 (2), 141-158.

Mandler, G. (1980). Recognizing: the judgment of previous occurrence. *Psychological Review*, 87, 252-271.

Maril, A., Simons, J.S., Weaver, J.J., & Schacter, D.L. (2005). Graded recall success: an event-related fMRI comparison of tip of the tongue and feeling of knowing. *Neuroimage*, 24, 1130-1138.

Masson, M.E.J., & Rotello, C.M. (2009). Sources of bias in the goodman-kruskal gamma coefficient measure of association: Implications for studies of metacognitive processes. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 35 (2), 509-527.

Metcalfe, J., Schwartz, B.L., & Joaquim, S.G. (1993). The cue-familiarity heuristic in metacognition. *Journal of Experimental Psychology, Learning, Memory, & Cognition*, 19 (4), 851-861.

Peynircioglu, Z.F. (1990). A feeling-of-recognition without identification. *Journal of Memory and Language,* 29, 493-500.

Rajaram, S. (1993). Remembering and knowing: Two means of access to the personal past. *Memory & Cognition*, 21 (1), 89-102.

Reder, L.M., (1987). Strategy selection in question answering. *Cognitive Psychology*, 19, 90- 138.

Reder, L.M., Nhouyvansivong, A., Schunn, C.D., Ayers, M.S., Angstadt, P., & Hiraki, K.

(2000). A mechanistic account of the mirror effect for word frequency: A computational model of remember/know judgments in a continuous recognition paradigm. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 26 (2), 294-320.

Reder, L.M., & Ritter, F.E. (1992). What determines initial feeling of knowing? Familiarity with question terms, not with the answer. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 18, 435-451.

Schwartz, B.L. (2008). Working memory load differentially affects tip-of-the-tongue states and feeling-of-knowing judgments. *Memory & Congition*, 36, 9-19.

Schwartz, B.L., & Metcalfe, J. (1992). Cue familiarity but not target retrievability enhances feeling-of-knowing judgments. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 18 (5), 1074-1083.

Singer, M., & Tiede, H.L. (2008). Feeling of knowing and duration of unsuccessful memory search. *Memory & Cognition*, 36 (3), 588-597.

Gruneberg, M.M., & Monks, J. (1974). Feeling of knowing and cued recall. *Acta Psychologica*, 38, 257-265.

Tulving, E. (1985). Memory and consciousness. *Canadian Psychology*, 26, 1-12.

Wais, P.E., Mickes, L., & Wixted, J.T. (2008). Remember/know judgments probe degrees of recollection. *Journal of Cognitive Neuroscience*, 20 (3), 400–405.

Widner, R.L., Smith, S.M., & Graziano, W. G. (1996). The effects of demand characteristics on the reporting of tip-of-the-tongue and feeling-of-knowing states. *American Journal of Psychology*, 109 (4), 525-538.

Wixted, J.T. (2007). Dual-process theory and signal-detection theory of recognition memory. *Psychological Review*, 114 (1), 152-176.

Wright, D.B. (1996). Measuring the feeling of knowing: Comment on schraw. *Applied Cognitive Psychology*, 10, 261-268.

Yaniv, I., & Meyer, D.E. (1987). Activation and metacognition of inaccessible stored information: potential bases for incubation effects in problem solving. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 13 (2), 187-205.

Yonelinas, A.P. (2002). The nature of recollection and familiarity: A review of 30 years of research. *Journal of Memory and Language*, 46, 441-517.

Yovel, G., & Paller, K.A. (2004). The neural basis of the butcher-on-the-bus phenomenon: When a face seems familiar but is not remembered. *Neuroimage*, 21, 789-800.

Table 1: Overall mean identification rates (Standard deviations in parenthesis).

| **Condition:** | **RWI** | | **FOK** | |
|---|---|---|---|---|
| | ***Studied*** | ***Non-Studied*** | ***Studied*** | ***Non-Studied*** |
| **Pilot Experiment** | .44 (.18) | .29 (.15) | .40 (.15) | .24 (.12) |
| **Experiment 1** | .41 (.16) | .28 (.14) | .40 (.15) | .29 (.12) |
| **Experiment 2** | .49 (.15) | .34 (.14) | .51 (.15) | .35 (.15) |

Table 2: Overall mean partial identification rates (Standard deviations in parenthesis).

| **Condition:** | **RWI** | | **FOK** | |
|---|---|---|---|---|
| | ***Studied*** | ***Non-Studied*** | ***Studied*** | ***Non-Studied*** |
| **Pilot Experiment** | .08 (.07) | .09 (.06) | .08 (.05) | .11 (.06) |
| **Experiment 1** | .05 (.04) | .07 (.05) | .07 (.06) | .08 (.06) |
| **Experiment 2** | .05 (.05) | .06 (.05) | .05 (.04) | .07 (.05) |

Table 3: Mean ratings given to unidentified test items (Standard deviations in parenthesis).

| **Condition:** | **RWI** | | **FOK** | |
|---|---|---|---|---|
| | ***Studied*** | ***Non-Studied*** | ***Studied*** | ***Non-Studied*** |
| **Pilot Experiment** | 4.43 (1.44) | 4.27 (1.32) | 4.30 (1.65) | 4.73 (1.55) |
| **Experiment 1** | 4.78 (0.96) | 4.77 (1.06) | 4.80 (1.06) | 5.31 (1.46) |
| **Experiment 2** | 5.06 (1.06) | 4.53 (1.05) | 4.48 (1.38) | 4.81 (1.38) |

Table 4: Mean gamma correlations for unidentified test items from Experiment 1 (Standard deviations in parenthesis).

| **Condition:** | **RWI** | | **FOK** | |
|---|---|---|---|---|
| | ***Studied*** | ***Non-Studied*** | ***Studied*** | ***Non-Studied*** |
| **Experiment 1** | .13 (0.46) | -.01 (.55) | -.01 (.60) | .03(.47) |

Collapsed Gamma across studied/non-studied:

| **Condition:** | **RWI** | **FOK** |
|---|---|---|
| **Experiment 1** | .21 (0.51) | -.07 (.56) |

Table 5: Mean G* correlations for unidentified test items from Experiment 1 (Standard deviations in parenthesis).

| **Condition:** | **RWI** | | **FOK** | |
|---|---|---|---|---|
| | ***Studied*** | ***Non-Studied*** | ***Studied*** | ***Non-Studied*** |
| **Experiment 1** | .02 (0.39) | -.04 (.53) | .02 (.47) | -.07(.38) |

Collapsed G* across studied/non-studied:

| **Condition:** | **RWI** | **FOK** |
|---|---|---|
| **Experiment 1** | .08 (0.44) | .08 (.44) |

Table 6: Mean R* correlations for unidentified test items from Experiment 1 (Standard deviations in parenthesis).

| **Condition:** | **RWI** | | **FOK** | |
|---|---|---|---|---|
| | ***Studied*** | ***Non-Studied*** | ***Studied*** | ***Non-Studied*** |
| **Experiment 1** | .06 (0.27) | -.02 (.38) | -.02 (.38) | .01(.30) |

Collapsed R* across studied/non-studied:

| **Condition:** | **RWI** | **FOK** |
|---|---|---|
| **Experiment 1** | .04 (0.22) | -.01 (.25) |

Table 7: Mean D_a correlations for unidentified test items from Experiment 1 (Standard deviations in parenthesis).

| **Condition:** | **RWI** | | **FOK** | |
|---|---|---|---|---|
| | ***Studied*** | ***Non-Studied*** | ***Studied*** | ***Non-Studied*** |
| **Experiment 1** | -.30 (.40) | -.06 (.47) | .02 (.54) | .14(.65) |

Collapsed D_a across studied/non-studied:

| **Condition:** | **RWI** | **FOK** |
|---|---|---|
| **Experiment 1** | -.40 (0.44) | -.07 (.53) |

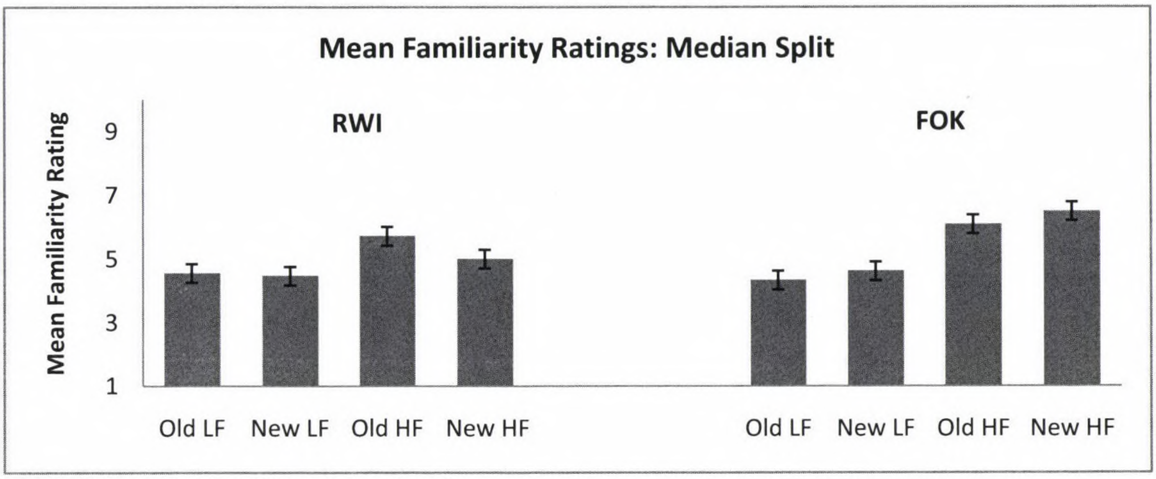
Table 8: Norming study

| | | | |
|---|---|---|---|
| **Q 1** | | | |
| Lava Beds | 1.96 | Jerusalem | 5.88 |
| Woodstock | 2.00 | Notre Dame Cathedral | 5.96 |
| Guggenheim | 2.04 | Teotihuacan | 6.12 |
| Kansai Airport | 2.16 | Mesa Verde | 6.40 |
| Angkor Wat | 2.32 | Sistine Chapel | 6.50 |
| Chesapeake Bay | 2.60 | London Tower | 6.52 |
| Denver Mint | 2.80 | Royal Gorge | 6.67 |
| Versailles | 2.80 | Taj Mahal | 7.04 |
| Templars Tomb | 2.83 | Parthenon | 7.05 |
| Windsor Castle | 3.00 | Central Park | 7.16 |
| Neuschwanstein Castle | 3.04 | San Diego Zoo | 7.20 |
| Olympean | 3.04 | Gateway Arch | 7.36 |
| Blue Hole | 3.12 | Vietnam War Memorial | 7.52 |
| Loretto Chapel | 3.16 | Epcot Center | 7.60 |
| Old Cape Henry | 3.17 | Hoover Dam | 7.72 |
| Berlin Wall | 3.20 | The Scream | 7.72 |
| Yucca Valley | 3.36 | Universal Studios | 7.72 |
| Panama Canal | 3.54 | Arlington National Cemetary | 8.12 |
| Karnak Temple | 3.76 | Red Rocks | 8.12 |
| Champs Elysees | 3.86 | Fenway Park | 8.20 |
| **Q 2** | | **Q 4** | |
| Elephant Butte | 3.88 | Arc de Triomphe | 8.24 |
| Petra | 3.88 | Liberty Bell | 8.24 |
| Tomb of the Unknown Soldier | 4.20 | Big Ben | 8.39 |
| Yankee Stadium | 4.20 | Daytona Speedway | 8.52 |
| The Met | 4.40 | Stonehenge | 8.56 |
| The Alamo | 4.48 | Leaning Tower of Pisa | 8.64 |
| Carnegie Hall | 4.60 | Old Faithful | 8.76 |
| Mardi Gras | 4.79 | Luxor | 8.80 |
| Mecca | 4.96 | Great Wall of China | 8.92 |
| The Thinker Statue | 5.08 | Rocky Mountains | 8.96 |
| Alcatraz | 5.16 | Seattle Space Needle | 8.96 |
| The Louvre | 5.16 | Times Square | 9.00 |
| White Sands | 5.17 | Las Vegas Strip | 9.24 |
| Pepsi Center | 5.26 | Pentagon | 9.32 |
| Forbidden City | 5.28 | Sea World | 9.32 |
| Area 51 | 5.30 | Sydney Opera House | 9.56 |
| Rainbow Bridge | 5.40 | Coliseum | 9.71 |
| St. Peter's Square | 5.52 | Eiffel Tower | 9.74 |
| Kremlin | 5.60 | Whitehouse | 9.84 |
| Abbey Road | 5.80 | Mount Rushmore | 9.92 |

Table 9: Mean Familiarity ratings from norming study.

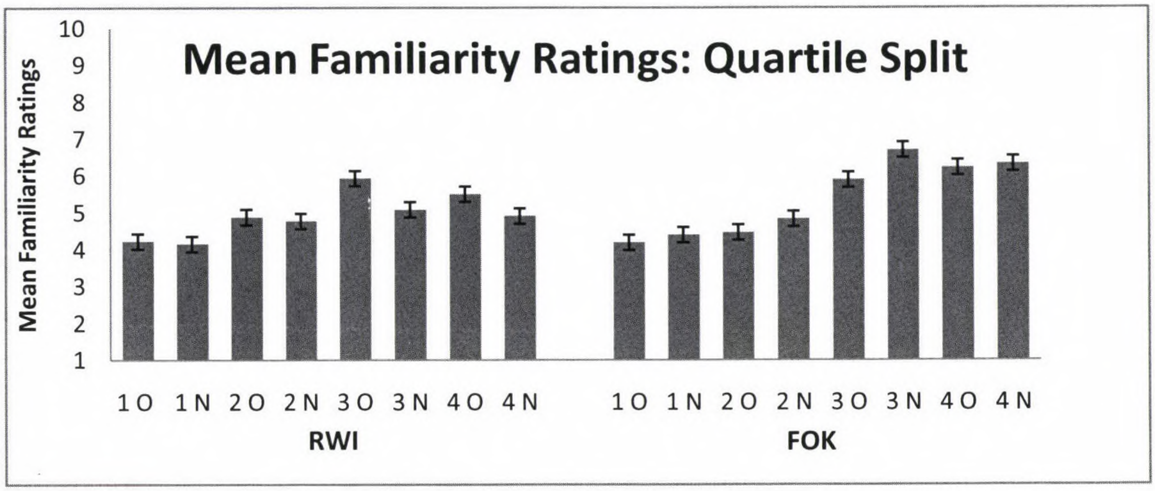
| **Median Split:** | **Low Familiarity** | | **High Familiarity** | |
|---|---|---|---|---|
| **Mean Familiarity Rating** | 3.90 (.57) | | 8.08 (.53) | |
| **Quartile Split:** | **Q1** | **Q2** | **Q3** | **Q4** |
| **Mean Familiarity Rating** | 2.89 (.56) | 4.94 (.56) | 7.13 (.73) | 8.99 (.51) |

Figure 1: Mean familiarity ratings for unidentified test items according to a median norming split.




LF = Low Familiarity / HF = High Familiarity

Figure 2: Mean Familiarity ratings for unidentified test items according to a quartile norming separation.




1 = lowest familiarity quartile / 4 = highest familiarity quartile
O = Old (studied) / N = New (unstudied)