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The feeling of knowing for names of faces

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Abstract

Prior to this study there had been little research into the Feeling of Knowing (FOK) in response to names of faces. The literature favoured inferential theories for explaining the bases of the FOK. Experiment 1 aimed to explore the two leading inferential theories (the cue-familiarity hypothesis and the target-accessibility hypothesis) in relation to names of famous faces. The study required participants to indicate their familiarity with each face and to retrieve semantic knowledge, where possible, whilst making a FOK judgement and a tip-of-the-tongue (TOT) judgement. The results provide some support for both theories; however, the results suggest that neither theory can account solely for the basis of the FOK. Experiment 2 explored psychophysiological arousal of the FOK state by measuring skin conductance response (SCR). The results revealed no difference in SCR between any of the analysed states (non-FOK, FOK and TOT).

Table of Contents

Chapter 1: Introduction

Metamemory is widely defined as knowledge and awareness of one's own memory. It includes the ability to self-monitor what is, and what is not, stored within memory. One fascinating aspect of metamemory is the experience referred to as the feeling of knowing (FOK). It is the state of believing that a specific piece of information exists within memory and can later be retrieved, even though that piece of information can currently not be recalled (Miner & Reder, 1994). The feeling of knowing is not just an experimental phenomenon, but an experience that serves a purpose and an importance in everyday life. Being able to reflect upon and monitor what we know is essential, so much so that Metcalfe and Shimamura (1994) describe both self-reflection and personal knowledge as forming the basis of human consciousness. The memory-monitoring process, which yields FOK judgements, is an important process that has been described as significantly contributing to the efficiency of the human information-processing system (Hart, 1965). Despite the diverse and sophisticated storage and retrieval capabilities of the human memory, it is still fallible, and it is this fallibility of memory that makes the everyday experience of FOKs invaluable (Hart, 1967b). A fallible memory storage means that retrieval failures are inevitable thus an additional process such as the FOK, that can assess storage states when such a failure occurs, is beneficial (Hart, 1967b).

Experiencing a FOK causes memory search-and-retrieval to be far more efficient. This is because the FOK can act like a signal. When presented with a question, or a need to attempt to retrieve information from memory, an individual may experience a FOK that signals that the sought-after information is indeed available (or, more likely to be available) in memory and it is therefore worth commencing, or continuing, a search for the sought-after information (Koriat, 2000). If the information is not available in store, and the individual does not have a FOK (non-FOK), then the individual will not waste time searching for it; thus FOKs enable the memory system to be more effective. Furthermore, FOK judgements are considered to be relatively reliable judgements. The generalised finding is that FOKs are good predictors of subsequent recognition of previously unrecalled targets (e.g. Hart, 1967a; Nelson, Gerler and Narens; 1984; Metcalfe, 1986), although they certainly are far from perfect (Blake, 1973).

The FOK is a remarkable experience, in the sense that even though the individual cannot remember the information, they know that they know it. It would seem that we can know we know something incredibly quickly; the FOK has been suggested to be rapid and based on unconscious processes (e.g. Paynter, Reder & Kieffaber, 2009). Souchay and Isingrini (2012) stress the importance of accurate metacognitive judgements. They state that accurate metamemory functioning leads to more effective memory performance, meaning that accurate metacognitive judgements are essential. If metacognitive judgements are incorrect, then the behavioural/control actions that follow as a result of the metacognitive judgement are likely to be ineffective. It is believed that such FOK judgements occur implicitly in everyday situations, yet one is not consciously aware of making these rapid decisions about knowing (Reder & Ritter, 1992). The FOK is not just an experimental phenomenon. FOKs are very common and occur for various forms of memory materials, including; names, dates, addresses, numbers and places (Hart, 1965).

However, despite being a common experience, the FOK is considered to be a complex experience. Brown (2000) expresses how complex the FOK experience is; "no single feeling, of rightness, familiarity and so forth is sufficient to describe them, nor has any single hypothesis so far been sufficient to account for them". This essential every day, yet complex, experience known as the FOK has sparked much debate into the bases of such an experience. There has been much research into FOKs since the first experimental investigations, such as Hart's studies (1965, 1967a, 1967b). However, as highlighted by Koriat (1993), the majority of the literature on memory monitoring shares a common attitude that avoids addressing the basis for the FOK. Instead, much of the literature takes the memory monitoring ability for granted and focuses primarily on why individual's metamemory judgements are not perfectly accurate (Koriat, 1993). Nevertheless, several theories attempting to explain the basis of the FOK have emerged. The theories for the bases of FOKs can be classified into two groups; direct access theories and inferential theories.

1.1 The Trace-access Theory

The earliest theory for the bases of FOK was the trace-access theory (Hart, 1965), also known as the direct-access theory. In a series of experiments, published in a series of papers (Hart 1965, 1966, 1967a, 1967b), Hart was the first to empirically investigate the FOK. Hart's view was that FOKs are based on individual's having a privileged direct-access to memory traces.

Hart's research focused on the accuracy of FOKs, primarily because Hart had noted that earlier investigations were limited in several respects and did not answer, nor ask, what Hart considered to be perhaps the most important question about FOKs;

are they accurate? Hart used general information questions (1965, 1967a) and learned paired-associates as memory materials (1967b). Hart aimed to test the presupposition that a FOK is an accurate indicator of what is in memory by using a paradigm that he termed the recall-judgement-recognition (RJR) paradigm. In the RJR paradigm, participants are given a cue (such as a general knowledge question) and asked to recall the answer. If participants fail to provide an answer, participants are then asked to make a FOK judgement as to whether they believe they would be able to select the correct answer in a multiple-choice test. To test the accuracy of the participant's FOK judgements, the final stage of the RJR paradigm is a multiple-choice test, in which participants are required to try and recognise the correct answer from a list of alternative answers.

Hart (1967a) hypothesised that if a FOK is an accurate indicator of memory storage then participants should perform better during the recognition test on items which they indicated a FOK compared to items that they indicated a non-FOK. The results of his studies confirmed this and Hart concluded that FOKs are accurate predictors of what is in memory. At the time, this was a novel finding, as prior to Hart's work it had not been empirically shown that individuals could accurately judge if an answer was in memory, despite not being able to currently recall that answer.

Hart's theory for the basis of FOKs has since been labelled *the trace-access theory*. This is because Hart expresses ideas that suggest that individuals have access to the strength of memory traces. Hart does not go into great detail about the bases of FOKs, because his research was primarily based on the accuracy of FOK judgements, not its basis. In fact, he explicitly states that how the monitor works is unknown;

along with the neural mechanisms necessary and the variables that affect it (Hart, 1965). Hart does, however, persistently refer to the process yielding FOK judgements as being the ‘memory-monitoring process’ (Hart, 1965, 1966, 1967a and 1967b), which has since been inferred that Hart believed individuals to have a monitor which has the ability to identify whether a piece of information is within memory or not. Hart (1965) describes the process of making a FOK judgement by stating that individuals '*in some way, monitor or check what they do remember and arrive at a decision about what they might remember’*. He states that the term 'memory-monitoring' describes the process that intervenes between recall and recognition (Hart, 1965).

The trace-access theory suggests that individuals have access to memory traces even when they are unable to recall the item from memory. The theory suggests that it is this access to memory traces that allows individuals to make judgements about their memory; thus, it is the access to memory traces that is the basis for the FOK experience. As discussed, Hart (1965) suggests that when individuals make FOK judgements, or non-FOK judgements, they monitor or check what they do remember to arrive at a decision about what they might remember. Hart’s opinion would mean that individuals have a privileged access to items in memory, despite being unable to currently recall the items.

Furthermore, Hart (1967b) discussed his idea of a recognition threshold. He suggested that there is a threshold for activation of a FOK signal that is activated via the memory-monitoring process. He suggests that this threshold lies between recall and baseline. The threshold for the FOK is lower than the threshold for recall. Hart’s idea of a threshold is that sometimes memory traces can exist which are too weak to be monitored; it is only when a memory trace reaches the threshold that a FOK judgement can be made. He suggests that memory traces that are too weak to be monitored will result in the individual being unable to predict that the item exists within memory and can later be recalled or recognised.

This direct access theory of FOKs has largely been abandoned and the leading theories are now inferential theories. Inferential theories suggest that FOKs do not emerge as a result of direct-access to memory traces; the FOK does not monitor the unrecalled target item. Instead, the FOK occurs due to individuals making inferences about their knowledge of the sought-after item by using other information in memory. Individuals make these inferences of the presence of a target in memory through a variety of clues. These clues may include; familiarity with the cue or question (e.g. Schwartz & Metcalfe, 1992), activations from the terms in the cue or question, and fragments of the target item itself (e.g. Koriat, 1993). The reason why inferential theories are more prominent is because the direct-access theory is difficult to test directly. It is difficult to measure independently of recall what is available but not accessible. Conversely, heuristic accounts are much easier to test; for example, by measuring the different clues which participants can accumulate and determining whether these correlate with indicating a FOK judgement. Therefore, inferential theories emerged in order to explain how FOKs may be based on making inferences from the question terms or from making inferences from information, other than the answer, which we can successfully retrieve from memory.

1.2 The Cue-familiarity Hypothesis

The cue-familiarity hypothesis (e.g. Reder, 1987; Reder & Ritter, 1992; Schwartz & Metcalfe, 1992) suggests that FOKs are based on familiarity with a retrieval cue (e.g. the question itself). This theory suggests that the FOK is based on how familiar, or recognisable, the cue is. It is the familiarity with the cue that forms the bases of the FOK rather than the partial retrieval of the target answer; as suggested by the target-accessibility hypothesis (e.g. Koriat, 1993). The cue-familiarity hypothesis suggests that initial FOKs are based on an evaluation of the question which leads to determining both how familiar the question terms seem and how much knowledge is known which is related to the question (Reder and Ritter, 1992). Unlike the trace-access theory (e.g. Hart, 1965) the cue-familiarity hypothesis does not assume that individuals, when making FOK judgements, have access to representations of the sought-after information in memory, and instead base their FOK judgements purely on the familiarity of the question terms/cue. Schwartz and Metcalfe (1992) state that *'feeling of knowing judgements are made without explicit access to the unrecalled information itself. Instead, the monitor assesses the familiarity or recognisability of the cue'*. The cue-familiarity hypothesis suggests that it is this assessment of familiarity or recognisability that causes an initial FOK.

The cue-familiarity model was proposed as an alternative explanation to the trace-access theory on the premise that previous research had found that FOKs are not completely accurate, and correlate relatively weakly with knowing (performing correctly on a recognition task), and therefore might be based on something other than *knowing* an answer (Reder and Ritter, 1992). This hypothesis would suggest that no information about the target is required to experience a FOK; merely an assessment of the familiarity of the cue is enough to experience a FOK. Any manipulation that increases the familiarity of the cue will in turn cause individuals to report higher rated FOK judgements (Metcalfe, 1993). Schwartz and Metcalf (1992) state that '*any variable that increases familiarity will similarly increase FOK*'. This relationship between FOK and familiarity is demonstrated in Reder (1987, 1988), who showed that priming words that would later appear in general information questions resulted in greater likelihood of a positive FOK. Reder (1998) manipulated cue-familiarity by asking participants to rate a list of words for how frequently they believe the words to occur. One third of the words in this task appeared later on in a general information question task. This was a method of priming, that allowed some question terms (cues) to be primed for familiarity and other cues not primed. The results revealed that the cues that had been primed resulted in greater FOK ratings without improving participant's ability to correctly answer the questions. These results (Reder, 1988) demonstrated that a manipulation of cue familiarity, that did not increase the likelihood of the retrieval of target information, increased FOK ratings, thus, supporting the cue-familiarity hypothesis.

In line with this cue-familiarity hypothesis, Schwartz, Benjamin and Bjork (1997) suggested that, in terms of names of faces, such FOK judgements are not made because one knows the person's name but because the person's face is familiar. The reasoning is that if the cue is familiar then it is likely that the target has also been learnt in the past and the likelihood of recognising the target is increased; thus a FOK is experienced. Therefore, the cue-familiarity hypothesis would suggest that when an individual finds a face familiar, they will experience a FOK for the name of the face.

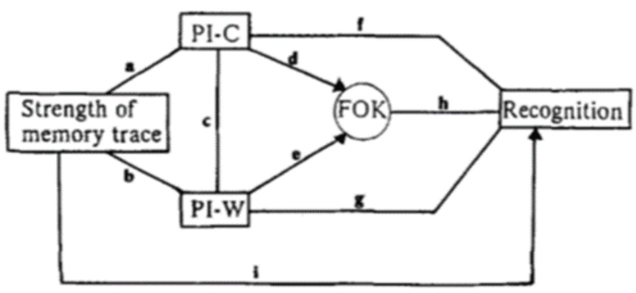
They will not experience a FOK because they know the person’s name, but because the face is familiar.

However, there is a potential problem with regards to cue-familiarity and FOKs for the names of familiar faces. It appears instinctively that there are faces which one may find highly familiar (for example, a person working in a local shop which is used on a regular basis). Their face may be highly familiar, we can identify where we have seen them before, and it may even be possible to retrieve a fair amount of semantic information about the person. Nevertheless, we know we do not know their name (a non-FOK). There are also faces that one may find only slightly familiar (for example, an actor) and we may also be familiar with their name and able to know that we know their name (a FOK). Such a situation poses a problem for the cue-familiarity hypothesis because the cue-familiarity hypothesis would predict that the person who is found highly familiar would be more likely to lead to a FOK than the person whom is found only slightly familiar (as any variable that increases familiarity should increase FOK). However, in everyday life, this would seem to not always be the case. Just because we find a face highly familiar (e.g. because we see the individual often in public) does not mean we automatically feel as though we know their name.

1.3 The Target-accessibility Hypothesis

In contrast to the cue-familiarity hypothesis, which is concerned with how familiar the cue itself is, the target-accessibility hypothesis is concerned with the amount of information retrieved. The target-accessibility hypothesis is also concerned with the ease of access of such information during the search-and-retrieval process that is activated when trying to retrieve the sought-after item from memory. Koriat (1993) proposed that a FOK is based on ‘clues accumulated during the initial stages’ of the search process. Koriat is against direct-access theories, and insists that individuals do not have privileged access to an internal monitor which can inform them as to whether a piece of currently unrecalled information exists within memory or not. Instead, it is the search-and-retrieval process itself which elicits a FOK. Koriat (1993) suggests that as individuals search through memory for a certain piece of information it causes a ‘variety of clues to come to mind’. Koriat (1993) states that these clues include ‘activations from the terms in the questions’, ‘structural, contextual, and semantic attributes’, and ‘fragments of the target, and so on’. Therefore, Koriat (1993) would seem to suggest that practically any information relating to the given question/cue, or any information retrieved during the search-and-retrieval process related to the sought-after target item, will be used to base a FOK judgement on. He suggests that these clues may influence motivation for further search for the sought-after item from memory. Koriat (1993) states that it is this successful access to partial information that encourages individual’s further efforts to search for the complete sought-after target. The idea is that individuals spend a greater length of time searching memory for items which they feel as if they do know, rather than items they feel as though they do not know, as demonstrated in several studies (Gruneberg, Monks, & Sykes, 1977; Lachman, Lachman, & Thronesbery, 1979; Nelson et al., 1984; Nelson, & Narens, 1980; as cited in Koriat, 1993). Koriat (1993) suggests that this behaviour of extended memory search is a result of individuals having access to partial information.

Furthermore, as the main assumption of the theory is that a FOK is dependent on the accessibility of partial information, it does not matter whether this information is correct or incorrect (Koriat, 1993). Koriat (1993) states that previous research (i.e. Blake, 1973; Eysenck, 1979; Schacter and Worling, 1985) supports the notion that a FOK increases with increasing amounts of *correct* partial information. Koriat (1993) goes on to say that he predicts not only a positive correlation between correct partial information and the FOK, but also a positive correlation between *incorrect* partial information and the FOK. Koriat (1993) suggests that it is not always evident to observe the correlation between the FOK and incorrect partial information, because this relationship is often masked by other factors. However, according to Koriat (1993), when the effects of correct partial information are controlled, it should be possible to observe the positive correlation between incorrect partial information and the FOK. Furthermore, he suggests that there is a negative correlation between correct partial information and incorrect partial information, as variables that increase correct partial information will generally decrease the amount of incorrect partial information. This relationship is outlined in the below figure (Figure *1*).



The accessibility model of the feeling of knowing (FOK). (PI-C = correct partial information; PI-W = wrong partial information. The letters *a*–*i* represent links.)

Figure 1; The Target-Accessibility model taken from Koriat (1993)

PI-C refers to correct partial information (i.e. the number of correct letters reported for a target answer) and PI-W refers to incorrect partial information (i.e. the number of incorrect letters reported for a target answer). Koriat states that this distinction between these two components is not available to participants; they do not know whether the letters they have reported are correct or incorrect. What is important is the total number of letters reported. The letters in the model represent links.

Koriat (1993) explains his model by making the following assumptions regarding the FOK process. FOK increases as PI-C increases (link *d*) and as PI-W (link *e*) increases. Although the two components are not distinguishable to participants, items that increase PI-C generally reduce PI-W and so the two should negatively correlate across items and conditions (link *c*). Strength of memory trace affects the likelihood of participants performing correctly at recognition (link *f*). Enhanced strength of memory trace will generally increase PI-C (link *a*) whilst reducing PI-W (link *b*). Strength of memory trace should therefore increase the ratio of PI-C to PI-W, and it is this which improves the quality of the accessed partial information; therefore, FOK judgements should increase with increased strength of the memory trace. PI-C and recognition should correlate positively (link *f*) due to the fact that both these items depend on the strength of the memory trace; meaning that PI-C is responsible for the accuracy of the FOK, whilst PI-W is responsible for the inaccuracy of the FOK (as PI-W is correlated negatively with recognition; link g, but positively with FOK; link e). Koriat suggests that factors that enhance memory strength will lead to an increase in FOK accuracy.

Furthermore, not only does accessibility of the answer play a role when retrieval fails, but also when an answer has been selected, according to Koriat (1993). Once an answer has been selected, such cues can be used to evaluate whether the answer is likely to be correct, based on the amount of information retrieved and on the ease of retrieval. It is this ease of access to such cues and the amount (intensity of detail) of information gathered during the search-and-retrieval process which is the most vital aspect of the bases of the FOK (Koriat, 1993). Individuals merely assess how much information has been retrieved, and the ease of accessing this information, in order to infer whether they know the answer or they do not know the answer.

Koriat (1993) also discusses memory strength as a determinant of the FOK. He states that memory strength and correct recognition have a positive correlation. Memory strength will affect whether partial information is correct or incorrect. For targets which are stored in memory, and have an enhanced memory strength, the correct partial information will exceed incorrect information and in turn will improve the quality of the partial information. Thus, Koriat (1993) states that FOKs should increase with increase in memory strength. Furthermore, due to the fact that both recognition and correct partial information depend on memory strength, Koriat (1993) suggests that both are correlated positively. Koriat (1993) suggests that incorrect partial information is responsible for inaccurate FOKs; meaning that incorrect partial information is negatively correlated with recognition, but positively correlated with FOKs. Koriat (1993) believes that incorrect partial information can be responsible for eliciting FOKs, but does not play a role in correct recognition, as outlined in Figure *1*.

Furthermore, Koriat (1993) discusses how ease of access of partial information affects the FOK. He highlights that intensity of the accessed information plays a role in individuals being so accurate at predicting recognition performance as well as judging the correctness of their responses. Koriat (1993) states that retrieval of correct partial information, or indeed retrieval of complete information, is retrieved quicker than incorrect information. And it is this retrieval latency that signifies to an individual if the information is likely to be correct or incorrect. In terms of the FOK, Koriat (1993) considers that ease of access affects the FOK judgement 'independent of the amount of information retrieved'. In other words, the ease of which the information comes to mind (retrieval latency), impacts the FOK judgement more so than the amount of such information.

This theory suggests that inaccurate FOKs are caused because FOKs are based on fast sampling that can sometimes be biased, thus resulting in an inaccurate FOK or an inaccurate non-FOK. It is this fast sampling that can cause partial information that is incorrect. As previously discussed, this incorrect partial information will elicit a FOK. However, when it comes to the recognition task; incorrect partial information is negatively correlated with correct recognition.

Koriat (1993) put this model to test, in three separate experiments that aimed to address the points proposed in his model. In the first experiment, thirty participants were required to memorise four-letter nonsense strings, consisting of English consonants. There was a total of forty of these strings. Using the RJR paradigm, participants were asked to recall as many letters from each string as possible. They were then asked to make a FOK judgment, on a scale of 0-100. Finally, participants were then administered a recognition test, in which eight distractors were used. The results revealed that the FOK judgements increased with the amount of accessed partial information, whether this information was correct or incorrect. Koriat (1993) states that his results show that ‘FOK judgements increase systematically and strongly as a function of the mere number of letters reported’. The results also support Koriat’s claim that correct partial information is positively related to both FOK judgements and correct recognition, whereas, incorrect partial information is positively related to FOK judgements and negatively related to recognition. Furthermore, Koriat also claims that his results demonstrate that improved memory is associated with improved metamemory, which is mediated by greater quality of the accessed partial information. Experiment two (Koriat, 1993) was much the same as experiment one. However, it used five-letter string words and recorded latency of recall. The results generally replicated the results from experiment 1, but provided additional support for the model. The results suggest that more accurate metamemory reports were associated with shorter recall latencies, than were the less accurate metamemory reports.

Experiment 3 differed from experiment 1 and 2 in terms of stimuli used. Both experiment one and two tested the target-accessibility model by defining accessed information in terms of number of individual letters recalled from a string. However, experiment three took into account that partial information can relate to other features than fragments of the target (singular letters). Therefore, words that differed to the participant’s language were used and participants were asked to recall the translated words and identify the attribute (the semantic connotations of the word as good or bad i.e. the word ‘murder’ would be considered bad and the word ‘fluffy’ would be considered good). The results revealed that FOK judgements were higher for the times that participants correctly identified the attributes (good or bad connotations), as compared to the times when participants had no partial attribute information. However, the results revealed that correct attribute identification and incorrect attribute identification showed no significant difference when it came to percentage of correct recognition. Recognition performance was decreased by incorrect attribute identification, but was not increased by correct attribute identification. In general, Koriat (1993) claims that the results from this third experiment indicate that participants' confidence in their FOK judgements is facilitated by access to attribute information, and that the target-accessibility hypothesis can be applied to situations where the partial information concerns attributes of the target, rather than fragments of the target.

1.4 The Noncriterial-recollection Hypothesis

Furthermore, Koriat's (1993) target-accessibility model was expanded by Brewer, Marsh, Clark-Foos and Meeks (2010), who developed a theory known as the noncritierial-recollection hypothesis. This hypothesis suggests that the retrieval of noncriterial information plays a role in metacognitive predictions, such a FOKs. Non-criterial information is a term used to describe additional information that is brought to mind during retrieval attempts regardless of whether it is directly relevant to the given task (Brewer et al., 2010). Although Koriat's (1993) model is focussed on the accumulation and ease of access of information, it does not go into depth about the effect additional irrelevant information may have on the magnitude of FOK judgements. Therefore, the noncriterial-recollection hypothesis expands Koriat's

(1992) target-accessibility model and explores the contribution that additional noncriterial information may have on FOK judgements.

Experimentally, noncriterial recollection is typically investigated using noncriterial recollection paradigms, in which participants encode information from two different source dimensions simultaneously (e.g. Toth & Parks, 2006; Yonelinas & Jacoby, 1996). One source dimension is encoded deeply, whereas the other is encoded weakly. This experimental design provides a way to investigate dual-process theories of memory. Brewer at al. (2010) used the paradigm to investigate FOK judgements about a weakly encoded source dimension, which in this case, was gender of a narrative voice. Their hypothesis was that stronger rather than weaker memory, for the irrelevant source dimension (the gender of the voice), would lead to more FOK judgements. The results were consistent with their hypothesis. These results, in their opinion, confirm that when additional information about a memory trace is available, even if it is noncriterial, it influences the individual's confidence to be able to recognise an unrecalled answer to the given question (FOK judgements).

1.5 The Combined Hypothesis

Initially the two hypotheses; target accessibility hypothesis and the cue-familiarity hypothesis were regarded as independent and competing hypotheses. However, more recently it has been proposed that both hypotheses could co-exist (Koriat & Levy-Sadot, 2001). It is suggested that the two could work hand-in-hand to cause and influence FOKs. Koriat and Levy-Sadot (2001) suggest that the two accounts have more in common than it first appears. They state that the major aspect that both these accounts share in common is the fact that both hypotheses suggest that a FOK relies upon an inferential process as opposed to an individual having direct access to memory traces (i.e. the trace-access theory by Hart, 1965). Furthermore, both hypotheses share in common the belief that cues, no matter how valid or invalid they may be, will equally influence the FOK. However, the two theories are fundamentally different in terms of their belief of what causes a FOK. The cue-familiarity hypothesis suggests that a FOK is based on cues which are received prior to attempted retrieval, whereas the target-accessibility hypothesis suggests that a FOK is based on cues retrieved once the search-and-retrieval process has begun. However, Koriat and Levy-Sadot (2001) make an influential point when they consider that the two mechanisms could be 'complementary, each making a separate and distinct contribution to FOK, and, furthermore, that they may interact in affecting FOK'. They suggest that familiarity with the cue is important because it leads to memory interrogation, which in turn leads to accumulation of partial information. Depending on how much information arises during this search depends on whether a FOK is experienced or not. Indeed, the results from their study (Koriat & Levy-Sadot, 2001) support this interactive model. The results revealed that both cue familiarity and accessibility affected FOKs; when cue-familiarity was higher, the effects of accessibility were stronger.

1.6 The Dual-process Hypothesis

Furthermore, one hypothesis suggests that both the cue-familiarity and target-accessibility hypotheses are two separate theories, which do not co-exist but are merely responsible for two different metamemory experiences. Sun, Chen, Bai and Chen (2014) compared FOK and the feeling of not knowing (non-FOK) judgements in a study that aimed to unveil the influence which processing depth and memory material has on such judgements. A non-FOK refers to the feeling that the answer is not known and is the only other outcome when a FOK judgement is not made i.e. if a participant is not experiencing a FOK then they are experiencing a non-FOK. Not having a feeling of knowing, and knowing that you do not know something, are both referred to as a non-FOK. Using the RJR paradigm with cue-target word pairs, they manipulated the depth of processing. The results revealed that the accuracy of FOK judgements increases under deep processing. The researchers suggest that this result indicates that a FOK judgement is determined by the amount of accessed information, and suggest that this is explained by Koriat's (1993) target-accessibility model. Conversely, non-FOK is not determined in such a way. Sun et al. (2014) suggest that their results imply that FOK and non-FOK judgements may 'belong to two dissociable cognitive processes', which they believe verifies the dual-process hypothesis, which was put forward by Lui, Su, Xu and Chan (2007). They suggest that the FOK judgement is based on accessibility, whereas, the non-FOK judgement is based on low cue-familiarity.

1.7 Tip-of-the-tongue

A tip-of-the tongue (TOT) is an experience defined as 'a strong feeling that a target word, although currently unrecallable, is known and will be recalled' (Schwartz, 2002; pg. 5). Although FOKs and TOTs are similar in the sense that both are related to knowledge that is currently unavailable, they are distinct experiences. Unlike being in a TOT state, whereby recall is felt to be imminent, a FOK is not concerned with the timing of retrieval but with the likelihood of recognising the currently unrecallable information at a later point in time (Brown, 2012). Imminence appears to be a part of what researchers consider important for a TOT; for example, Brown and McNeil (1966) instructed participants with the following; ‘If you are unable to think of the word but feel sure that you know it and that it is on the verge of coming back to you then you are in a TOT state’.

Furthermore, another difference between the two phenomena is that TOTs occur for only a small number of items, whereas FOKs are thought to occur at a much higher frequency; in fact, it is suggested that FOKs can apply to all items (Brown, 2012). Previous research supports this claim that FOKs and TOTs are two separate cognitive functions. Schwartz (2008) showed that working memory load decreased the number of TOT judgments but increased the number of FOK judgments; suggesting that FOKs and TOTs have differing underlying processes to one another. Widner et al. (1996) found that the manipulation of demand characteristics affected TOT ratings but not FOKs. Furthermore, patients with frontal damage, resulting in impaired functioning in the prefrontal cortex, are susceptible to impaired FOKs. However, this same impairment is not reflected in TOTs; suggesting that the two may either rely on differing underlying processes or that making a FOK judgement is a more difficult task than making a TOT judgement (Widner, Otani, & Winkelman, 2005).

However, some researchers suggest that the two are not distinct processes and that TOTs are merely extreme FOKs (e.g. Litman et al, 2005), and have participants rank their experience on a scale with levels of FOK and a TOT as the end point of the scale (Gardiner, Craik & Bleasdale, 1973; Ferrand 2001, experiment 1). Brown (2012), concludes that the research to date suggests that TOT and FOK responses are likely to be highly related though still separate cognitive functions which may share some of the same underlying processes. Therefore, in this current study the two will be referred to as two separate experiences and both FOKs and TOTs will be assessed to compare their predictive power at recognition of previously unrecalled information.

Much like FOKs, most explanations of TOTs can be classified into one of two broad categories (Brown, 2012). These categories are direct access and inferential. The direct access view is that a TOT emerges due to partial access of the information stored within memory; although the target word cannot currently be recalled, the individual has access to the sought-after word's trace within memory and the sought-after word receives partial activation. Conversely, the inferential view is that TOTs emerge due to the individual making inferences about their knowledge of the sought-after word. Inferences are made from other information about the sought-after word that they can access from memory; for example, how familiar the cue is (e.g. Metcalfe et al., 1993), or an assessment of how much information about the target can be retrieved (e.g. Koriat, 1993).

1.8 Face Processing

Using faces when investigating the bases of FOKs may be a better option, than word stimuli, to investigate the cue-familiarity hypothesis. This is not only because putting a name to a face happens in everyday life, but also because FOKs for names of faces may provide the strongest support for the cue-familiarity hypothesis as compared to FOKs for word stimuli. Faces are more likely to drive familiarity-based recognition than other types of stimuli; individuals rely more heavily on familiarity for face recognition than for recognition of other types of stimuli (Aly, Knight & Yonelinas, 2010). In their study, Aly et al. (2010) required participants with amnesia to study 120 drawings of faces, followed by a recognition task. Aly et al. (2010) also administered a verbal memory task, in which they used single words as stimuli. The results showed that overall word recognition was more impaired than overall face recognition in amnesic patients. Aly et al. (2010) argued that their findings suggest that the reason why amnesic patients may often appear less impaired on face recognition, than word recognition, may be because face recognition relies more heavily on familiarity than other types of stimuli and it is the familiarity aspect which has been less affected. Thus, using faces, as opposed to word stimuli, may provide a better assessment of the cue-familiarity hypothesis. It would be expected that if cue-familiarity elicits FOKs, then using faces as stimuli would provide strong support for the cue-familiarity hypothesis. On the other hand, if FOKs for names of faces do not appear to be based primarily on cue-familiarity, then we can infer that the likelihood of cue-familiarity being responsible for FOKs for verbal stimuli (i.e. general knowledge questions) is very unlikely.

The research on face perception has been led, and highly influenced, by the work of Bruce and Young (1986). They proposed a model to explain face recognition. It was a stage model; in that the components, or stages, of face processing are sequential and have to be fulfilled before another stage of face processing can take place. Their model suggests that once the face has been seen, the first stage of the model is structural encoding. This structural encoding produces a set of descriptions of the face that has been presented (Bruce & Young, 1986), and provides information for the facial recognition units (FRU).

Bruce and Young (1986) state that it is each FRU that contains structural codes relating to the description of one face known to a person. FRUs compare the incoming information, from the face currently being presented, to structural information (i.e. lip shape, nose shape) stored about familiar faces. Furthermore, the FRUs can access what Bruce and Young (1986) termed the *person identity nodes.* They suggest that just like the FRUs, there is one person identity node (PIN) for each person known. The PINs contain specific information about the person, such as their job, their hobbies, and so on. The difference between the FRUs and PINs is that the PIN is the point where the *person* is recognised, whereas the FRU is the point where the *face* is recognised. The FRU will respond to any view of a person's face, but will not respond to hearing the person's voice or their name. Whereas, the PIN can be accessed via a variety of ways; the face, name, voice or even clothing (Bruce and Young, 1986).

From the PIN, Bruce and Young (1986) suggest that a name is generated. It would not be possible to go straight from recognising a face to generating a name; the PIN must be activated first. They suggest that this is the point, at name generation, when TOT's arise; the FRU has been activated, the PIN has also been activated, but we are unable to recall the name. Although the authors consider where a TOT may arise, they do not consider the FOK. However, to relate the FOK to the model; it is evident that the FRU must be activated before a FOK in response to the name of a face can be elicited. This means that the face must be presented, and be established as familiar; the structural code of the incoming face must match the stored structural codes of a familiar face. The cue-familiarity hypothesis would appear to suggest that this is the only stage from Bruce and Young's (1986) model that needs to be activated to elicit a FOK. However, the target accessibility hypothesis (Koriat, 1993), and in particular the expanded view of the target accessibility hypothesis (the noncriterial-recollection hypothesis, Brewer et al., 2010), would suggest that not only would the FRU need to be activated, but so would the PIN. The activation of the PIN would mean that person specific information was then available to the individual; something which Brewer et al., (2010) would consider essential for the occurrence of a FOK.

Following the Bruce and Young (1986) model, Burton, Bruce and Johnson (1990) proposed an Interactive Activation with Competition (IAC) model which built upon this earlier model. Though still keeping with the basic principles of FRUs and PINs, this IAC model suggests that the units are connected to each other through links that can either be excitatory or inhibitory; in that they either increase the unit's activation or decrease the unit's activation. One such important difference between the two models is the difference between the model's explanations of PINs (Bruce and Young 2012). Burton et al. (1990) suggest that a visual input of a face is classified as familiar at the PINs, unlike Bruce and Young (1986) who suggested that feelings of familiarity happened at the FRUs. Bruce and Young's (1986) model did not explicitly state where semantic information was stored, whereas in the IAC model, Burton et al., (1990) clearly state that, unlike the earlier model, semantic information is separate to the PINs and that the PINs act as nodes that allow access to the semantic information.

In relation to the FOK, using this updated model of face recognition, both hypotheses (cue-familiarity and target-accessibility) would suggest that the PIN is accessed. As Burton et al. (1990) suggest that in order for a face to seem familiar, it is not just the FRU that needs to be activated but also the PIN. Therefore, the cue-familiarity hypothesis would suggest that the PIN would be accessed but that the link from the PIN to the semantic information is not yet activated, or it is blocked; and this is all that is needed in order for a FOK to occur. However, the target-accessibility hypothesis would suggest that not only would the PIN need to be accessed, but that the link between the PIN and the semantic information would need to be active, in order to retrieve semantic information about the person.

Furthermore, Bruce and Young (2012) discuss the phenomenon of how name recognition does not tend to fail in the same way in which naming a person does. Recalling a person's name happens in a sequential pattern, as described in their model (1986); whereby the face is first recognised, followed by the retrieval of person specific semantic information, which in turn results in the generation of the name. This recall of names often lets us down, whereas the same cannot be said when it comes to name recognition; when we read or hear a known name, we often have no problem recalling who the person is (Bruce and Young, 2012). They suggest that problems arise only when we have to generate a name output code in response to a face. This phenomenon, whereby generating a name output in response to a face is more challenging and prone to failure than name recognition, reflects the onset of the TOT and the FOK experiences.

In this thesis, faces will be used as stimuli to investigate the real-world phenomenon of FOKs for names of faces. As individuals, we are presented with faces which we are required to 'put a name to' in our everyday lives. Cleary (2011) highlights how *'most FOK studies use stimuli other than faces and their* *corresponding names, even though people's faces and names are often used to illustrate the real-world phenomenon'*. Previous research investigating FOKs has focused primarily on verbal information. Much of the research has involved general information/trivia questions (e.g. Hart, 1965; Metcalfe, 1986; Smith and Clark, 1993) and cue-target word pairs (e.g. Metcalfe, Schwartz & Joaquim, 1993; Thomas, Bulevich, Dubois, 2012; Sacher. Isingrini and Taconnat, 2013). There have been few studies that have deviated away from trivia questions and target word pairs. Namely, FOKs for songs and instrumental music have been investigated (Rabinovitz & Peynircioğlu, 2011) and FOKs for translations of words (Peynircioğlu & Tekcan, 2000) have been investigated. Despite the fact that faces are experienced in our everyday lives, thus FOKs for names in response to faces are likely to occur on a relatively regular basis, there has been little research carried out into FOKs for names of faces.

1.9 Faces and The Feeling of Knowing

One study that has investigated FOKs in response to names of faces is that of Hosey, Peynircioğlu and Rabinovitz (2009). In their study, participants viewed photographs of faces and were required to report which strategy they used to base their FOK ratings on; either the cue-familiarity strategy or the target-accessibility strategy. The RJR paradigm was used. In experiment 1, Hosey et al. (2009) presented fifty-five famous female faces to their participants. If participants could not recall the name of the face, they were required to give a FOK rating between 1 and 5; corresponding to '*not at all certain*' to '*very certain*'. During the recognition phase, participants were also required to select one of two options for each face; either they indicated that they based their FOK rating on '*a general sense of familiarity with the* *photograph*', or they indicated that they based their FOK rating on '*any specific information they remembered about the woman depicted*'. When participants reported the use of the target-accessibility strategy, they were also asked to write down this semantic information. This meant that selecting the target-accessibility strategy was more time-consuming for participants than simply selecting the cue-familiarity strategy that required no additional information. This is something that may have affected the results, as it would have been easier for participants to opt for the cue-familiarity strategy. Crucially, the participants were not allowed to select both options. Hosey et al. (2009) do not state why they did not allow participants to report both strategies (i.e. "I felt the face was highly familiar, but I also was able to recall semantic information, and this is why I stated that I had a FOK"). Presumably, it is because, at this point, Hosey et al. (2009) did not believe, or had not considered that the two strategies could co-exist, and were of the opinion that the cause of a FOK must be mutually exclusive. This meant that Hosey et al. (2009) were unable to consider whether target-accessibility followed a high cue-familiarity ranking. Not only this, but participants were also timed. They were given just twenty seconds to complete the task for each face. This could be considered as a downfall, due to the fact that participant's search-and-retrieval process was essentially being interrupted. Not only were participants under time pressure to *rate* their FOK judgement but they were also under time pressure to *report* which strategy they had used to make their FOK judgement.

Furthermore, in experiment 1, once participants had completed the first phase they were then required to complete a recognition test. This test required participants to select one name from a list of four possible names. The results of the study revealed that there was no difference in performance on the recognition test between the strategies used (cue-familiarity or target-accessibility). In other words, strategy used to give a FOK rating made no difference to how accurate that FOK rating was in terms of predicting performance on the recognition test. The results also revealed that participants were more likely to base their FOK rating on cue-familiarity, rather than on target-accessibility.

In experiment 2, Hosey et al. (2009) chose not to use famous faces, but instead used photographs of the faces of non-famous women. Their participants were required to complete a study phase, in which they were given sixty photographs of these women which were labelled with a name and had three pieces of additional information associated with each photograph. Participants were given 30 seconds per photograph to study the information and make an '*association between them in their mind using any strategy that they found helpful*'. Just like experiment 1, participants then completed the recall/judgement phase and the recognition phase. However, one difference between this experiment and the previous one was that this experiment included lures during the recall/judgement phase. This meant that there was an additional sixty faces used, which were not in the study phase. The lures were used to prevent the participants from giving '*artificially high FOK ratings*' because they knew that all the photographs had been studied. Just like in experiment 1, participants were only able to select one strategy. Again, the results of this experiment revealed that participants were more likely to report using the cue-familiarity strategy, rather than the target-accessibility strategy.

Experiment 3 (Hosey et al., 2009) overcame the methodological flaw, whereby participants had no option to report the use of both strategies; cue-familiarity and target-accessibility. In experiment 3, participants were allowed to report both strategies. Hosey et al., (2009) also modified the way in which the target-accessibility strategy was reported. In the first two studies, it would have been a longer task for participants to select the target-accessibility strategy (as it required them to write down more information, as compared to selecting the cue-familiarity strategy), whereas, experiment 3 required participants to write a lengthy sentence even if they did not recall any information. This was an attempt to discourage participants from merely selecting the cue-familiarity strategy, instead of the target-accessibility strategy, due to ease. Another modification included only presenting 48 female faces. Participants were also asked to rate the attractiveness of each face on a five-point scale, and to rate on a five-point scale how well the information about each person 'suited' that particular person. Hosey at al. (2009) state that these additional ratings were used just to make sure that their participants paid attention to all aspects of the stimulus that was presented to them. Experiment 3 also used verbal cues in some cases, instead of photographs. However, the results revealed that the use of stimuli, whether verbal or pictorial, had no effect on which strategy participants reported.

The results for experiment 3 (Hosey at al. 2009) revealed that participants were trying to make use of both strategies. However, participants rarely reported the use of the target-accessibility strategy by itself, without the cue-familiarity strategy. It was also found that when cue-familiarity was high, target-accessibility was not necessarily present. Hosey et al., (2009) suggested that this reflects that the cue-familiarity strategy '*could be used on its own and dissociated*'.

Overall, Hosey et al. (2009) concluded that from their three experiments that FOKs, in response to names of faces, are based on the cue-familiarity hypothesis. However, one could argue that a crucial flaw in the Hosey et al. (2009) study is that it relied upon participants' subjective and introspective judgements on deciding which strategy they had employed. This subjectivity and use of introspection raises questions in terms of the reliability of such self-reports in the domain of metamemory. If it were that straightforward, and indeed accurate enough, to rely upon individuals' subjective self-report as to which strategy they had used to report a FOK, there would have been little need for the research throughout the years into what FOKs are based on.

Furthermore, as suggested by Hosey et al. (2009), participants most likely report the cue-familiarity strategy more frequently than the target-accessibility strategy, in circumstances where both strategies are being used, due to a bias. In experiments 1 and 2, participants are more likely to have a bias in favour of selecting the strategy that comes into play at an earlier-stage and appears to be a more dominant strategy. It certainly seems plausible that when forced to choose just one strategy, and not being given the option to select both, participants would opt for the strategy that seems most prominent. Thus, it would seem difficult to infer from these two experiments that FOKs for names of faces are predominately based on cue-familiarity. Experiment 3, overcame this problem by allowing participants to report using both strategies. However, experiment 3 (just like experiment 2) did not use famous faces, but instead required participants to partake in a study period prior to the recall/judgement phase; whereby participants learnt the names and information corresponding to a selection of unknown faces. Because of this study period, of just

30 seconds per face, it is possible that participants failed to remember much episodic information. When an individual is time-constrained, it is difficult to memorise episodic information. Thus, in the recall/judgement phase, it would have been much easier for participants to rely on the cue-familiarity strategy simply because it is likely that all the participants had to rely on to make their FOK judgments was familiarity. It could be suggested that participants simply would have struggled to memorise new episodic information relating to 48 new faces (which included a name, and three pieces of information about the person). Thus, using the familiarity of the face would have been an easier strategy. This suggested struggle with memorising all this new episodic information is reflected in how well the participants perform on the name recall task. Experiment 1, which used famous faces, showed that 39% of the names of faces were recalled correctly. Whereas, in experiment 2 and 3, which used novel faces and study phases, only 5% and 2.29% (respectively) of the studied names were recalled correctly. This highlights that participants struggled to recall information about the to-be-learned novel faces; even the names were difficult to retain and recall, let alone further semantic information about the faces. Thus, it was no wonder that participants would not have been able to use the target-accessibility strategy as often. This suggests that by giving participants faces to learn, along with episodic information, does not reflect a realistic representation of making FOK judgements in everyday life, outside of the lab. Thus, it would seem that the Hosey et al., (2009) methodology would influence the likelihood of the cue-familiarity strategy being selected and it is not a surprise that their results support the cue-familiarity hypothesis.

Furthermore, the study also favoured inferential theories, rather than trace-access theories, as the only two possible outcomes from the study was either one of two inferential theories. The results would have led to either the cue-familiarity strategy being the cause of a FOK or the target-accessibility strategy being the cause of a FOK. Using the methodology of Hosey et al., (2009), the results would have always revealed one of these two strategies; as participants were forced to select one of the two. The study did not have scope to investigate whether a FOK could be based on another hypothesis.

Chapter 2: The Feeling of Knowing for names of faces

2.1 Introduction

This study aims to investigate FOKs for names of faces. Previous research in this area (namely, one study by Hosey et al., 2009) had several limitations; in particular, the study relied on participants subjectively reporting the strategies that they used to make their FOK judgements. This current study aims to use a more objective approach, and not rely on introspection, in order to investigate the bases of the FOK for names of faces.

This study will assess the cue-familiarity hypothesis (e.g. Schwartz & Metcalfe, 1992) which suggests that familiarity of the cue (the face) is the basis of the FOK. A previous study (Batchelor, 2014) investigated whether FOKs for names of famous faces were based on the cue-familiarity hypothesis or the target-accessibility hypothesis. The study used the RJR method and required participants to indicate whether they found each face familiar (to assess the cue-familiarity hypothesis), to supply some semantic information about the person (to assess the semantic aspect of the target-accessibility hypothesis) and to indicate whether they were experiencing a FOK and/or a TOT. The results did not provide support for the cue-familiarity hypothesis or the target-accessibility hypothesis. The results revealed that familiarity with the face did not always lead to a FOK. In fact, participants were more likely to report a non-FOK than a FOK when a face was found familiar but semantic information was not recalled. However, the Batchelor (2014) study did not assess the levels of subjective familiarity, so it could be speculated that FOKs are experienced whenever familiarity reaches a certain threshold.

Therefore, this current study aims to investigate how differing levels of cue-familiarity may influence the FOK by requiring participants to select a level of familiarity with each face, on a four-point scale (1: unfamiliar, 2: slightly familiar, 3: moderately familiar, 4: highly familiar). This study will investigate whether a FOK will be experienced with all three levels of familiarity and whether an increase in familiarity is what causes a FOK. If familiarity with the face (the cue-familiarity hypothesis) is responsible for causing a FOK, then familiarity levels 2, 3 and 4 should all be more likely to lead to a FOK than a non-FOK. If a strong feeling of familiarity is required then level 4 familiarity, but not level 2 or 3, should be more likely to lead to a FOK than a non-FOK.

This study also aims to assess the validity of the target-accessibility hypothesis (Koriat, 1993). The target-accessibility hypothesis suggests that when individuals interrogate their memory for a piece of information, a variety of clues come to mind, and these include; structural, contextual, and semantic attributes (Koriat, 1993). Koriat (1993) suggests that FOKs '*monitor the mere amount of information accessible*' during the search-and-retrieval process. Therefore, Batchelor (2014) assessed the role that retrieval of semantic information pertaining to a given face/person has on likelihood of experiencing a FOK. The results of the study revealed that FOKs are not primarily based on semantic knowledge retrieved during the search-and-retrieval process; participants were equally as likely to experience a FOK as they were to experience a non-FOK when they could retrieve semantic information in response to a face. However, the study did not determine the varying depths of retrieved semantic information. Therefore, it could be speculated that retrieval of strong semantic information causes a FOK. This current study aims to investigate whether retrieval of a certain depth/amount of semantic information is required to cause a FOK. Hanczakowski, Pasek, Zawadzka and Higham (2013) suggested that future FOK research should be directed towards investigating the role of other factors beyond cue-familiarity on metamemory processes. They suggested that one such further investigation would be the volume of information accessed during the retrieval process. They express that this is a factor which is '*clearly related to the efficacy of the retrieval process and is at the same time known to be linked to the process of metacognitive monitoring*'. Thus, the strength of retrieved semantic information will be assessed in this study.

If the target-accessibility hypothesis were a good explanation for the bases of FOKs, we would expect that the results of this study would show that when participants can recall semantic information pertaining to the target person, they will experience a FOK. If participants recognise a face, and are able to recall strong semantic information, it should lead to a FOK. If participants recognise a face, yet are unable to recall semantic information, it should lead to a non-FOK.

Following Koriat and Levy-Sadot's (2001) hypothesis that cue-familiarity and target-accessibility may be two mechanisms that work together to affect a FOK, this study will also be investigating if such a dual-model does play a role in the FOK experience. If the results reveal that high levels of familiarity combined with retrieval of strong semantic information is required before a FOK can be experienced, then it will support the notion that the two originally competing hypotheses (cue-familiarity and target-accessibility) do make a combined contribution to the bases of the FOK. It is hypothesised that if the results of this study support this dual-model (Koriat & Levy-Sadot, 2001), then it will only be with the combination of higher levels of familiarity and a strong amount of semantic information.

Furthermore, this study aims to explore the recognition accuracy of FOKs and non-FOKs defined by levels of cue-familiarity and strength of retrieved semantic information. The study will assess whether the different levels of cue-familiarity have an effect on accuracy on a recognition test, for both FOKs and non-FOKs. It is hypothesised that if cue-familiarity is the bases of FOKs, then greater cue-familiarity will increase the accuracy of the FOK. Therefore, this study will use the RJR paradigm to assess the accuracy of FOKs, and non-FOKs, for subsequent recognition of previously unrecalled target names. The study will also assess whether the ability to recall varying strengths of semantic information has an effect on accuracy on a recognition test, again, for both FOKs and non-FOKs. This will enable us to not only understand more about how factors which occur before the search-and-retrieval process (cue-familiarity), and factors which occur during the search-and-retrieval process (accumulation of semantic information) affect recognition performance, but it will also help us to determine which is the most predominant factor (FOK, cue-familiarity or retrieval of semantic information) at predicting subsequent recognition of previously unrecalled target names.

2.2 Method

Participants: 40 participants, who were undergraduate students and received course credits for participation, were tested individually (32 females and 8 males). The mean age of participants was 19 years.

Design: The study used a within-subjects design. The dependent variable was the participants' responses to each face.

Apparatus: The experiment was run with SuperCard. The stimuli were presented on an Apple iMac; 21.5" screen.

Materials: 44 images of celebrity faces were used in both the recall and recognition phase (see appendix for sample materials). The images were obtained online and cropped so that each image was a uniform size. None of the faces contained distinctive headwear, eyewear or backgrounds which could help the participant to obtain any semantic information about the celebrity, and all images were frontal-shots. The celebrity faces ranged in terms of occupation of the person (e.g. actors, comedians, sportsmen).

In the recall phase, for each face, participants were presented with questions. The questions were (in the given order): '*what is this persons' name?*', '*does this face look familiar to you?*' (with the following response options: '*not at all familiar, slightly familiar, moderately familiar, extremely familiar*'), '*would you be able to select the correct name from a list of four names?*' (this was the FOK question; the response options were: '*yes*' or '*no*'), '*are you in a tip of the tongue state*' (response options were: '*yes*' or '*no*') and '*what is this person's occupation?*' (this was used to assess semantic information. Participants were given a text box to type their own response) and '*if you can, please give a fact/piece of information about this person*' (this was used to assess the strength of semantic information. Again, participants were given a text box to type their own response).

In the recognition phase, participants were presented with a multiple-choice test consisting of four names for each given face. The correct name was presented within the list in a random order. The other three names consisted of other celebrities who were the same gender, of the same occupation and who had names of the same ethnic origin as the target name.

Procedure: Participants were seated in front of the screen and were presented with the general instructions. The instructions informed participants that the experiment consisted of forty-four faces in which they were to answer the given questions as honestly as possible. The participants were also given a sheet of paper with the definition of a TOT state, and participants were made aware that they should refer to this definition if they were to forget it at any point throughout the duration of the study. A TOT state was defined as follows: '*the feeling that you know the name and that recall is imminent (likely to occur at any moment)*'.

Firstly, in the recall phase, participants were shown a photo of a face and asked to give the name of the celebrity. If they could recall the name they were to input it and proceed to the next face; they were not required to answer the remaining five questions. If participants were unable to recall the name, they were required to proceed to the remaining five questions for that face, before proceeding to the next face. Participants were required to respond to all forty-four faces in the recall phase before proceeding to the recognition phase.

In the recognition phase, participants were told they would be given a multiple-choice test and were instructed to select the correct name from a list of four names, for each face. Participants were made aware that they must select a name for each face. The participants were shown the same forty-four faces on the screen one at a time. Half the participants were shown the faces in the same order as the recall phase, and half the participants were shown the faces in reverse order, to control for order effects. After each face was presented, the participants were given the multiple-choice test for each face.

Throughout the experiment all participants were tested individually and were able to view each face and work through the questions at their own pace. Participants were not permitted to go back to a face or previous questions if they had already completed them.

To classify weak and strong semantic information, the responses to the two questions pertaining to semantic information were used. If participants could only correctly answer 'what is this person's occupation?', then they were classified as having only weak retrieval of semantic information. If participants could also correctly give a response to the following question, then they were classified as having strong retrieval of semantic information; 'if you can, please give a fact/piece of information about this person'. If participants could not answer either of these questions then they were classified as having no retrieval of semantic information. This method of classification was used in order to allow a distinction between whether participants provided information which clearly specified that they knew who the given person was as opposed to vaguely knowing who the given person was. This focus on strength was chosen over merely assessing the amount of information retrieved (i.e. looking at how many sentences of facts a participant could recall) because Koriat (1993) had stated that it is not necessarily amount of such information that impacts the FOK judgement. We also considered that if we were to ask participants to recall facts, and then judge their amount of retrieval, it may not be a true representation of everything the participants had recalled due to the participants not wanted to spend additional time typing out all of the information they knew about a famous person. Therefore, we chose to select this method of asking two questions (one to signify the participant vaguely knew the person (weak semantic information) and one to signify that the participant clearly knew who the given person was and was able to recall more (strong semantic information).

2.3 Results

The means (maximum 44) and standard deviations are displayed in table 1.

TOT	FOK	Non-FOK	Face Unknown	Named Correctly	Named Incorrectly
5.48 (3.64)	4.85 (2.42)	8.68 (5.1)	9.75 (6.15)	13.23 (7.84)	0.55 (0.85)

Table 1: Means (SD's) for responses during the recall phase.

The number of times each metacognitive state (non-FOK, FOK, TOT) was experienced during varying levels of cue-familiarity (see figure 2), or varying depths of semantic information (see figure 3) could then be identified.

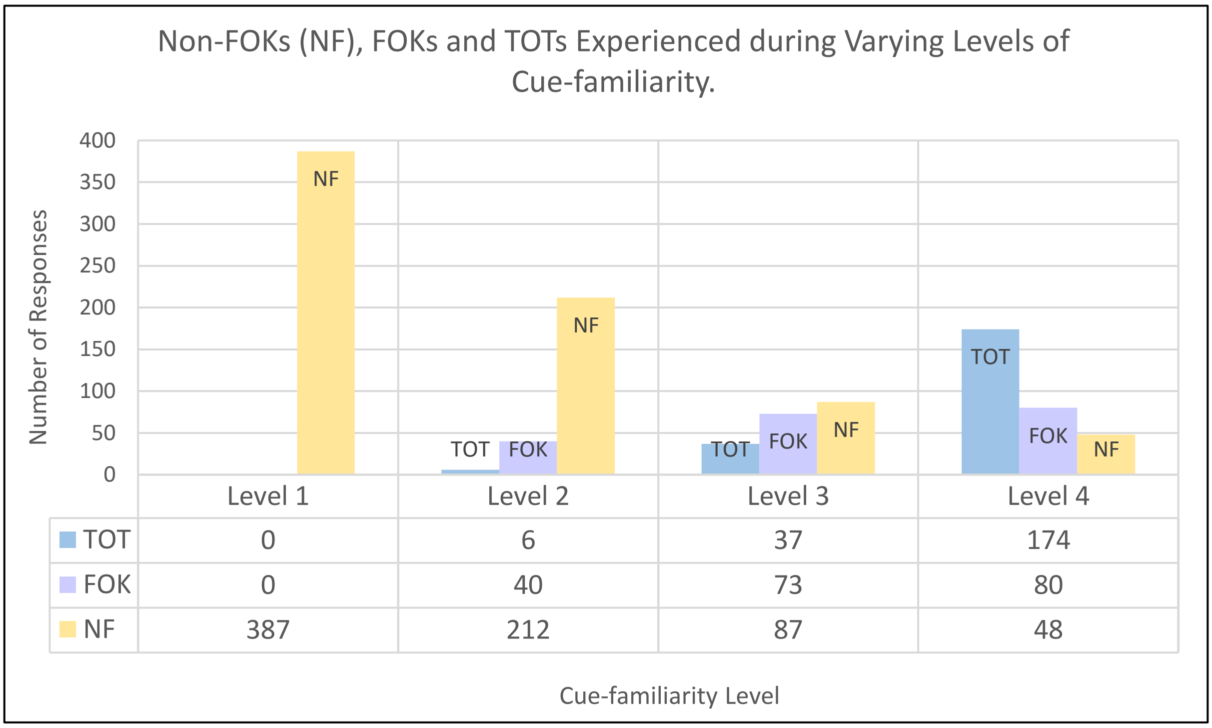


Figure 2: Graph to demonstrate the number of times each state was experienced during each level of cue-familiarity.

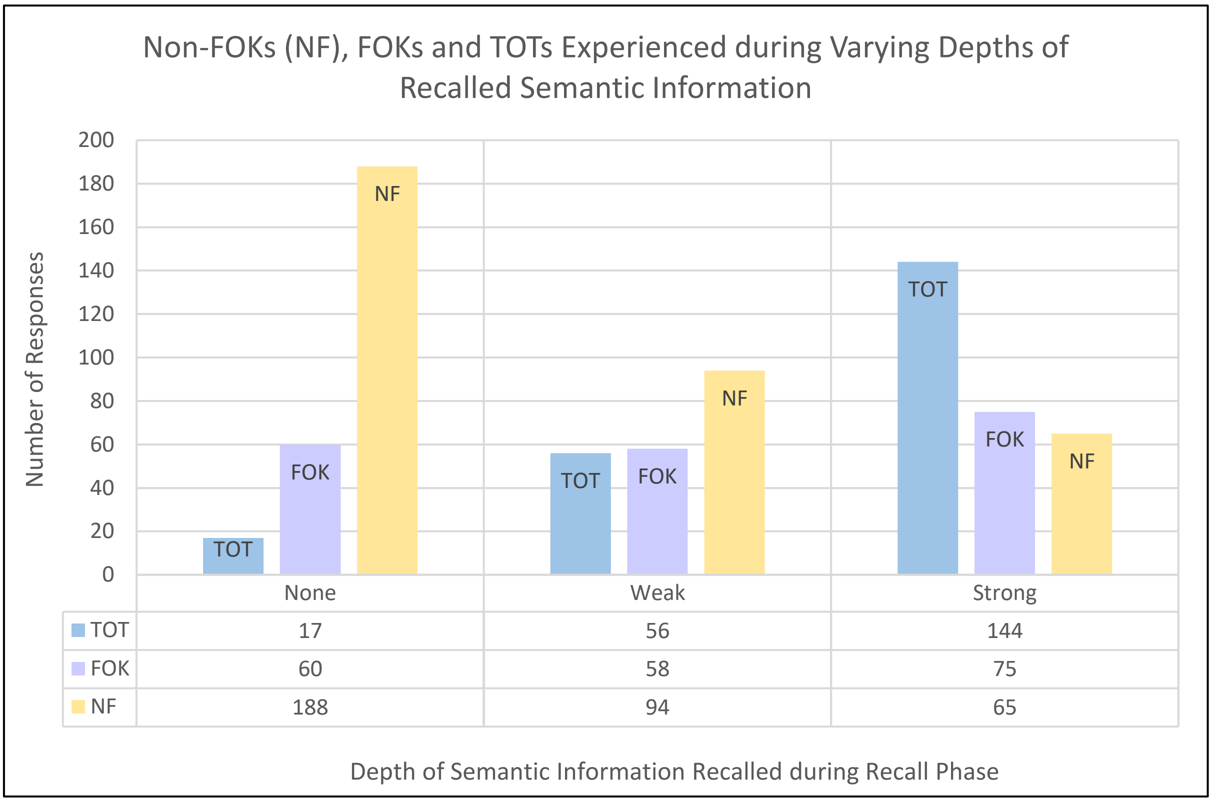


Figure 3: Graph to demonstrate the number of times each state was experienced during each level of recalled semantic information.

ANOVAs

A series of ANOVAs were carried out to determine the effect cue-familiarity and retrieval of semantic information has on the likelihood of participants experiencing a FOK.

In order to assess the effect of familiarity on likelihood of experiencing a FOK, a within-subjects ANOVA was performed. In this ANOVA, FOKs were considered separately to TOTs, thus TOTs were excluded from the data. The familiarity levels were; 2 (slightly familiar), 3 (moderately familiar) and 4 (highly familiar). There was a statistically significant difference in likelihood of experiencing a FOK for the three levels of familiarity, $F(2,52) = 38.991$, $p < .001$. Post hoc tests using the Bonferroni correction revealed that there was a significant difference between each pair of familiarity levels. Likelihood of experiencing a FOK increased from an average of 13% for familiarity level 2 to 40% for familiarity level 3 ($p < .001$) and then increased from 40% for familiarity level 3 to 68% for familiarity level 4 ($p < .001$).

In order to assess the effect of familiarity on likelihood of experiencing a FOK, a within-subjects ANOVA was performed. In this ANOVA, FOKs and TOTs were not considered as two separate phenomena, thus TOTs were included in the data. The familiarity levels were; 2 (slightly familiar), 3 (moderately familiar) and 4 (highly familiar). There was a statistically significant difference in likelihood of experiencing a FOK for the three levels of familiarity, $F(2,70) = 131.229$, $p < .001$. Post hoc tests using the Bonferroni correction revealed that there was a significant difference between each pair of familiarity levels. Likelihood of experiencing a FOK increased from an average of 15% for familiarity level 2 to 51% for familiarity level 3 ($p < .001$) and then increased from 51% for familiarity level 3 to 88% for familiarity level 4 ($p < .001$).

In order to assess the effect of semantic retrieval on likelihood of experiencing a FOK, a within-subjects ANOVA was performed. In this ANOVA, FOKs were considered separately to TOTs, thus TOT were excluded from the data. The levels of semantic retrieval were; none, weak and strong. There was a statistically significant difference in likelihood of experiencing a FOK for the three semantic levels, $F(2,54) = 8.644$, $p < .001$. Post hoc tests were carried out using Bonferroni correction and revealed that there was no significant difference between average percent likelihood of experiencing a FOK for weak semantic retrieval and strong semantic retrieval ($p > .05$); with only an increase from 47% for weak semantic to 53% for strong semantic. There was a significant difference between all other pairwise comparisons ($p <. 05$), with an increase from an average of 25% for no semantic retrieval.

In order to assess the effect of semantic retrieval on likelihood of experiencing a FOK, a within-subjects ANOVA was performed. In this ANOVA, FOKs and TOTs were not considered as two separate phenomena, thus TOTs were included in the data. The levels of semantic retrieval were; none, weak and strong. There was a statistically significant difference in likelihood of experiencing a FOK for the three semantic levels, $F(2,54) = 52.240$, $p < .001$. Post hoc tests using the Bonferroni correction revealed that there was a significant difference between each pair of semantic levels. Likelihood of experiencing a FOK increased from an average of 7% for no semantic retrieval to 38% for weak semantic retrieval ($p < .001$) and then increased from 38% to 67% for strong semantic retrieval ($p < .001$).

Recognition accuracy t-tests

To determine whether there was a difference in performance on the recognition test for FOKs and for non-FOKs, a series of analyses were carried out. 3 x 2 ANOVAs were attempted but due to insufficient data points (as data had to be discarded when subjects did not experience all of the states it left only 4 subjects who experienced all 6 of the states) t-tests were carried out.

Including TOTs (familiarity)

In the following t-tests, FOKs and TOTs were not considered as two separate phenomena, thus TOTs were included in the data.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects were experiencing level 2 familiarity. There was not a significant difference in the recognition accuracy for FOK (M = .596, SD = .379) and non-FOK (M = .485, SD = .245) whilst in level 2 familiarity; $t(20) = 1.188$, $p > .05$. This result provides no support for the notion that FOKs are associated with higher recognition accuracy.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects were experiencing level 3 familiarity. There was a significant difference in the recognition accuracy for FOK (M = .779, SD = .274) and non-FOK (M = .361, SD = .365) whilst in level 3 familiarity; $t(28) = 6.316$, $p < .001$. This result suggests that experiencing a FOK leads to better recognition accuracy.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects were experiencing level 4 familiarity. There was a significant difference in the recognition accuracy for FOK ($M = .792$, $SD = .229$) and non-FOK ($M = .566$, $SD = .405$) whilst in level 4 familiarity; $t(19) = 2.799$, $p < .05$. This result suggests that experiencing a FOK leads to better recognition accuracy.

Excluding TOTs (familiarity)

In the following t-tests, FOKs and TOTs were considered as two separate phenomena, thus TOTs were excluded from the data.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects were experiencing level 2 familiarity. There was not a significant difference in the recognition accuracy for FOK ($M = .623$, $SD = .397$) and non-FOK ($M = .495$, $SD = .261$) whilst in level 2 familiarity; $t(20) = 1.323$, $p > .05$. This result provides no support for the notion that experiencing a FOK leads to better recognition accuracy.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects were experiencing level 3 familiarity. There was a significant difference in the recognition accuracy for FOK (M = .756, SD = .293) and non-FOK (M = .339, SD = .346) whilst in level 3 familiarity; $t(25) = 5.077$, $p < .001$. This result suggests that experiencing a FOK leads to better recognition accuracy.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects were experiencing level 4 familiarity. There was a significant difference in the recognition accuracy for FOK (M = .779, SD = .327) and non-FOK (M = .5, SD = .0) whilst in level 4 familiarity; $t(14) = 3.303$, $p < .01$. This result suggests that experiencing a FOK leads to better recognition accuracy.

Including TOTs (semantic retrieval)

In the following t-tests, FOKs and TOTs were not considered as two separate phenomena, thus TOTs were included in the data.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects retrieved no semantic information. There was a significant difference in the recognition accuracy for FOK (M = .727, SD = .360) and non-FOK (M = .481, SD = .252) for no semantic retrieval;

t(26) = 3.541, *p* < .01. This result suggests that experiencing a FOK leads to better recognition accuracy.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects retrieved weak semantic information. There was a significant difference in the recognition accuracy for FOK (*M* = .800, *SD* = .244) and non-FOK (*M* = .502, *SD* = .351) for weak semantic retrieval; *t*(26) = 4.150, *p* < .001. This result suggests that experiencing a FOK leads to better recognition accuracy.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects retrieved strong semantic information. There was a significant difference in the recognition accuracy for FOK (*M* = .824, SD= .186) and non-FOK (*M* = .501, *SD* = .381) for no semantic retrieval; *t*(24) = 4.287, *p* < .001. This result suggests that experiencing a FOK leads to better recognition accuracy.

Excluding TOTs (semantic retrieval)

In the following t-tests, FOKs and TOTs were considered as two separate phenomena, thus TOTs were excluded from the data.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects retrieved no semantic information. There was a significant difference in the recognition accuracy for FOK (M = .679, SD = .394) and non-FOK (M = .457, SD = .237) for no semantic retrieval; $t(25) = 3.029$, $p < .01$. This result suggests that experiencing a FOK leads to better recognition accuracy.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects retrieved weak semantic information. There was a significant difference in the recognition accuracy for FOK (M = .747, SD = .369) and non-FOK (M = .505, SD = .342) for weak semantic retrieval; $t(23) = 2.799$, $p < .05$. This result suggests that experiencing a FOK leads to better recognition accuracy.

A paired-samples t-test was conducted to compare recognition accuracy in FOKs and in non-FOKs, whilst subjects retrieved strong semantic information. There was a significant difference in the recognition accuracy for FOK (M = .794, SD = .289) and non-FOK (M = .485, SD = .400) for strong semantic retrieval; $t(20) = 2.833$, $p < .05$. This result suggests that experiencing a FOK leads to better recognition accuracy.

2.4 Discussion

The aim of this study was to assess the validity of the cue-familiarity hypothesis and the target-accessibility hypothesis for explaining the bases of FOKs for the names of faces. Furthermore, this study also aimed to assess expanded hypotheses, such as dual-models (Koriat & Levy-Sadot, 2001, and Sun et al., 2014) and the noncriterial-recollection hypothesis (Brewer et al., 2010). We explored the contribution of recalled semantic information and cue-familiarity in a paradigm that allowed us to assess the level of both of these variables. Both the bases of FOKs and the accuracy of FOKs and non-FOKs, as defined by the differing levels of cue-familiarity and semantic information, were assessed.

Previous research in this area for FOKs relating to names of famous faces favoured the cue-familiarity hypothesis (Hosey et al., 2009); suggesting that FOKs are based mainly on the familiarity of the cue. However, research by Batchelor (2014) was not consistent with the cue-familiarity hypothesis. The results revealed that when participants found the face familiar-only they were not always experiencing a FOK; in fact, they were more likely to experience a non-FOK than a FOK. However, because the Batchelor (2014) study did not assess the levels of familiarity, it was speculated that FOKs could be based on a specific level of familiarity; i.e. a certain threshold of familiarity is required before a FOK can be experienced. Therefore, this current study aimed to assess different levels of cue-familiarity to determine if an increase in cue-familiarity would affect the FOK. It was then possible to determine whether familiarity needed to reach a certain threshold before a FOK would be experienced, or whether familiarity with the face, at any level, has no impact on eliciting a FOK.

The results found that greater levels of cue-familiarity increased the likelihood of experiencing a FOK. This was true when TOTs were considered as FOKs (TOTs included in the analysis) or as separate phenomena (TOTs excluded from the analysis). The results showed that the likelihood of experiencing a FOK increased significantly between each familiarity level. This suggests that as familiarity increases, the likelihood of experiencing a FOK increases. These results are consistent with the cue-familiarity hypothesis, which suggests that FOKs are based on familiarity with the cue. These results are also consistent with the research by Hosey et al., (2009) which conclude that cue-familiarity is responsible for FOKs for names of faces. The idea of a threshold of cue-familiarity that needs to be met before a FOK can be experienced, as suggested following the Batchelor (2014) study, has not been supported. This is because FOKs were experienced during all levels of cue-familiarity; weak, moderate and strong. What can be concluded is that as level of cue-familiarity increases so does the likelihood of experiencing a FOK.

Although the results from the analyses of this study provide general support for the cue-familiarity hypothesis, there are still FOKs that are not accounted for by the hypothesis. Even when participants found the face highly familiar it did not always lead to a FOK and this is problematic for the cue-familiarity hypothesis. Therefore, it could be speculated that FOKs are not entirely based on familiarity. It could be speculated that some FOKs are based on familiarity whilst other FOKs are based on another factor. Alternatively, FOKs could be based on a different factor entirely and familiarity is merely correlated with it.

It could be considered that experiencing a FOK causes participants to select higher levels of familiarity. A FOK may not be the result of experiencing a level 4 familiarity, perhaps a level 4 familiarity is merely being selected because the participant is experiencing a FOK. Consider that a feeling of high familiarity or warmth could sometimes be a by-product of experiencing a FOK, thus high familiarity levels may just sometimes co-exist with FOKs, as opposed to causing FOKs. Alternatively, perhaps participants may feel as though they should select higher levels of familiarity when they are indicating a FOK; a result of demand characteristics. It is as if participants could be experiencing a FOK and feel as though they need to justify their reasons (in a lab setting) for indicating a FOK; therefore, they indicate high familiarity more often than lower levels of familiarity. Furthermore, consider the direct-access theory. If individuals had privileged access to unrecalled target answers, through memory traces, the finding that FOKs are more likely to occur than non-FOKs when cue-familiarity is high does not contradict the trace-access theory. If the name of a person is stored within memory, it is more likely that the individual will experience familiarity for the face. Again, familiarity may just co-exist with FOKs because generally we only learn and store the names of people we have encountered before.

Furthermore, even though the results have shown that greater familiarity with the face is more likely to lead to a FOK, cue-familiarity may play a secondary role in driving the process of a FOK rather than being the single determinant. Koriat and Levy-Sadot (2001) suggested, in their combined hypothesis, that familiarity may act as a gating mechanism. They suggested that familiarity must be strong enough to drive memory search before target-accessibility can come into play. A level of familiarity could be acting as a trigger for the search-and-retrieval process which may occur before a FOK can be elicited. It could be that that as familiarity increases a FOK is more likely to be experienced simply because higher familiarity is more likely to drive the search-and-retrieval process than lower levels of familiarity. Therefore, it does not mean that familiarity itself is directly the primary basis of the FOK. If one were to assume that familiarity drives the search-and-retrieval process then the more familiar the participant finds the face, the greater the likelihood that the search-and-retrieval process will be initiated. Thus, it increases the likelihood of (but does not directly cause) a FOK. Just because a FOK is more likely to occur with very high levels of familiarity, does not mean that the familiarity is causing the FOK, it may just co-exist as a gating mechanism.

This study considered the possibility of the two hypotheses, cue-familiarity and target-accessibility, working together as two separate mechanisms (as proposed by Koriat and Levy-Sadot, 2001). To assess whether such a dual-model does play a role in the FOK experience, this study looked at whether a high familiarity combined with a strong amount of semantic information would lead to a FOK. However, high familiarity with retrieval of strong semantic information only led to 63% FOKs and 38% non-FOKs; thus, the combination of both factors cannot account for FOKs.

However, something this study can conclude, regarding the relationship between cue-familiarity and the bases of FOKs, is that a FOK requires at least some degree of familiarity with a face. When participants found the face unfamiliar they never experienced a FOK. This finding is consistent with recent research (Sun et al., 2014) that supports the dual-process hypothesis (Liu et al., 2007). The dual-process hypothesis suggests that FOK and non-FOK judgements belong to two dissociable cognitive processes; FOK judgements are based on the target-accessibility model, whereas non-FOK judgements are based on cue-familiarity. This model would predict that non-FOKs are a result of such judgements being based on the cue-familiarity, thus when there is no cue-familiarity a non-FOK will be automatically indicated by participants. The findings in this current study support this idea that the cue-familiarity model may provide a better account for non-FOKs; because no familiarity or low familiarity results in non-FOKs. However, it must be noted that non-FOKs still occur even when familiarity is very high (38% of high familiarity responses for a face led to non-FOKs), so the cue-familiarity model for the bases of non-FOKs cannot explain all situations in which a non-FOK was the outcome. Again, cue-familiarity may be used as driving the search-and-retrieval process. When the face is unfamiliar or barely familiar, the search-and-retrieval process may not be initiated, thus eliciting a non-FOK. In conclusion, our results support the notion that there is a dual-process in terms of non-FOKs and FOKs possibly being based on two different cognitive processes.

This study also aimed to investigate the target-accessibility hypothesis. Koriat (1993) suggested that ‘FOK judgements monitor the mere amount of information accessible’ and that a participant must base their FOK on ‘the quantity and intensity of the information accessible’. Koriat (1993) suggests that FOKs are based on clues accumulated during the initial stages of search-and-retrieval, and that these ‘clues’ include ‘semantic attributes’. Koriat’s (1993) model would predict that the more semantic information retrieved pertaining to the target the more likely the individual is to experience a FOK. Therefore, level of retrieved semantic knowledge was assessed to determine whether the ability to recall semantic information about the person (target) would cause participants to report a FOK.

On this premise, we hypothesised that if participants recalled no semantic information, it would lead to a non-FOK. The greater the level of semantic information, the greater the likelihood of participants reporting a FOK. Previous research (Batchelor, 2014) revealed that the ability to recall semantic information did not cause participants to experience automatically a FOK. However, this previous research did not investigate the varying amounts of semantic information retrieved about a given target. Therefore, it could be suggested that a certain level of semantic information needs to be recalled before a FOK can be experienced; this current study investigated this. The amount of retrieved semantic knowledge was classified into three levels; none, weak and strong, to determine if the level of semantic knowledge had an effect on the FOK.

The results revealed that retrieving semantic information increased the likelihood of experiencing a FOK. This was true for when TOTs and FOKs were considered as either the same phenomena (TOTs included in the analysis) or as separate phenomena (TOTs excluded from the analysis). When TOTs were included in the analysis, the results showed that the likelihood of experiencing a FOK, rather than a non-FOK, was significantly different for each of the semantic levels; participants experienced more FOKs when achieving greater semantic retrieval. However, when TOTs were excluded from the analysis, and therefore FOKs were considered as a separate phenomenon to TOTs, there was not a significant difference between the likelihood of experiencing a FOK for weak semantic retrieval and for strong semantic retrieval. This result suggests that retrieving greater semantic information does not have an impact on the likelihood of the participant experiencing a FOK. This result is not consistent with the target-accessibility hypothesis (Koriat, 1993) and opposes Koriat's suggestion that greater quantities and intensities of information accumulated during the initial stages of search-and-retrieval process will result in a FOK. There was, however, a significant difference between no semantic retrieval and both weak and strong semantic retrieval; suggesting that retrieving semantic information, whether weak or strong, will be more likely to lead to a FOK than retrieving no semantic information.

The results do not provide strong support for the target-accessibility theory. The theory would predict that as amount of semantic retrieval is increased the amount of FOKs reported would increase. However, the results of this study are not consistent with this trend; there was no significant difference in amount of FOKs reported between weak semantic and strong semantic retrieval (when FOKs were treated as a separate phenomenon to TOTs). This suggests that an increase in amount of semantic retrieval does not affect the likelihood of experiencing a FOK, which is problematic for the target-accessibility hypothesis. Although it is evident that receiving semantic information is more likely to lead to a FOK than receiving no semantic information at all.

It could be argued that the results partially support the target-accessibility hypothesis (Koriat, 1993) because the results reveal that participants always experience a FOK when they reported a TOT; as the target name feels accessible and participants are able to accumulate clues (i.e. structural clues, such as the first letter of the word). However, it can be argued that despite a FOK always being experienced with a TOT, it may not be that partial activation of the name is responsible for causing the FOK. Instead, partial activation of the name may exist independently of the FOK and have nothing to do with causing the FOK; partial activation of the name and a FOK may be two separate independent components that are causing the TOT. Furthermore, the target-accessibility hypothesis does not account for all of the reported FOKs; as FOKs were also experienced when participants were not in a TOT state. This is further support for the notion that there is another factor that plays a role in causing a FOK, and that the target-accessibility model does not explain the bases of FOKs for names of faces.

The ability to retrieve semantic information may co-exist independently of the causation of a FOK. That is, whatever causes the FOK may exist with semantic information alongside it, without a causal relationship from the retrieval of semantic information to the report of a FOK. It is possible that semantic information is retrieved after the experience of a FOK; as a FOK is often considered to be a fast experience which occurs rapidly (Paynter, Reder & Kieffaber, 2008). Consider then that FOKs are not based on the amount of information retrieved, but that there is a possibility that target-accessibility instead plays a role in the magnitude of FOKs, rather than the bases. The more semantic information an individual can recall, the more likely they are to feel confident about the FOK judgement and perhaps then rate the judgement higher. The magnitude of the FOK is greater because the individuals can retrieve greater intensities/amounts of semantic information; this acts as a 'reassurance' to the individual that their FOK is correct. This explanation accounts for results where retrieval of noncriterial information plays a role in the magnitude of FOKs, e.g. Brewer et al., (2010) and Schwartz at al. (2014). In these studies, the results have not necessarily shown that retrieval of noncriterial information causes FOKs but that there is a relationship between retrieval of noncriterial information and the magnitude of FOKs. Therefore, future research could explore retrieval of semantic information in relation to the magnitude of FOKs.

Furthermore, this study aimed to investigate the accuracy of FOKs and non-FOKs in predicting subsequent successful recognition of previously unrecalled target names. This was assessed using the RJR paradigm, in which participants were presented with a recognition task in the final phase of the study. Previous research has not explored the recognition accuracy of FOKs and non-FOKs defined by levels of cue-familiarity or by varying amounts of retrieved semantic information.

FOKs whilst in a TOT state were good predictors of correct recognition with 85% of TOTs leading to correct recognition (only 45% of non-FOKs led to correct recognition). This is consistent with previous research which shows that TOTs are good predictors of recognition (e.g. Schwartz, 2002). FOKs, with no TOT, were also good predictors of correct recognition (73% of FOKs led to correct recognition). Participants performed at above chance in the recognition task for both states. This outcome is consistent with Hart's (1965) finding that FOKs are better predictors of recognition than non-FOKs.

The results revealed that when participants found the cue slightly familiar (level 2 familiarity), there was not a significant difference in recognition accuracy for FOKs and Non-FOKs. Participants were no more likely to perform correctly in the recognition test when they were experiencing a FOK. This was true for when TOTs were included in the data and when TOTs were excluded from the data.

Furthermore, the results revealed that when participants found the cue moderately familiar (level 3 familiarity), there was a significant difference in recognition accuracy; participants performed better on the recognition test if they were experiencing a FOK. This was true for when TOTs were included in the data and when TOTs were excluded in the data.

The results also revealed that when participants found the cue highly familiar (level 4 familiarity), there was a significant difference in recognition accuracy; participants performed better on the recognition test if they were experiencing a FOK. This was true for when TOTs were included in the data and when TOTs were excluded in the data.

These results regarding familiarity level and recognition accuracy, suggest that participants perform better on the recognition test when they are experiencing a FOK; this is only true when familiarity reaches level 3. FOKs experienced with level 2 familiarity are no more likely to lead to better recognition than non-FOKs. Therefore, the best predictors of correct recognition are FOKs with moderate or high cue-familiarity. These results suggest that FOKs are only accurate predictors of correct recognition when experienced alongside specific levels of cue-familiarity.

It was expected that the higher the familiarity with the face, the greater the chances that the face was genuinely well-known to the participant and that the participant would have known the name and have been more likely to recognise the target name. In line with the cue-familiarity hypothesis, which states that any factor which increases the familiarity of the cue will simultaneously increase the magnitude of the FOK (Metcalfe, Schwartz & Joaquim, 1993), it was hypothesised that if this theory were correct then an increase in cue-familiarity would positively affect the accuracy of the FOK. The results are consistent with this theory.

The results revealed that experiencing a FOK lead to better recognition accuracy than experiencing a non-FOK, for each level of semantic retrieval. FOKs were better predictors of correct recognition (than non-FOKs) when participants retrieved no semantic information, weak semantic information, or strong semantic information. This was true for when TOTs were included in the data and when TOTs were excluded in the data.

The results show that FOKs, with any level of semantic retrieval (whether none, weak or strong), were more likely to lead to correct recognition than incorrect recognition; demonstrating that FOKs are accurate predictors of behaviour in the sense that they are more likely to lead to correct recognition rather than incorrect recognition. Thus, the results indicate that a FOK is an authentic state/experience and affects behaviour in terms of recognition performance, regardless of the level of semantic retrieval.

In conclusion, the results of this study have not provided strong support for the target-accessibility hypothesis (Koriat, 1993) nor the expanded hypothesis (the dual-model, Koriat & Levy-Sadot, 2001); suggesting that FOKs are not based on the amount of accessed semantic information. The results have provided general support for the cue-familiarity hypothesis (e.g. Schwartz & Metcalfe, 1992), thus, offering support for previous research on FOKs for famous faces (Hosey at al., 2009). The results have shown that increasing cue-familiarity will increase the number of FOKs reported, however, even high familiarity lead to 38% non-FOKs which is problematic for the cue-familiarity hypothesis; although it is possible that this may include some cases of familiar faces whose names are unknown (as discussed in the Introduction to this chapter). When assessing the effect cue-familiarity has on accuracy of FOKs, the best predictors of subsequent recognition are FOKs with moderate to high familiarity. FOKs experienced with low cue-familiarity were not accurate predictors of correct recognition. The accuracy of FOKs experienced for each level of semantic retrieval were also assessed and revealed that, regardless of semantic level, FOKs were more likely to lead to correct recognition that incorrect recognition.

Chapter 3: Electrodermal activity for metamemory judgements in response to names of faces

3.1 Introduction

Electrodermal activity (EDA) is a method of psychophysiological recording which measures changes in the electrical activity of palmar and plantar skin (Boucsein et al., 2012). EDA is an umbrella term which encompasses various measures. As the skin possesses electric properties which are known to change on a short time scale of seconds and are closely related to psychological processes, EDA is a method which measures changes in the skin's conductance and is a useful tool for measuring affective processes (Figner & Murphy, 2011).

Changes in EDA are related to changes in sweating from the eccrine sweat glands; which are the major sweat glands of the human body (Stern, Ray, & Quigley, 2000). The eccrine sweat glands are in highest density in the palms and the soles, thus why EDA measurements are usually taken from these locations (Stern, Ray, & Quigley, 2000). The eccrine glands secrete sweat, and it is the sweat which is an electrolyte solution. Thus, the more the skin sweats the more conductive the skin becomes. Changes in the sweating of the eccrine glands is controlled by the sympathetic branch of the autonomic nervous system (ANS) (Figner & Murphy, 2011). And it is the arousal of the sympathetic ANS which accompanies various different psychological processes. Thus, EDA measurements can be used to measure psychological processes which are related to sympathetic arousal (Figner & Murphy, 2011).

This current study focuses on a measurement of EDA known as skin conductance response (SCR). SCR is the main indicator of phasic changes and is better suited for the nature of this current study due to its relatedness to specific events (such as experiencing different metamemory states) and because it can be operationalised across shorter time intervals than skin conductance levels (SCL) (Figner & Murphy, 2011). SCR is most often used as an indicator of affective processes; it indexes the intensity of arousal (Figner & Murphy, 2011). SCR is often used as an indirect measure of attention, cognitive effort, or emotional arousal (Critchley, Elliott, Mathias, Dolan, 2000). As SCR is a multifaceted phenomenon and does not reflect just one single psychological process, it has been deemed a useful method for a range of research in psychology and related disciplines.

SCR has been used in a wide variety of research, including; covert recognition in developmental prosopagnosia (Bate & Cook, 2012), pain assessment in premature newborn babies (Munsters, Wallstrom, Argen, Norsted & Sindelar, 2012), in panic disorder (Doberenz, Roth, Wollburg, Breuninger and Kim, 2010), as a measure of schizotypy and psychopathy (Ragsdale, Mitchell, Cassisi & Bedwell, 2013), as a trait marker for suicidal propensity in depression (Thorell et al., 2013), in decision-making research (e.g. Crone, Somsen. Been & Van Der Molden, 2004; Crone & van der Molen, 2007), in sexual decision-making in males (Spokes, Hine, Marks, Quain & Lykins, 2014), and in research into mindfulness (Delgado-Pastor et al., 2015).

Despite the wide use of SCR as a tool in various areas of research, to date there is no such research into SCR and metamemory. However, there has been research into SCR and various types of memory. For example, one study by

Cunningham et al., (2014), investigated psychophysiological arousal (SCR and heart rate) for emotional memory following sleep. A study by Rothen and Meier (2014) looked into SCRs and prospective memory, whilst Holper, Jäger, Scholkmann and Wolf (2013) investigated SCR for memory during spatial navigation. But, to date, no research has considered SCR and metamemory.

One study, by Kikyo and Miyashita (2004), investigated the neural correlates of the FOK induced by face-name associations. In this study, they used event-related functional magnetic resonance imaging (fMRI) whilst using the RJR paradigm. Participants ranked their degree of FOK from 1-6. But, level of familiarity with the face and amount of semantic information recalled about the individual, was not measured. As the main objective of this study was to look at neural correlates of the FOK, the study revealed the brain regions which were active during a FOK, but did not look at neural differences between different states (non-FOKs, FOKs, TOTs).

This current study aims to investigate SCR whilst individuals experience various metamemory states. SCR is a valuable psychophysiological tool which would allow us to investigate psychological arousal in relation to metamemory. However, there are also suggestions in the literature that implicitly relate SCR to metamemory. It has been shown than the ventromedial prefrontal cortex (vmPFC) is linked to SCR. One study by Zhang et al., (2014) investigated this link between the vmPFC by looking at causality between cerebral blood oxygenation level-dependent and SCR in participants whom were taking part in a cognitive task during a fMRI. Their results found that increased activity in the vmPFC caused a decrease in SCR. Other research has also shown that the vmPFC plays a dominant role in skin conductance (Patterson, Ungerleider & Bandettini, 2002). Patterson, Ungerleider and Bandettini's (2002) results revealed that brain activity in the vmPFC area correlated with changes in SCR and was activated independent of the participant's cognitive state. Furthermore, research has shown that when the vmPFC has lesions, patients experience a loss of SCR (Bechara, Tranel, Damasio & Damasio, 1996).

The literature also shows a link between the prefrontal cortex and FOK judgements. For example, Modirrusta and Fellows (2008) found that the medial prefrontal cortex plays a critical role in FOK judgments. Schneyer, Nicholls and Verfaellie (2005) also showed that the vmPFC is engaged whilst accurate FOK judgements are made. Damage to the vmPFC has also been associated with impaired FOK accuracy. A study on patients with frontal lesions revealed that the vmPFC plays a critical role in FOK judgements and that damage to this area causes impaired FOK judgements (Schnyer et al., 2004).

In summary, the research has shown that the vmPFC plays a role in SCR and that damage to this same area causes impaired FOK judgements. It could be speculated that these findings are linked and that there is a causal link between SCR and FOK judgements; high SCR when viewing a face could lead to a FOK. Thus, the emotional value attached to the cue (the face) could play a role in causing a FOK. Therefore, exploring a relationship between SCR and FOK judgements seems valid.

This current study is interested in psychological arousal during the different metamemory states; non-FOKs, FOKs and TOTs. As SCR reflects psychological processes, as previously discussed, it should be an effective tool to understand if there are differences in intensity of psychological arousal during each of these states. This study is interested in comparing the SCRs for TOTs, FOKs, and non-FOKs, whilst defining each state by a level of familiarity. As the results of study 1 did not provide strong support of the target-accessibility hypothesis, this study will only explore the cue-familiarity hypothesis. We have therefore chosen to focus on four levels of cue-familiarity; not at all familiar, slightly familiar, moderately familiar and extremely familiar. This study is particularly interested in the comparison between psychological arousal of FOKs and non-FOKs with the same level of familiarity. If there is greater skin conductance response for FOKs than there is for non-FOKs (in which participants indicate a level of familiarity) then we can infer that there is something more to a FOK than merely familiarity; as greater SCR for FOKs than non-FOKs would reflect a greater intensity of psychological arousal.

If the results do indeed reveal that SCR differs between these two states then it will provide support against the cue-familiarity hypothesis and suggest that FOKs are merely an evaluation of familiarity with the cue. This is because it would demonstrate that there is more to a FOK than just familiarity, and that a greater psychological arousal is experienced when a FOK occurs than when a non-FOK occurs with the same level of familiarity.

Previous research (Tranel, Fowles & Damasio, 1985) has shown that participants have a greater SCR when viewing familiar faces than they have when viewing unfamiliar faces, even in patients who show no covert recognition. Therefore, we hypothesise that there should be a difference in SCR between faces which participants indicate as familiar and faces which participants indicate as unfamiliar.

Furthermore, the state which we expect to show greatest SCR is the TOT state, due to the emotive affect this state is suggested to cause (Brown, 2012).

As Experiment 2 was designed to investigate possible differences in metacognitive states as detected by SCR, it was not an exact replication of Experiment 1. Experiment 2 did not measure levels of target-accessibility and also differed in the questions asked of participants. Therefore, the full range of analyses conducted on the results of Experiment 1 was not appropriate for Experiment 2.

3.2 Method

Participants: 63 participants were tested individually. Two participants were excluded for interrupting the recording and one participant was excluded because the equipment did not record properly. The mean age of participants was 26 years (25 females and 35 males).

Design: The study used a within-subjects design. The dependent variable was the responses to each face.

Apparatus: The experiment was run with SuperLab. The stimuli were presented on an Apple iMac; 27" screen. The SCR data was collected using electrodes which were connected to a Cendrus RB-834 Response Pad and Nexus-10, connected to a Dell Latitude E4310 laptop computer. The recordings were recorded using the software; BioTrace+ V2013. The site for electrodes was prepared using alcohol prep pads (saturated with 70% isopropyl alcohol) and Ten20 conductive paste.

Materials: 54 images of celebrity faces (27 female and 27 male) were used in both the recall and recognition phase (see appendix for sample materials). The images were obtained online and cropped so that each image was a uniform size. The celebrity faces ranged in terms of occupation of the person (e.g. actors, comedians, sportsmen). All images were frontal shots, with happy expressions to minimise any effect that other expressions may have on participant's SCR.

In the recall phase, for each face, participants were presented with questions. The questions were (in the given order): ‘*Do you have a feeling of knowing; would you be able to select the correct name from a list of four names?*’ (the response options were: ‘*yes*’ or ‘*no*’), ‘*does this face look familiar to you?*’ (with the following options: *not at all familiar, slightly familiar, moderately familiar, extremely familiar*), and ‘*are you in a tip of the tongue state?*’ (the response options were: ‘*yes*’ or ‘*no*’).

In the recognition phase, participants were presented with a multiple-choice test consisting of four names for each given face. The correct name was presented within the list in a random order. The other three names consisted of other celebrities who were the same gender, of the same occupation and who had names of the same ethnic origin as the target name.

Procedure: Participants were made aware that they would have two electrodes attached to two of their fingers on the hand which they do not type or use the mouse with. Participants were seated in front of the screen and participant’s distal phalanges of their index and third finger were wiped with alcohol prep pads to remove any residue or oil on the fingers. After allowing the alcohol wipe to briefly dry, electrode gel was then applied to the same two fingers before two electrodes were then attached to the fingers. The opposite hand to which participants use to type or use the mouse with was used. Participants were supplied with a cushion to rest their hand/forearm on.

Each participant was instructed to take a deep breath to check for sufficient gain in SCR. Skin conductance measurements were taken continuously during the 5-min baseline whilst participants were presented with the general instructions. The instructions informed participants that the experiment consisted of fifty-four faces in which they were to answer the given questions as honestly as possible. Participants were instructed not to move their hand with the electrodes throughout the duration of the study and to keep other body movements to a minimum; including avoiding deep breathes or sighs. The participants were also given a sheet of paper with the definition of a TOT state and a FOK, and participants were made aware that they should refer to this definition if they were to forget it at any point throughout the duration of the study. A TOT state was defined as follows: '*the feeling that you know the name and that recall is imminent (likely to occur at any moment)*'. A FOK was defined as follows: '*you feel as though you know the name and you would be able to select the correct name from a list of names. You may not be able to recall the name imminently, but you feel as though you do know the name. The name is within your memory*'.

Firstly, in the recall phase, participants were shown a photo of a face and asked to give the name of the celebrity. If they could recall the name they typed the name into the text box. If participants were unable to recall the name, they were required to hit the '/' key on their keyboard, which was labelled with a brightly coloured star to make it distinctive. Once they had done this, participants were required to click '*next*'. They were then presented with the three questions, whilst an image of the face still remained on the screen. Participants were required to answer all of the questions by clicking answers with the mouse. Once all questions were answered participants proceeded to the next face. Participants were required to respond to all fifty-four faces in the recall phase before proceeding to the recognition phase.

In the recognition phase, participants were told they would be given a multiple-choice test and were instructed to select the correct name from a list of four names, for each face. Participants were made aware that they must select a name for each face. The participants were shown the same fifty-four faces on the screen, one at a time, along with four names to select from. During the multiple-choice test, participants were told that they could now relax their hand as SCR was no longer going to be recorded.

Throughout the experiment all participants were tested individually and were able to view each face and work through the questions at their own pace. Participants were not permitted to go back to a face or previous questions if they had already completed them.

Measurement

An individual SCR refers to a peak in skin conductance, and is described as “a discrete and short fluctuation in skin conductance that lasts several seconds and usually follows a characteristic pattern of an initial, relatively steep rise, a short peak, and then a relatively slower return to baseline” (Figner & Murphy, 2001, p.165). In other words, SCR is measuring the phasic change in electrical conductivity of skin. In this study, SCR was recorded in Biotrace. Because we wanted to measure event-related SCRs (SCR in relation to individual faces), markers/triggers were used. A new marker was used to signal when a new face (along with it's given questions) were presented to the participant. This allowed the SCR to be recorded with markers which indicated when a new face was being presented, and another marker to indicate when participants had completed the questions for this given face, so that the SCR data could be considered individually for each face. The SCR was recoded from the exact moment that the participant was shown the face and during the behavioural measures (whilst the participant was answering the given questions). SCR was not recorded during the second part of the experiment; the recall phase.

Data handling

The SCR data collected via BioTrace were analysed by importing the raw skin conductance signal (which was measured in microSiemen) into a specialist software *Ledalab*, which is built in MatLab. Ledalab can perform event-related analysis relative to the event markers (the markers were used to flag the event of a new face being presented to participants). The method of EDA analysis which was used was The Continuous Decomposition Analysis (CDA), which performs decomposition of the data into continuous signals of phasic and tonic activity and is the most appropriate analysis for analysing data relative to event markers. The analysis for each participant was optimised, an option in Ledalab, which applies the most appropriate parameters in the decomposition window. The SCR data were then collated with the data from the task (the participant's responses to the questions).

3.3 Results

The task data were coded so that each state (non-FOK, FOK, TOT) which was indicated during the recall phase could be identified. The means (maximum 54) and standard deviations are displayed in table 2. The SCR for each state during varying levels of cue-familiarity could then be identified.

TOT	FOK	Non-FOK	Face Unknown	Named during recall
4.97 (3.24)	13.9 (6.48)	14.53 (10.03)	17.1 (8.46)	4.5 (5.27)

Table 2: Means (SDs) for responses during the recall phase.

A series of between subjects one-way ANOVAs were conducted to compare the difference in SCR for the different metacognitive states (non-FOK, FOK and TOT) and for the different levels of cue-familiarity, to determine whether metacognitive state or cue-familiarity level has an effect on SCR.

A between subjects one-way ANOVA was conducted to compare the effect of metacognitive state on SCR, for the occasion on which participants found the face slightly familiar (familiarity level 2). There was no statistically significant difference in SCR between the familiarity levels ($F(2,99) = .455$, $p > .05$).

A between subjects one-way ANOVA was conducted to compare the effect of metacognitive state on SCR, for the times in which participants found the face moderately familiar (familiarity level 3). There was no statistically significant difference in SCR between the familiarity levels ($F(2,110) = .023$, $p > .05$).

A between subjects one-way ANOVA was conducted to compare the effect of metacognitive state on SCR, for the times in which participants found the face highly familiar (familiarity level 4). There was no statistically significant difference in SCR between the familiarity levels ($F(2, 97) = .241$, $p > .05$).

A between subjects one-way ANOVA was conducted to compare the effect of cue-familiarity level on SCR, to determine whether familiarity with a face has an effect on SCR, regardless of metacognitive state. There was no statistically significant difference in SCR between the familiarity levels ($F(3,222) = .142$, $p > .05$).

These analyses provide no evidence that SCR as measured in this Experiment differs according to the metacognitive states participants report. There were no significant differences between TOT, FOK and Non-FOK states for any level of familiarity.

3.4 Discussion

This current study aimed to investigate SCR whilst participants experienced various metamemory states. There has been a wealth of previous research investigating SCR, and also a wealth of research investigating metamemory. However, no such research has combined the two and investigated SCR for metamemory judgements. In particular, this study was interested in SCR when participants experienced a FOK. Research into FOKs has been concerned with the accuracy of FOKs (Hart, 1965; Nelson, Gerler & Narens, 1984; Perrotin, Bellevill & Isinggrini, 2007; Mathilde Sacher, Isingrini & Taconnat, 2013) and the bases of FOKs (Schwartz & Melcafe, 1992; Metcalfe, Schwartz & Joaquim, 1993; Koriat, 1993). However, previous research into FOKs has not explored psychophysiological measures of the FOK, nor considered the possibility that greater psychophysiological arousal may play a role in eliciting FOKs.

This current study aimed to investigate possible differences in SCR levels for each metamemory state (non-FOK, FOK, TOT). The aim was to determine whether participants experienced increased SCR whilst making metamemory judgments, with particular interest in the FOK judgement. Participants were required to view faces and, using the RJR paradigm (developed by Hart, 1965), indicate which state they were experiencing (non-FOK, FOK, or TOT). However, the results did not reveal a significant difference in SCR between the states, suggesting that there is no difference in intensity of physiological arousal between any of the states. When participants felt as though they would be able to recognise the name of the face (FOK), or when they felt as though the name was imminent and they were about to recall the name (TOT), it caused no increase in psychological arousal as compared to when participants felt as though they would not be able to recognise the name of a face they found familiar (non-FOK). This was a somewhat surprising result that even a TOT did not elicit higher SCR, as it is often thought that the TOT experience is a rather frustrating experience; with some researchers describing the TOT experience as a torment or agony (Brown & McNeill, 1966) and suggesting that an affective reaction is either a central part of the TOT experience of at least a by-product of the experience (Gruneberg, Smith & Winfrow; 1973; Yarmey, 1973; cited in Brown, 2012). Therefore, if any state were to cause greater SCR, it would have been expected that the TOT experience would be the most likely to do so. However, as already stated, this was not the case and the results revealed no difference in SCR between any of the states.

This current study was also concerned with the level of cue-familiarity in which each state was experienced in. The study focussed on determining the level of cue-familiarity in which participants indicated whilst experiencing each of the states, with an aim to compare the SCR for these. Participants were required to rate the familiarity of each face on a four-point scale, from unfamiliar to highly familiar, in order to determine whether different levels of familiarity would result in a difference in SCR. In particular, this study was interested in looking at the difference in SCR between the levels of cue-familiarity for FOK judgements; to determine whether FOKs experienced during higher levels of familiarity result in higher levels of psychological arousal, or whether all FOKs, no matter what level of familiarity, would result in the same level of arousal. The results revealed that there was no significant difference in SCR between cue-familiarity levels. There was no difference in SCR between the four levels of familiarity; unfamiliar, slightly familiar, moderately familiar, and highly familiar, for all of the states.

It was expected that there would be a difference in SCR between faces which were found familiar, and faces which were found unfamiliar, as this is something which is widely accepted in SCR research (e.g. Tranel, Fowles & Damasio, 1985). However, as previously stated, this was not the case and the results revealed that there was no significant difference in SCR between any of the familiarity levels.

In a study by Sherer and Mikulka (1996), the effect of facial familiarity and task requirement on electrodermal activity was investigated. Sherer and Mikulka (1996) assert that faces are arousing stimuli, whether this be from an innate attraction towards faces or from prior association of a face with an emotional event in one’s life. Following on from the findings of Tranel et al. (1985) which found that familiar faces elicit larger EDA responses than those of unfamiliar faces, Sherer and Mikulka (1996) re-examined this effect.

Whereas, Tranel et al. (1985) merely asked participants to view faces, with no other task requirements or response requirements, Sherer and Mikulka (1996) manipulated the task requirement. Their participants were divided into two groups; a control group, who were asked to rate the attractiveness of the faces, and an experimental group who were asked to name the faces. It was expected that in the control group, where participants were required to judge the attractiveness of each face, it would divert the participant's attention from trying to name the faces. The aim of the study was to look at the automatic electrodermal response to the faces and to look at the effect of EDA responses from the subsequent processing which is used to retrieve the identify-specific information about the face.

Sherer and Mikulka's (1996) results revealed that task requirement interacted with face familiarity to affect the magnitude of EDA response. Greater EDA occurred when participants were required to name the familiar face. However, whether a face was familiar or not, EDA did not vary for those participants who were busy rating facial attractiveness. Sherer and Milulka (1996) conclude that their findings show that familiar faces do not evoke an automatic increase in arousal, but that the context of the specific task is important. When the individual is required to retrieve information, such as identity-specific information, the arousal when presented with a familiar face is increased. The presentation of a familiar face, when the participant is not required to give any identify-specific information (such as rating facial attractiveness) does not produce this increase in arousal, thus no increase in EDA. This result contrasts to that of previous research (Tranel et al., 1985) that suggested that merely the presentation of a familiar face would automatically cause an increase in EDA. Sherer and Mikulka (1996) argue that their results were not due to participants in the control group not paying attention to the stimuli as participants did have to attend to the faces in order to make attractiveness ratings. They also explored the idea that the task of rating facial attractiveness was too simple thus bored the participants. However, they point out that in the Tranel et al. (1985) study participants had no task requirement at all. Thus, boredom and therefore lack of arousal through the task requirements, could not explain the results. Sherer and Mikulka (1996) go on to suggest that because the participants in the Tranel et al. (1985) study had no task requirements, their participants were attempting to identify the faces, without covertly stating this. Thus, this may have been what caused their finding of greater EDA in response to familiar faces. Furthermore, they suggest that the novelty of the faces used in the Tranel et al., (1985) study may have been a major factor in the increased arousal that their study found (only 8 out of the 50 faces were familiar, the rest were novel).

As Sherer and Mikulka (1996) suggested, minimal task requirements have been suggested to reduce arousal, thus reduce EDA (including studies such as; Germana (1968); Lieblick (1969); Ohman (1979), as cited in Sherer & Mikulka, 1996). In this current study, it cannot be claimed that minimal task requirements are responsible for the lack of variety in EDA responses, as the study contained several task requirements from participants. Furthermore, inattention cannot be suggested to be responsible for the results. Because, just as in the Sherer and Mikulka (1996) study, participants had to attend to the faces to be able to fulfil the task requirements i.e. to be able to attempt to name the face, or to be able to rank the familiarity of the face.

However, unlike the suggestion that minimal task requirements reduce arousal, perhaps the results of this study reflect the opposite. It may be the case that instead of the task requirements being too minimal, the task requirements may have been too high and this is what led to familiar and unfamiliar faces evoking the same level of SCR. It could be that the task requirements in this current study have influenced any SCR differences that would otherwise have been observed. The activity of the search-and-retrieval process (attempting to retrieve a name from memory), making a familiarity judgement, a FOK judgement, and a TOT judgement, may have caused a high level of cognitive demand. Previous research on EDA and facial familiarity, used far less task requirements (i.e. Tranel et al., 1985). Thus, this may explain why the results of this current study do not show any difference in EDA between familiar and unfamiliar faces, let alone a difference in EDA between the different states or different levels of familiarity. It has also been shown that cognitive processes influence electrodermal activity, even merely anticipating a higher level of cognitive demand has been shown to cause anticipatory SCRs (Botvinivk & Rosen, 2009). Therefore, it could be speculated that in order to observe a difference in SCR between each of the states (i.e. SCR for FOKs versus non-FOKs); the participant has to partake in minimal activity to reduce cognitive demand.

Furthermore, as pointed out by Sherer and Mikulka (1996), novelty of faces may have played a role in EDA in response to faces. Essentially, every face used in this current study was a famous face. And, although it was designed so that the familiarity level of the faces (from unfamiliar to familiar) was varied, the fact is that every single face was a celebrity face and meant that it was possible that even those faces deemed ‘unfamiliar’ by participants may not have been that novel after all. There is the possibility that the participant may have seen the face, for example, in a movie; without overtly remembering that they had seen the face. Participants were also told that all the faces were familiar, therefore they were anticipating familiar faces and this may have played a factor in their SCR to the faces. Therefore, future research should consider using some definite novel faces to ensure an even mixture of familiar and definite unfamiliar faces.

Therefore, as the results do not reveal a difference in SCR between any of the states or any of the familiarity levels, this study cannot suggest that experiencing a

FOK causes greater psychological arousal, or that experiencing a FOK is based on greater psychological arousal. However, future research into metamemory and SCR should not be abandoned. Future research should aim to eliminate extra task requirements, in order to reduce cognitive demand of the task, with the hope that this would eliminate any extra SCR which has occurred as a result of the task requirements. The use of novel faces would ensure that at least some of the faces are definitely unfamiliar to the participants and would ensure that they are also not expecting all of the faces to be familiar. Furthermore, using psychophysiological methods with metamemory is a novel research idea and something that could be explored further. For example, future research could look at using EEG recordings whilst participants make metamemory judgements.

Chapter 4: General Discussion

4.1 Interpretations of present findings

The studies in this thesis have explored the nature of the FOK. In particular, this thesis has been concerned with the bases of FOKs for names of faces. The FOK is a fascinating phenomenon, whereby individuals can quite accurately determine what is and what is not within memory, even though that particular piece of information cannot currently be recalled. Empirical investigations into the FOK began in the 1960s, however, no consensus has been made as to what FOKs are based on.

The aim of experiment 1 was to investigate whether FOKs for names of faces are based on familiarity with the face (the cue-familiarity hypothesis) or based on the ability to retrieve semantic information relating to the given person (an aspect of the target-accessibility hypothesis). The study used a method that allowed for the level of each of these factors to be measured and assessed in terms of their contribution to both the bases of the FOK and to the accuracy of the FOK.

Prior to this study, the inferential theories were favoured for explaining the basis of the FOK and previous research, into the basis of FOKs for names of faces, supported the cue-familiarity hypothesis (Hosey et al., 2009). The results of experiment 1 showed that the likelihood of experiencing a FOK increased significantly between each familiarity level. This suggests that as familiarity increases, the likelihood of experiencing a FOK increases. Therefore, the results of this study provide some support for the cue-familiarity hypothesis and the existing research into FOKs for names of faces (Hosey et al., 2009). Although the results from the analyses of this study provide general support for the cue-familiarity hypothesis, there are still FOKs that are not accounted for by the cue-familiarity hypothesis. This study found that even when the highest level of cue-familiarity was experienced, participants didn't always experience a FOK. In fact, 38% of the time participants reported a non-FOK when they found the face highly familiar. This is problematic for the cue-familiarity theory that would hypothesise that high familiarity will lead to a FOK.

Furthermore, the tested aspect of the target-accessibility hypothesis (semantic retrieval) as a determinant of the FOK for names of faces was not fully supported. The results of this study found that retrieval of additional semantic information, as opposed to just weak semantic information, did not increase the likelihood of a FOK (when FOKs were treated as a separate phenomenon to TOTs). This result is not consistent with the target-accessibility (Koriat, 1993) theory which would suggest that greater amounts of semantic retrieval would increase likelihood of a FOK. However, the results did show that retrieving any level of semantic information is a better determinant of experiencing a FOK than not retrieving any semantic information at all; this is consistent with the target-accessibility theory. Furthermore, non-FOKs were still experienced when participants were able to recall a strong amount of semantic information, which is problematic for the target-accessibility hypothesis.

Previous research into FOKs for names of faces was limited and suggested that FOKs for faces were based on cue-familiarity, based on the research by Hosey et al. (2009). However, the study by Hosey et al., (2009) relied rather heavily on participants' introspections as to what had made them report an FOK. Hosey et al.,

(2009) did not request familiarity ratings or retrieval of semantic information for all of the faces that could not be named. It was therefore difficult to determine whether feelings of familiarity or retrieval of semantic information were genuinely predictive of FOKs (for a detailed overview see the general introduction). However, the current study provided a much more objective investigation into what FOKs for names of faces are based on, as it did not rely on participant's subjective and retrospective reports. Furthermore, the Hosey et al., (2009) study was predestined to result in one of two inferential theories (cue-familiarity or target-accessibility) being responsible for the cause of FOKs for names of faces, as their study was not designed in a way in which could account for any other possible explanations. Whereas, this current study did not limit the possible determinants of FOKs to two possible outcomes (cue-familiarity or target accessibility). This current study also took into account that level of cue-familiarity ranges and investigated how differing levels of cue-familiarity may influence participants reporting a FOK and their performance on subsequent recognition of previously unrecalled target names.

Challenges for the inferential theories

There are several points that one could claim are a challenge for the inferential theories. Accumulating information, or assessing the latency or fluency in which information comes to mind (target-accessibility hypothesis) takes time, whereas, FOKs seem to occur quickly. Furthermore, FOKs also appear to occur quicker than familiarity does. In one study by Paynter, Reder and Kieffaber (2009), event-related potentials (ERPs) were recorded to identify the time course of FOKs. The study found that the ERPs for familiarity was 300ms following the onset of the stimuli, whereas the ERPs for the FOK was only 200ms after the onset of stimuli. This suggests that

FOKs may happen before familiarity is assessed and that the initial FOK manifests long before the stimuli have been consciously processed. The authors concluded that their study demonstrates that initial FOKs are based on processes that ‘come on-line quite rapidly’. This suggests that FOKs possibly occur before the individual has made inferences; such as assessing the familiarity of the stimuli or assessing the amount, or latency, of clues that come to mind during the search-and-retrieval process.

Furthermore, it is apparent that certain clinical groups of individuals have impaired FOKs. Research has found that patients with obsessive compulsive disorder have lower FOK ratings and make FOK judgements which are not reliable predictors of their recognition performance (Tuna, Tekcan & Topcuoglu, 2003). Another study suggests a metamemory monitoring deficit in patients with schizophrenia; the results revealed that patients had less FOKs and their overall FOK accuracy was significantly lower than normal participants (Chiu, Liu, Hwang, Hwu & Hua, 2015). Furthermore, it has been found that children with autism spectrum disorder make episodic FOK judgements that are not reliable predictors of their recognition performance (Wojcik, Moulin & Souchay, 2013). However, despite having impaired FOKs, it would seem unlikely that these clinical populations have familiarity impairments. Impaired familiarity is a profound inability that should be quite apparent. One would assume that if individuals with conditions such as OCD, schizophrenia, or autism spectrum disorder, have a familiarity impairment then it would be well documented. If FOKs were based on familiarity alone, we would expect these clinical populations to exhibit familiarity impairment, but it is unlikely that they do.

The trace-access theory (Hart, 1965) has long been abandoned as a competing theory for inferential theories. The theory suggests that rather than having to accumulate information and make inferences in order to elicit a FOK, perhaps we have an intuitive ability to monitor what is and what is not within memory. The idea of a monitoring module that has access to memory traces, and is therefore able to determine the availability of the sought-after information within memory, would add to the efficiency of memory. Having such a memory monitor would, as Hart (1965) suggests, add to the efficiency of human memory by saving us time searching memory for an item that is not stored. Such a monitor would also allow us to continue our search efforts if the monitor signals that the sought-after information does exist within memory. However, the trace-access theory is a difficult theory to provide support for, as it is difficult to measure what can be directly accessed.

In terms of how well the inferential theories were tested, in this current study, raises a couple of questions. The cue-familiarity hypothesis is a relatively straight forward hypothesis to test in terms of there being only one factor to test- *how familiar do participants find the cue (in this case, the face)?* Therefore, by requiring participants to select a familiarity level on a four-point scale, the cue-familiarity hypothesis was sufficiently tested. Previous research had not segregated FOKs and non-FOKs into states which could occur with varying levels of cue-familiarity. Therefore, by considering familiarity as a dimension with varying levels, rather than as black and white (familiarity or no familiarity), has allowed a more thorough investigation of the cue-familiarity hypothesis.

However, the target-accessibility hypothesis has various factors, or determinants, which could be tested. As listed by Koriat (1993), there are various clues which the target-accessibility hypothesis suggests FOKs are based on; structural, contextual and semantic attributes that are activated from the terms in the question, and fragments of the target itself. This current study chose to measure the depth of semantic information retrieved by participants. The retrieved semantic information was determined as either being none, weak (when the participant could recall only the target person's occupation), or strong (when the participant could also recall a fact about the target person). By measuring the depth of retrieved semantic information, this study was testing the noncriterial-recollection hypothesis. The hypothesis is an expanded view of Koriat's (1993) target-accessibility hypothesis, and although it is still based on the idea that clues accumulated during the search-and-retrieval process are responsible for FOKs, it has an emphasis on the information retrieved, rather than on other aspects of the target-accessibility hypothesis (i.e. fragments/letters of the target). By investigating just one of the clues suggested by Koriat (1993) the other clues were ignored. Therefore, it could be speculated that had the other clues have been measured then there would have been the possibility that the results may have provided stronger support for the target-accessibility hypothesis. Much of the research that tests the target-accessibility hypothesis focuses on testing the structural fragments of the target word (e.g. Blake, 1973; Eysenck, 1979). However, this current study did not measure the letters recalled for the target word because it was thought that when an individual begins to recall letters from the target name it is very similar to the definition of a TOT, rather than a FOK. When letters of the target name are retrieved the difference between a FOK and a TOT becomes very unclear. Another clue that we could have tested for was retrieval of episodic information; such as retrieval of times, places, or associated emotions with the given face. Furthermore, this study could also have looked at retrieval latency for semantic/episodic information. As Koriat (1993) suggests that the ease of which the information comes to mind may impact the FOK judgement more so than the amount of information. This is an aspect of the target-accessibility hypothesis that could be tested in future research into FOKs for names of faces.

Furthermore, prior to these studies, psychophysiology combined with the study of metamemory had not been investigated before. The study aimed to investigate the different SCR levels for each metamemory state with a focus on the FOK judgement. It was hypothesised that perhaps greater psychophysiological arousal in response to stimuli may be what leads participants to report that they are experiencing a FOK. However, the results found no difference in SCR between the different metamemory states; suggesting that greater psychological arousal does not occur as a result of a FOK nor plays a role in the basis of the FOK.

FOKs for faces vs verbal stimuli

It has long been debated whether faces are special in the sense that there may be visual processing mechanisms unique to faces (e.g, Yue, Tjan & Bederman, 2006; Riddoch, Johnston, Bracewell, Boutsen & Humphreys, 2008). Riddoch et al. (2008) highlight that the ability to recognise individual faces is '*of crucial social importance for humans and evolutionarily necessary for survival*'. They go on to say that, as a consequence of evolution, faces may be considered special stimuli in which we have '*developed unique modular perceptual and recognition processes*' in which is supported by cases of Prosopagnosia; whereby the patient is unable to recognise faces but their ability to recognise other objects is preserved. Furthermore, even if it is disagreed that faces are special in the sense that they are perceived and recognised in a special way, which differs to that of other objects, it cannot be claimed that they are not special in other ways. For example, McKone and Robbins (2011) highlight that there is no doubt that in many ways faces are special *functionally*; they provide information about expression, gaze direction, the person's identity and they provide visual clues to speech; all of which cannot be found in objects.

Therefore, if faces can be considered special in various ways; functionally and/or perceptually, it is not illogical to consider that FOKs for faces may be 'special' too. Due to the way that faces may be perceived differently, the bases of FOKs for faces may differ to that of other stimuli. Therefore, it should be considered that any suggested determinants for the bases of FOKs for other stimuli (e.g. verbal stimuli; trivia questions or word pairs), may not have the same impact on FOKs for faces. This distinction between FOKs for faces and FOKs for other stimuli has already been discussed by Cleary (2011). Cleary (2011) suggested that future research on FOKs could focus on investigating how reliance on cue-familiarity differs between FOKs with faces and FOKs for other types of stimuli. It was predicted that faces would provide better support for the cue-familiarity hypothesis than other types of stimuli (see general introduction) as Aly et al., (2010) suggested that faces require a greater reliance on familiarity than do other types of stimuli; suggesting that FOKs for faces may rely on different determinants than FOKs for other types of stimuli.

It should be considered that just because this current study provides some support for the cue-familiarity hypothesis, it cannot be applied to FOKs for *all types* of stimuli. It may be that FOKs for faces rely more heavily on cue-familiarity than FOKs for other types of stimuli. Therefore, it is important not to generalise the results of this current study to FOKs for other types of stimuli due to the fact that faces are considered different to other stimuli in terms of functionally and/or perceptually.

In this study, famous names were used as distractors in the recognition task, rather than novel names. This is the same method that previous research into FOKs for names of faces used (Hosey et al., 2009). Furthermore, items given to participants in the multiple-choice (recognition) test have usually been answers which are not novel, from when Hart first developed the RJR paradigm (Hart, 1965). Therefore, we decided to keep the methodology of the typical RJR paradigm and not use novel distractors. It is possible that participants could have used a recall-to-reject strategy, whereby they selected the correct answer through eliminating the names that they knew were wrong. However, we tried to reduce this somewhat by using distractor names that were of the same occupation as the target name. If all novel names had been used (with the one correct answer, which would have been potentially the only familiar name), this would have caused the participants to opt for the only familiar name. Thus, participants would only have selected the correct name because it was the only vaguely familiar name. Future research will need to disentangle the roles of specific familiarity with a particular face and knowledge of the broad category of occupation to the recall-to-reject strategy, perhaps by the use of several familiar names (from same or different categories) and several novel names in the recognition task.

Accuracy of FOKs and non-FOKs

This thesis also focussed on exploring the factors that may influence the accuracy of FOKs. Are FOKs, which are experienced with high cue-familiarity, better predictors of subsequent recognition than those FOKs that are experienced with low cue-familiarity? Are FOKs, which are experienced alongside retrieval of a strong depth of semantic information, better predictors of subsequent recognition than those FOKs that are experienced with little or no semantic retrieval?

Experiment 1 aimed to answer these questions and unveiled some interesting findings. The results revealed that participants perform better on the recognition test when they are experiencing a FOK. However, this is only true when familiarity level reaches level 3 and level 4. The best predictors of correct recognition are FOKs in which we find the face highly familiar (80% of these type of FOKs led to correct recognition). FOKs experienced with level 2 familiarity are no more likely to lead to better recognition than non-FOKs. This means that FOKs that are experienced with moderate to high levels of familiarity are better predictors of subsequent recognition than those FOKs that are experienced with low cue-familiarity. These results are consistent with the cue-familiarity theory ((Metcalfe, Schwartz & Joaquim, 1993).

The results also revealed that FOKs, with any level of semantic retrieval (none, weak, or strong), were more likely to result in the participant performing correctly on the recognition test. This result demonstrates that FOKs are accurate predictors of subsequent recognition regardless of the level of semantic retrieval. This result is problematic for the target-accessibility theory, as it was hypothesised that if target-accessibility plays a role in the FOK then we would expect that no semantic retrieval would lead to FOKs with incorrect recognition and strong semantic retrieval would lead to FOKs with correct recognition. However, this is not the case and target-accessibility appears to make no difference to the accuracy of the FOKs. This result differs greatly to the impact that cue-familiarity has on the accuracy of FOKs.

4.2 Future research

An interesting direction for future research would be to see what influence these factors (cue-familiarity and semantic retrieval) have on the magnitude of FOKs. Finding a face very familiar and/or being able to recall a strong depth of semantic information may affirm and boost an individual's confidence in their metamemory judgements. Therefore, future research could use the same cue-familiarity rating scale ***or*** assessment of semantic information retrieval, whilst asking participants to select their FOK rating. Rather than asking participants if they are experiencing a FOK or not, participants would be asked to select from a scale (i.e. no FOK, weak FOK, moderate FOK, strong FOK, TOT). It would therefore be possible to determine whether cue-familiarity and target-accessibility have an influence on the magnitude of FOKs for names of faces. However, the reason that FOK magnitude was not tested in this current study is because it would have meant that too many aspects (4 levels of familiarity x 4 levels of FOK strength) were being tested, thus further fragmenting the data. It may also have led to participants relating their FOK magnitude to their cue-familiarity rating i.e. if the participant selects level 3 familiarity they would most likely feel more inclined to select the coinciding level of FOK magnitude.

Furthermore, it would be interesting to explore the other suggested clues from Koriat's (1993) theory because, as previously mentioned, this study only looked at one aspect; retrieval of semantic information. It would not be possible to refute the target-accessibility hypothesis as the basis for FOKs of names of faces without further exploring the other factors in the target-accessibility hypothesis in relation to names of faces. As previously mentioned, these factors include; structural fragments of the name, episodic information (such as retrieval of times, places, or associated emotions with the given face) and retrieval latency of semantic/episodic information. For example, structural fragments of the target word in relation to names of faces could be explored in future research, whilst using the same paradigm. This could be achieved by measuring the level of cue-familiarity whilst measuring the number of letters from the target name that participants can recall. There is the possibility that the ability to recall structural information (letters from the target word) combined with high familiarity may lead to a FOK.

4.3 Final note

From when FOKs were first subjected to empirical investigation, Hart (1965) highlighted why the study of the FOK would be so intriguing. Hart (1967a) suggested that the FOK is a fascinating experience, one in which he described as being able to demonstrate the link between subjective processes and behavioural processes. By this, he was alluding to the subjective experience of a FOK which influences individual's behaviour. As demonstrated in this current research, we can predict future memory performance based on subjective experiences (FOKs and TOTs), and we can determine what factors will, or will not, affect memory performance based on subjective experiences (i.e. cue-familiarity will influence memory performance when an individual does not experience a FOK, but cue-familiarity will not have the same effect if the individual is experiencing a FOK).

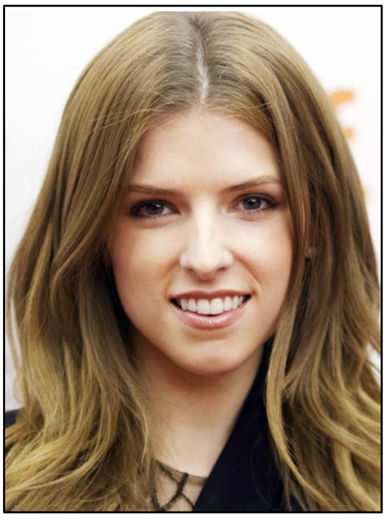
It is interesting to observe that it is possible to experience a high familiarity with a face and be able to retrieve biographical information about the person, yet experience a non-FOK. An everyday example would be when you are asked a newsreaders name; you find the face highly familiar and you can recall semantic information about the person, yet, you know you do not know the name. This ability to recall strong semantic information and find the face highly familiar, only led to a FOK 63% of the time.

This study has provided some support for both theories; the cue-familiarity hypothesis and the target-accessibility hypothesis, but has shown that neither theories alone can account for the basis of all FOKs. This study has provided general support for the cue-familiarity theory for the basis of the FOK for names of faces, and supports other existing research into FOKs for names of faces (Hosey et al., 2009), by demonstrating that as cue-familiarity increases so does the occurrence of FOKs. However, the finding that non-FOKs occur even when familiarity is high is problematic for the cue-familiarity theory and suggests that familiarity alone cannot account for all FOKs. The study has shown that cue-familiarity also has an effect on participant's accuracy on a recognition test; suggesting that FOKs with moderate to high levels of cue-familiarity are better predictors of subsequent recognition. This study has found that retrieving semantic information will increase the amount of FOKs reported, which is consistent with the target-accessibility hypothesis. However, there was no significant increase in number of FOKs reported when level of semantic retrieval increased from weak to strong (when FOKs were considered as a separate phenomenon to TOTs), and this is inconsistent with the target-accessibility hypothesis. Furthermore, non-FOKs still arose when participants could recall a strong amount of semantic information; this is problematic for the target-accessibility hypothesis. Therefore, although this study has provided some support for both theories, neither theory can account solely for the basis of the FOK. A combination of both theories (dual-hypothesis) also does not provide a sufficient account. Therefore, it can be speculated that there is something more to a FOK than merely a feeling of familiarity or the ability to recall semantic information.

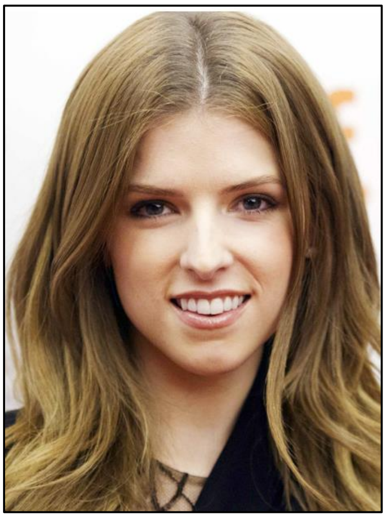
Appendix

Sample Materials

Materials for the recall phase:



Materials for the recognition phase:



Anne Hathaway
Blake Lively
Anna Kendrick
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Ray Romano
Will Ferrell
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Kate Winslet
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