

THE INFLUENCE OF RECOLLECTION-DRIVEN FACTORS
ON THE MAGNITUDE OF FEELING-OF-KNOWING JUDGMENTS:
A NON-CRITERIAL RECOLLECTION PERSPECTIVE

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DECLARATION OF ORIGINALITY

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ABSTRACT

The Influence of Recollection-Driven Factors on the Magnitude of Feeling-of-Knowing Judgments: A Non-Criterial Recollection Perspective

In the last decade, non-criterial recollection (NCR) hypothesis (Brewer, Marsh, Clark-Foos, & Meeks, 2010) extended the accessibility account (Koriat, 1993) and demonstrated that in addition to retrieval of target-related partial information, retrieval of contextual information can also increase FOK judgments. However, contrary to accessibility account, NCR hypothesis argued that correct retrieval led to higher FOK compared to incorrect retrieval. The present thesis further tested the NCR account by investigating how presence and accuracy of a memory about the semantic relationship between cue and target words impact FOK. Participants studied a list made up of strongly associated (e.g., PROTEIN-MEAT), weakly associated (e.g., PROTEIN-NUTRIENT) and unrelated cue-target pairs (e.g., PROTEIN-BRUSH). Following the FOK phase, they reported the cue-target association strength or gave “don’t know” response when they did not remember it. They indicated their recollective experience after recognition by choosing either the Remember, Know, or Guess options. As we expected, participants gave higher FOK ratings when they also reported the nature of the cue-target relationship instead of “don’t know”. There was no difference between FOKs of correct and incorrect retrievals, in line with expectations drawn from the accessibility account. Further analyses revealed an interaction between the association strength and recollective experience, which affected FOK magnitude. Implications of the results are discussed to suggest that the FOK might be a product of simultaneous and interactive trade-off between recollective experience and other stimuli-related factors.

ÖZET

Hatırlamaya Dayalı Etkenlerin Bilme Hissi Büyüklüğüne Etkileri:

Ölçüt-Dışı Hatırlama Perspektifiyle

Son on yıl içinde, “Ölçüt-Dışı Hatırlama Hipotezi” (ÖDH) Bilme Hissinin (BH) “Hedef Ulaşılabilirliği” (HU) modelini genişleterek, sadece hedef kelime ile bağlantılı bilgiyi değil, bağlantısız bilgiyi hatırlamanın da BH’ni arttırdığını göstermiştir (Brewer, Marsh, Clark-Foos, & Meeks, 2010). Ancak HU modelinden farklı olarak doğru hatırlamanın yanı sıra daha fazla artırıcı etkisi olduğunu öne sürmüştür. Bu tezin amacı, ipucu-hedef kelimeler arasındaki anlamsal ilişkiye dair bir hatırlamanın varlığı ile doğruluğunu ayırıştırarak, ÖDH hipotezini test etmektir. Katılımcılar güçlü ilişkili (örn., PROTEİN-ET), zayıf ilişkili (örn., PROTEİN-BESİN) ve ilişkisiz (örn., PROTEİN-FIRÇA) kelime çiftlerinden oluşan bir liste çalıştılar. BH yargısını takiben kelime çiftinin ilişki gücünü veya hatırlayamadıklarında “bilmiyorum” cevabını belirtmelerini istedik. Hedef tanıma aşamasından sonra yapılan Hatırlama Deneyimi (HD) testinde ise hedef sözcükleri hatırlama (H) tipinde mi, bilme (B) tipinde mi yoksa tahminen (T) mi tanıdıklarını belirttiler. Beklediğimiz gibi, katılımcılar ipucu ile hedef sözcük arasında bir ilişki olduğunu belirttiklerinde, bu ilişkinin doğruluğundan bağımsız olarak, daha yüksek BH değerleri verdiler. Ayrıca doğru ve yanlış hatırlamaya ait BH yargıları arasında fark olmaması HU modelini desteklemiştir. Ek analizler kelime çiftinin ilişki gücü ile HD tipi arasında etkileşim olduğunu göstermiştir. Sonuçlar üzerinden yapılan çıkarımlar tartışılmış ve BH’nin, HD ile diğer uyaran-bağlantılı etkenler arasındaki eşzamanlı ve interaktif bir ödünleşimin ürünü olabileceği önerilmiştir.

To Ekin...

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CHAPTER 1

INTRODUCTION

It is well known that the attempt to retrieve a specific piece of information triggers the recollection of other contextual information either related or unrelated to that information (Thomas, Lee, & Hughes, 2016; Yonelinas & Jacoby, 1996). These retrieval processes have also been shown to drive feeling-of-knowing (FOK) judgments (Koriat, 1993; Thomas, Bulevich, & Dubois, 2012) in which individuals evaluate their likelihood of successful recognition of an item, despite immediate failure to recall it. A dominant view argues that recollection of target-related partial information determines the magnitude of FOK judgments (Koriat, 1993). A more recent line of research, supporting the non-criterial recollection view, has demonstrated that non-target related contextual information also increased FOK judgments (Brewer, Marsh, Clark-Foos, & Meeks, 2010; Hertzog, Fulton, Sinclair, & Dunlosky, 2014; Schwartz, Pillot, & Bacon, 2014). The goal of the present study was to further test the non-criterial recollection hypothesis by investigating whether the semantic relationship between the cue and the target could create a richer “context” to foster FOK judgments. To test this idea, we examined if the presence and accuracy of the memory for cue-target relationship increase FOK magnitude.

Feeling of knowing judgments have most commonly been investigated by the episodic recall-judgment-recognition (RJR) paradigm (Hart, 1965; 1966; 1967), to which some methodological changes were introduced in time (e.g., for a review see Schwartz, Boduroglu & Tekcan, 2016). In this paradigm, FOK ratings are collected after a typical cued-recall phase, during which participants judge whether they would

be able to recognize the target if it was presented along with some alternatives.¹ Then, participants complete a recognition phase. By comparing FOK judgments and recognition performance, researchers determine the extent of the concordance between the FOK judgments and the actual recognition performance. To delineate the underlying mechanisms driving FOK judgments, researchers have studied both FOK accuracy and magnitude. Most models explained FOK judgments by inferential mechanisms that are based on the familiarity of the cue (Metcalf, Schwartz, & Joaquim, 1993; Reder, 1987; Schwartz & Metcalfe, 1992) or the recollected partial information about the non-retrieved target (Koriat, 1993). Hybrid models integrating these views have suggested that only when the cue familiarity is sufficiently high to drive the memory search, access to target related partial information can affect FOK magnitude (Benjamin, 2001; Hosey, Peynircioğlu, & Rabinovitz, 2009; Jemstedt, Schwartz, & Jönsson, 2017; Koriat & Levy-Sadot, 2001). A more recent account called the “non-criterial recollection hypothesis” extended Koriat’s target-accessibility model and argued that recollection of peripheral contextual information at retrieval also resulted in increases in FOK ratings (Brewer et al., 2010; Schwartz et al., 2014; Thomas, Bulevich, & Dubois, 2012). Contextual information was either source information about the original encoding context (e.g., the background picture or a visual detail) or features about the pair or the target “relating in any way to the target, but not actually referring to it” (Schwartz et al., 2014, p. 97) (e.g., mentally created images binding cue and target or extra information about imaginary animals; see Hanczakowski, Zawadzka and Macken; 2017; Hertzog et al., 2014; Schwartz et al., 2014).

¹ More recent studies collected FOK for all items (e.g., Boduroglu, Pehlivanoglu, Tekcan, & Kapucu, 2015; Boduroglu, Tekcan, & Kapucu, 2014; Schwartz et al., 2015; Thomas et al., 2012). This procedure, excluding the effect of recall, ensured that retrieval only could be the sole determinant of FOK (Schwartz et al., 2015).

In their study, Brewer et al. (2010) required participants to study either line drawings or colored pictures presented along with the voice of a male or female speaker reading the label of each picture. Participants were instructed to pay attention to whether the picture was a line drawing or whether it was in color, with no specific emphasis regarding the speaker's voice, creating an impression that it was irrelevant for the future memory task. However, in the test phase, participants were asked both about the sex of the voice associated with each label and whether the picture was a line drawing or a colored one. The results showed that FOK for the speaker's sex was higher when the picture dimension was correctly recalled. This study was first to demonstrate the impact of episode-related contextual information on FOK judgments.

Brewer et al. (2010) specifically measured accessibility in their Experiment 1B by adding a "don't know" option to the context information question about the picture. They argued that the "don't know" option allowed for a stronger test of the model by helping to conceptually dissociate the presence of a memory about the context and the accuracy of it. In their results, like Koriat's target-accessibility account (1993) which showed lowest FOK when no partial information was retrieved, they found that FOK for the speaker's sex was lowest when participants had no memory for the picture dimension. However, contrary to Koriat's findings (1993, 1995), accuracy of the retrieved context still mattered as there were significant differences between FOKs for trials in which context were either correctly or incorrectly retrieved after excluding "don't know" trials. Thus, in their seminal study, both the presence of a memory about the non-criterial context and its accuracy modulated FOK magnitude.

In additional studies supporting the non-criterial recollection, however, the presence and accuracy of a memory about contextual information has not been dissociated. Hertzog and colleagues (2014) asked participants to use interactive imagery to encode unrelated word pairs. Participants orally described the mediator they produced immediately after studying each pair. After a seven-day delay, they were asked to report anything they remembered about the mediator following the FOK phase. Results showed that when the mediator was partially reported or its gist was reported or when the exact verbatim report was retrieved, all these levels of strategy recall were associated with higher FOKs compared to incorrect strategy recall with omission and commission errors. This finding supported Brewer et al.'s (2010) findings demonstrating that both the strategy retrieval and its accuracy led to higher FOKs. However, omission and commission errors were combined preventing the dissociation between incorrect response and no response trials. Excluding the trials in which participants had no memory about the strategy might help clarifying FOK differences between correct retrieval, incorrect retrieval and no-retrieval conditions.

Similarly, Thomas et al. (2012) found higher FOK for the accurate retrieval of conceptual information compared to inaccurate retrieval of it without dissociating the no-response trials and incorrect response trials. Thomas et al. (2012) asked participants whether the cue and target were in the same category and whether the font of the target was same as the cue word. Mainly focusing on the accuracy of the retrieved information, they found that accuracy mattered for the conceptual information but not for the perceptual (font) information. However, the context information retrieval phase about the cue-target relationship involved only “yes” and “no” options as a response. The participants did not have a “don’t know” choice

which could help dissociating the presence of a memory of the context and the accuracy of it. A binary evaluation of the retrieval process of a participant like “there is an accurate memory about the context” vs. “there is no accurate memory about the context”; might have restricted the evaluation of the retrieval process. Adding the “abstain” response as Koriat (1993) did for the target-related partial information question or as Brewer et al. (2010) did for the context information might provide further support for non-criterial recollection hypothesis including its accuracy component.

Within the non-criterial recollection framework, Brewer et al. (2010) also emphasized the association between recollection qualified by “Remembering” (R) and FOK magnitude. They specifically suggested that subjective awareness of remembering something specific to an episode increased FOK more than a general sense of knowing. FOK was higher when participants reported remembering the picture dimension than when it was reported as knowing it. R-FOK relationship was also found for recollective experience associated with target recognition. Isingrini et al. (2016) demonstrated that conscious recollection of the target when prompted with cue right after the FOK phase led to higher FOK compared to familiarity and no memory conditions. They showed that FOK incrementally elevated between “no memory”, “know” (K) and “remember” (R) responses respectively. Based on the dual-process model (Gardiner, 1988), recollective experience was also suggested to interact with the quality of original encoding (Boduroglu et al., 2015; Nelson, Leonesio, Shimamura, Landwehr, & Narens, 1982; Sacher, Isingrini, & Tacconnat, 2013). For example, Boduroglu et al. (2015) showed that FOK magnitude was significantly correlated with R responses only in the self-referencing condition, in which participants encoded cue-target pairs by relating the pair to themselves, but

not in a control condition. Thus, we may suggest that stimuli-related properties that affect the processing of the pairs might affect FOK distinctively depending on whether the target elicited recollection, familiarity or guessing.

Based on these findings, we wanted to further test the non-criterial recollection hypothesis both in terms of context information retrieval, accuracy and recollective experience. We sought to observe if, and if so how FOK is modulated by the report of a memory for the context information and the accuracy of this information. Regarding R-FOK relationship, we aimed to determine if conscious recollection (R) during the target recognition phase would elicit higher FOK and if it would interact with stimuli-inherent properties to affect FOK.

To accomplish these goals, participants studied lists that were comprised of strongly associated, weakly associated and unrelated word pairs for a cued-recall test. Then, they first provided FOK ratings for all cues. This was followed by a forced-choice recognition task, in which they had to pick the correct target from among 4 choices and provide additional remember (R), know (K) or guess (G) judgments for their choices. Afterwards, we asked participants to recall the strength of the relationship between the cue and target. We asked them whether the cue and target were strongly associated, weakly associated, unrelated with an additional “don’t know” option. Based on the non-criterial recollection hypothesis (Brewer et al., 2010), we expected FOK ratings to be higher for the pairs for which participants identified some type of a present or absent relationship compared to those given “don’t know” responses, regardless of whether the relationship was identified correctly or incorrectly. Additionally, we predicted correct compared to incorrect context retrieval to lead to higher FOK from within the trials assigned a type of relationship (excluding “don’t know” responses). Regarding the recollective

experience, similar to Isingrini et al. (2016) we expected an incremental FOK pattern between G, K and R reports. We also expected FOK judgments associated with familiarity (K) to be greater in the strong pairs because strong targets could have higher processing fluency (Rajaram, 2000) given that they have higher word frequency.

CHAPTER 2

METHOD

2.1 Participants

Eighty-one Boğaziçi University undergraduates enrolled in “Introduction to Psychology” and “Social Psychology” courses took part in the study on a voluntary basis. They were given 1 credit added to their final course grades in exchange for their participation.

2.2 Materials

All words used to construct cue-target word pair lists were chosen from the association set database consisting of 600 Turkish words (Tekcan & Göz, 2005). This association norm set was created by asking 900 participants to write the first word that came to mind that was meaningfully related or strongly associated with each word. The associative set size was determined by the total of unique responses generated to cues. Concreteness, imagery, and frequency scores were also taken from this database whenever they were available.²

We first identified all possible cue words from the database, having medium set size (25-30) and medium frequency levels (22-92). There were a total of 57 words that were moderately imaginable and concrete, with mean imagery and concreteness ratings of 4.78 (1.33), and 5.23 (1.61), respectively, on a 7-point scale. Mean frequency level of the cue words was 59.14 ($SD = 20.69$; see Appendix A). Then, we identified strongly associated, weakly associated and unrelated targets to each one of these cues from the available association norms (Appendix B). We used

² Imagery and concreteness scores were not available for 100 words.

the proportion of participants giving the associate response as an indicator of the cue-target strength. We used first associates of the cues as strong targets with the constraint that the difference between the first and second associate was at most 25% so that the first associate was not the obvious answer (e.g., CALL-PHONE). Associates produced by at least 2% and at most by 4% of the participants were taken as weak targets. Other words from the database having medium set size (10-13) and medium frequency (22-92) were pseudo-randomly paired with cue to create the unrelated pairs.³ We used the same unrelated targets in each list to minimize word variety.

We created three lists of 57 pairs in which the same cues were associated with different targets (Appendix C). In each list, 19 of the cues were paired with their strong associates, 19 with their weak associates and 19 with unrelated associates. In the second list, the 19 cues that were previously paired with strong associates, were now paired with weak associates, and in the third list, with unrelated associates. Thus, the lists were constructed in such a way that each cue was paired with each type of associate across different lists. For instance, ATIK (WASTE) was paired with ÇÖP (TRASH) (strong associate) in one list, with LAĞIM (SEWER) (weak associate) in the other list and with BİLEK (WRIST) (unrelated) in the third list.

In order to control inherent properties of stimuli and to eliminate any differences between the lists, we performed an extensive pilot study. We collected imagery and concreteness scores of the targets that were missing in the database we used (Appendix D). Moreover, we asked participants to rate the imagery and concreteness of cue and target together as a pair (Appendix E). Based on our analyses, we equated the three lists in terms of target frequency, target imagery,

³ Only items produced by two or more subjects were counted as a member of the set (Nelson & McEvoy, 1978)

target concreteness, pair imagery and pair concreteness. The final target frequency scores for the lists were 59.63 (16.24) for List 1, 62.42 (14.97) for List 2 and 60.74 (16.37) for List 3. For the finalized list, the pair imagery scores were 5.07 (1.47) for List 1, 4.94 (1.45) for List 2 and 5.25 (1.43) for List 3, and the pair concreteness scores per lists were 5.41 (1.90), 5.14 (1.93) and 5.57 (1.88) respectively. We additionally tested the same measures in function of cue-target association strength. We found higher word frequency for targets of strong pairs (e.g., Nelson & McEvoy, 2000; Rubin & Friendly, 1986) and higher pair imagery and pair concreteness scores for strong and weak pairs compared to unrelated pairs (e.g., Paivio, 1965; Day & Bellezza, 1983; Marshark & Hunt, 1989). See Table 1 for descriptives. These differences were consistent with the literature and were inherent properties of our stimuli.

Table 1. Imagery and Concreteness Scores Across Association Types

	Imagery		Concreteness	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Strong pairs	5.61	0.87	5.14	1.57
Weak pairs	5.31	0.83	4.90	1.63
Unrelated pairs	3.30	0.76	4.28	0.98

2.3 Procedure

Each participant was tested individually on a standard personal computer via E-prime software (Psychology Software Tools, Pittsburgh, PA, USA). The episodic FOK procedure, which consists of encoding, retention interval, cued recall, FOK rating, recognition test was used in the experiment. For each response pick participants were asked to make a R/K/G judgment (see Figure 1 for procedure).

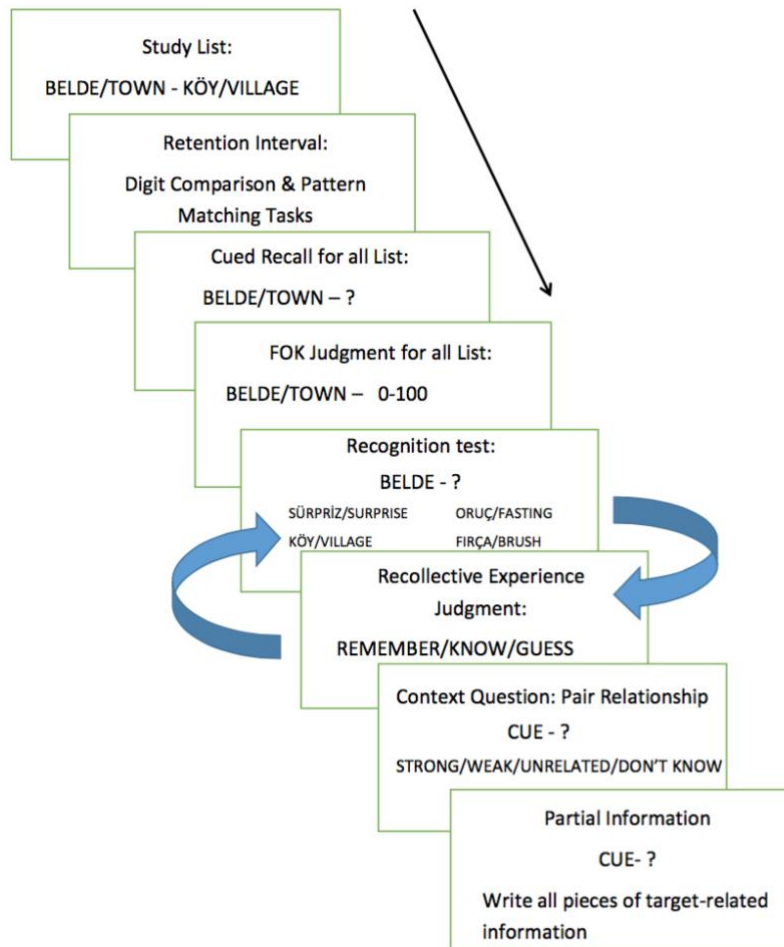


Fig. 1 Procedure of the experiment

In the beginning of the study, participants were randomly assigned to one of the three study lists which were visually presented with 57 word pairs, at a rate of 5 seconds per item. All participants studied 19 strongly associated, 19 weakly associated and 19 unrelated word pairs, randomly intermixed. The order within the lists were same for all participants. After the encoding phase, there was a 10-minute retention interval to prevent recency and minimize possible ceiling effects. During this period participants completed the Digit Comparison and Pattern Matching tasks. Then, we presented participants with the cue words of each study pair and asked them to report the corresponding target word. At the end of the cued recall phase, participants were asked to report for all cues their likelihood of recognizing the target in a subsequent multiple-choice test using a 0 - 100 Likert scale. Participants were instructed to use

the scale as evenly as possible. Subsequently, participants received a four-choice recognition test. The four choices consisted of the actual target word, another target word paired earlier with another cue during study, another cue from the study list and a totally novel lure. For the novel lures, we additionally assigned 57 words with medium frequency (22-92) and medium set size (10-15).⁴ In the recognition test, participants also indicated their subjective state of awareness accompanying that recognition by clicking on either the REMEMBER, KNOW or GUESS options on the screen right after recognition response of each pair. Based on Gardiner's (1988) study, participants were informed to give the REMEMBER response only if they were sure that they saw the word in the study phase and remember some aspects of what they experienced during the study phase (e.g., aspects of the physical appearance of the word, or of something that happened in the room, or of what one was thinking or doing at that time). They were instructed to select the KNOW option if they were sure that they had previously encountered the word but could not remember any specific details about it. To "decontaminate" the KNOW option from guess responses (e.g., Gardiner, Java, & Richardson-Klavehn, 1996; Mungan, Peynircioglu, & Halpern, 2011), we also presented participants with a GUESS option.

After the recognition phase, we asked participants whether they remembered the strength of the relationship between the cue and target. The existence of such a manipulation was not mentioned at any time in the experiment. For each cue they were asked to recall whether their previously paired targets were strongly, weakly, or not associated to the cues. In addition, they were given a "don't know" option. Finally, we asked participants to write all pieces of target-related information that

⁴ Again, only items produced by two or more subjects were counted as a member of the set (Nelson & McEvoy, 1978).

comes to their mind presenting them again with the cues. In the instructions, we gave them some examples of partial information such as the first letter, the number of syllables or any word associated with the target word. The total duration of the experiment was approximately 60 minutes.

CHAPTER 3

RESULTS

For each participant, we separately calculated memory accuracy (cued recall, recognition), FOK magnitude, FOK accuracy (gamma calculations), and the % of Remember, Know, Guess judgments.⁵ For the associate response, we computed the total number of trials that participants retrieved correct, incorrect and no context information (don't know) separately for the strong, weak, and unrelated pairs.⁶ In addition, we computed the mean FOK magnitude as a function of both the R/K/G judgments and the Correct/Wrong/Don't Know responses

We excluded data from two participants because they misunderstood the task and gave the same response in all trials. Additionally, three participants from the remaining 79 were found to be outliers based on z-scores with -3/+3 range criteria, one in terms of mean FOK ratings, one for recognition accuracy and another for relationship accuracy. Analyses were carried out on data from the remaining 76 participants. We present our findings in 3 sections. We first describe the impact of the association strength on memory measures. In the second section, we discuss the predictions drawn from the non-criterial recollection approach and the in the final third section, we discuss findings regarding the interaction between recollective experience and association strength.

⁵ We chose to use median while computing the central tendency of the FOK ratings because the trial number for unrecalled items was different for Strong, Weak, Unrelated pairs and recalled items were mostly rated as 100.

⁶ For the percentage of recall and recognition accuracy, we counted blank responses as incorrect because our main interest was whether the target word was retrieved or not. Similarly, we computed the percentage of Remember, Know and Guess reports based on total trial numbers.

3.1 The impact of association strength on memory measures

As can be seen in Table 2, unrelated cue-target pairs were recalled less, recognized less, and guessed more than strong and weak pairs. However, there was no difference between strong and weak pairs except in the recall task.

Table 2. Memory and Metamemory Measures Across Association Types

	Strong Mean (SD)	Weak Mean (SD)	Unrelated Mean (SD)	<i>F</i>	<i>p</i>	η_p^2
Memory Measures						
Recall (%)	0.69 (0.19) ^{a,b}	0.58 (0.21) ^{a,c}	0.34 (0.20) ^{b,c}	173.01	0.00*	0.70
Recognition (%)	0.95 (0.07) ^b	0.94 (0.08) ^c	0.80 (0.18) ^{b,c}	59.63	0.00*	0.44
Cond. recognition (%) ⁷	0.89 (0.19) ^b	0.90 (0.15) ^c	0.74 (0.20) ^{b,c}	28.73	0.00*	0.28
Metamemory Measures						
FOK magnitude	85.88 (23.06) ^b	79.04 (28.77) ^c	57.86 (32.96) ^{b,c}	41.41	0.00*	0.36
Correctly recalled	98.08 (6.80) ^b	97.66 (5.60) ^c	88.60 (23.51) ^{b,c}	12.87	0.00*	0.15
Incorrect	41.24 (27.90)	46.07 (26.69) ^c	39.99 (26.69) ^c	3.69	0.03*	0.05
Correctly recognized	89.63 (18.90) ^{a,b}	80.96 (28.04) ^{a,c}	62.82 (34.10) ^{b,c}	31.30	0.00*	0.29
Recollective Experience for All Trials						
Remember (%)	0.48 (0.24) ^b	0.45 (0.23)	0.39 (0.25) ^b	5.23	0.01*	0.07
Know (%)	0.25 (0.22)	0.26 (0.21)	0.21 (0.17)	2.02	0.14	0.03
Guess (%)	0.14 (0.12) ^b	0.17 (0.16) ^c	0.27 (0.22) ^{b,c}	30.43	0.00*	0.29
Recollective Experience for Correctly Recognized Trials only						
Remember (%)	0.50 (0.25)	0.47 (0.24)	0.45 (0.24)	1.57	0.21	0.02
Know (%)	0.26 (0.23)	0.26 (0.22)	0.25 (0.19)	0.14	0.87	0.00
Guess (%)	0.12 (0.12) ^b	0.14 (0.13)	0.18 (0.17) ^b	6.86	0.00*	0.08

Notes. Significant findings are indicated with *. Bonferroni correction is applied for multiple comparisons. Pairwise differences are shown with a: strong-weak, b: strong-unrelated, c: weak-unrelated.

3.2 Context retrieval, accuracy and recollective experience

First, to determine if there was a relationship between the strength of the cue-target association and FOK ratings, we first compared FOK magnitude across strong, weak, and unrelated pairs for unrecalled trials. We focused on the FOK ratings given for unrecalled targets, because FOK ratings given to recalled targets are driven by a recall-based strategy as opposed to an inferential one (Schwartz et al., 2016). We

⁷ Average unrecalled trial numbers were 26 (10) in total with 6 (4) strongly related, 8 (4) weakly related, and 13 (4) unrelated pairs.

found that participants gave significantly higher FOK ratings for weak pairs compared to unrelated pairs, although with a very low effect size, .05. ($p < .05$, see Table 2). There was no difference in FOK between weak and strong pairs.

To test the non-criterial recollection hypothesis, we checked whether presence of a memory about the contextual association (i.e. the cue-target relationship) elicited higher FOK compared to no memory condition (don't know). We found that whenever participants identified the context regardless of whether it was correct ($M = 47.49$, $SD = 21.15$) or incorrect ($M = 47.95$, $SD = 21.62$), they gave higher FOK ratings than when they reported that they did not have any memory about the nature of the cue-target relationship ($M = 34.58$, $SD = 22.67$), [$F(2, 132) = 24.89$, $MSE = 154.97$, $p < .001$, $\eta_p^2 = .27$]. This suggests that participants were utilizing non-criterial context information to a certain degree. We wanted to see whether the difference observed in FOK ratings between weak and unrelated pairs were driven by disproportionate amounts of context information reported for weak compared to unrelated pair conditions. Consistent with our expectation, we found that participants reported more context information for weak ($M = .74$, $SD = .27$) compared to unrelated pairs ($M = .63$, $SD = .28$), [$F(2, 146) = 7.42$, $MSE = .032$, $p < .01$, $\eta_p^2 = .09$].⁸ Contrary to predictions drawn from the non-criterial recollection account, correct context retrieval ($M = 47.49$, $SD = 21.15$) and incorrect context retrieval ($M = 47.95$, $SD = 21.62$) did not differ from each other ($p > .05$). Only trials given "don't know" responses ($M = 34.58$, $SD = 22.67$) were assigned significantly lower FOK compared to both correct and incorrect context retrievals [$F(2, 132) =$

⁸ Across all 3 association types of pairs approximately similar amounts of partial information was reported. Proportion of total partial information did not correlate with FOK ($p > .05$). These results were not surprising because partial information phase was the 5th retrieval phase after recall, FOK, recognition, context retrieval respectively. Additionally, because 38 of the 57 studied pairs were related to each other, participants mostly produced targets related to the cue. See Appendix F for partial information percentages across association types.

24.89, $MSE = 154.97$, $p < .001$, $\eta_p^2 = .27$]. However, when we counted “don’t know” responses as incorrect, similar to studies without “don’t know” or “no memory” options (e.g., Thomas et al., 2012), within-subjects t-test showed a significant difference between FOKs of correct ($M = 48.97$, $SD = 21.30$) and incorrect ($M = 41.85$, $SD = 21.00$) context retrieval, $t(73) = 4.07$, $p = .00$, $r = .75$.

In line with our expectations from a non-criterial recollection perspective, higher FOK ratings were associated with R responses. Participants assigned higher FOK to the pairs given Remember judgments ($M = 57.25$, $SD = 23.92$) compared to those given Know judgments ($M = 48.33$, $SD = 23.76$) and Guess judgments ($M = 35.17$, $SD = 22.09$), [$F(2, 124) = 26.78$, $MSE = 290.26$, $p < .001$, $\eta_p^2 = .30$]. FOK ratings for pairs reported to be familiar (K) were also higher than the FOK ratings for guessed targets (all $ps < .05$).⁹

3.3 Recollective experience and association strength interaction

Based on the dual-process models of recognition (Yonelinas, 2002), we expected an interaction between the cue-target association strength and the recollective experience. Because of higher word frequency and processing fluency (Rajaram, 2000), targets from strong compared to weak and unrelated cue-target pairs recognized as familiar (K) were expected to elicit higher FOK magnitude. Analyses revealed the expected interaction in two ways. FOK ratings of the “remembered” targets were found to be significantly higher when they were members of strong and weak pairs compared to unrelated pairs ($ps < .01$, see Table 3).¹⁰ Secondly, FOK

⁹ Analysis included only unrecalled trials but results were same when repeated with all trials.

¹⁰ Mean trial number per association type was 8.77 (4.25) for R, 5.59 (3.57) for K and 4.78 (3.00) for G. Participants having zero trial in any of the 3 association conditions were excluded from the analyses. Sample size was 71, 55, and 52 respectively for R, K, and G analyses.

ratings of K targets were higher for strong pairs compared to weak and unrelated pairs ($ps > .01$).

Table 3. Mean FOK Ratings as a Function of Recollective Experience (all trials)

	Strong	Weak	Unrelated	<i>F</i>	<i>p</i>	η_p^2
	Mean (SD)	Mean (SD)	Mean (SD)			
Recollective Experience						
FOK of Remember	86.37 (13.93) ^b	83.92 (13.82) ^c	71.33 (24.21) ^{b,c}	23.65	0.00	.25
FOK of Know	68.77 (25.57) ^{a,b}	60.85 (26.94) ^a	53.47 (27.32) ^b	9.90	0.00	.16
FOK of Guess	35.81 (25.99)	35.53 (24.68)	33.24 (21.38)	0.66	0.52	.01

Notes. Significant findings are indicated with *. Bonferroni correction is applied for multiple comparisons. Pairwise differences are shown with a: strong-weak, b: strong-unrelated, c: weak-unrelated.

CHAPTER 4

DISCUSSION

In this study, to our knowledge, we were the first to investigate how recollection-driven factors impact FOK judgments, by integrating predictions drawn from the non-criterial recollection hypothesis and dual-process models of recognition. Our results supported the non-criterial recollection hypothesis by demonstrating a relationship between FOK magnitude both the presence of a memory about context information and recollection-based recognition. FOK magnitude was higher when participants reported greater recollection and having memory about the strength of association, regardless of its accuracy. We will explain this fact shortly. Contrary to claims from the non-criterial recollection hypothesis, the correct and incorrect retrieval of the cue-target relationship contributed to FOK magnitude. This finding is partially in line with the target-accessibility account that argue that both correct and incorrect target-related clues can equally contribute to FOK judgments (Koriat & Levy-Sadot, 2001). We also showed that there was an interaction between cue-target associative strength and recollective experience. FOK for targets of strongly associated pairs was higher only when the target recognition was associated with a Know (K) response. Overall, our findings supported previous propositions that recollection (R) is the most powerful modulating factor of FOK (Koriat, 1993; 1995) regardless of the recollected information's source or accuracy. More critically, we demonstrated that recollection might interact with other variables such as stimuli-related properties or context retrieval accuracy to impact FOK ratings.

We primarily emphasized the existence of any recollection about the context information, contrasting it with the absence of it. For the sake of clarity, we

purposefully conceptualized the presence/absence of context information and the accuracy of this information separately. In support of the non-criterial recollection hypothesis, we specifically found that when participants reported the cue-target relationship to be either strong, weak, or unrelated, they assigned higher FOK ratings compared to when they reported not remembering the context. However, contrary to Brewer et al. (2010)'s findings, correct context retrieval did not increase FOK more than incorrect retrieval. When "don't know" responses were excluded, there was no difference between the FOK responses for trials in which the context was correctly or incorrectly identified. This finding is partially in line with what has been argued by Koriat (1993) in his target accessibility model. Koriat (1993) found that both correct and incorrect partial information retrieval elicited higher FOK compared to the abstain condition, similarly he found no difference between FOK for trials in which correct and incorrect partial information was retrieved. Our findings suggest that a combination of these two accounts may be better at explaining FOK judgments: the non-criterial recollection emphasizing the importance of information indirectly associated with the target and the target-accessibility model stating that retrieved information does not have to be fully accurate to increase FOK ratings.

It is noteworthy to mention that our accuracy findings supporting Koriat's studies might also be driven by the quality of the context information.

Conceptualized as "context information", cue-target association strength partly refers the target word and might have provided clues about target word. In contrast, Brewer et al.'s picture information might not provide clues regarding the gender of the voice because these two pieces of information are independent with the former piece of information being visual and the latter being auditory. Thus, it is possible that the context information in the present study may be more similar to Koriat's partial

information than the contextual information in Brewer's study. Koriat defined partial information as any "clues including fragments of the target, semantic attributes, episodic information pertaining to the target, and activations emanating from other sources." (Koriat, 1995, p. 312).

Our further analysis on accuracy showed that when "don't know" reports were considered as incorrect, FOK of correct context retrieval was significantly higher than FOK of incorrect context retrieval. Thus, we may suggest that when omission and commission errors are combined, accuracy modulated FOK as found in some studies (Thomas et al., 2012; Hertzog et al., 2014). Nevertheless, some studies providing "don't know" or "abstain" options after either the context (Brewer et al., 2010) or partial information question (Thomas, Bulevich, & Dubois, 2011; Norman, Blakstad, Johnsen, Martinsen, & Price, 2016) still found accuracy to affect FOK. Contradicting Koriat's findings, Thomas et al. (2011) demonstrated that when the retrieval phase followed FOK judgments instead of preceding it, correct target-valence retrieval resulted in higher FOK compared to incorrect retrieval and incorrect retrieval resulted in higher FOK than no-retrieval condition. Their results were in line with Brewer et al.'s (2010) findings. A recent study (Norman et al., 2016) similarly collected open-ended partial information about general knowledge questions following the FOK phase. After excluding the trials in which participants gave no information about the target, they demonstrated that the effect of accuracy on FOK depended on the amount of partial information reported. While report of one piece of incorrect partial information increased FOK as much as the correct ones, the report of 2 or 3 pieces of incorrect partial information did not lead to any further increase in FOK ratings, suggesting that incorrect and correct partial information may have different impact on FOK.

In our study, we suggest that these contradictory findings about the effect of accuracy of retrieved information on FOK might be driven by the overwriting effect of recollective experience. More specifically, regarding the context retrieval and recollective experience relationship, Brewer et al. (2010) had additionally showed that participants made higher FOK predictions when they later claimed that they remembered seeing the picture in color or as a line drawing even though they reported that they did not remember the original picture. Additionally, the reaction times to make a “don’t know” response were slower if they reported “remembering” the context information than “knowing” it. These additional findings suggest that the recollective experience of context information is another factor affecting FOK along with the presence of a memory about it. In other words, an incorrect context retrieval might elicit higher FOK if “remembered” (recollection) compared to a correct one which is “known” (familiarity). Our results of recollective experience seemed to endorse this inference even though we collected R, K, G judgments about the target after the recognition instead of relationship response.

Our suggestion may also be interpreted and endorsed with the terms of the metacognitive knowledge about the accuracy of the retrieved information. Koriat (2008) explained high FOK judgments being mostly accurate by proposing that people access correct rather than incorrect information from memory. However, Metcalfe and Eich (2019) recently conducted a series of experiments on hypercorrection and demonstrated that people somehow have privileged access to accuracy of information. Using the standard paradigm, they presented participants with general information questions and asked them to express their confidence in the correctness of their answers and gave true or false feedback. Participants hypercorrected their mistakes when they were given correct feedback after their high

confidence errors compared to low confidence errors. Correct responses when provided false feedback were not affected. The hypercorrection after the false feedback occurred only when it followed an error. Because the false feedback influenced their final response depending on their initial response accuracy, Metcalfe and Eich (2019) suggested that people somehow have privileged access to accuracy of information above and beyond their confidence ratings. At that point, the overwriting effect of the recollective experience on accuracy we found in this present study might be rooted in its being the source of this access. Conscious recollection (R) of information might potentially provide a privileged access to accuracy of information and the resolution of this access might be altered depending on the type of recollective experience, whether it was consciously recollected (R) or recognized by familiarity (K), or by guessing (G).

In support of the non-criterial recollection, we found recollection (R) to be associated with higher FOK compared to familiarity (K) and guessing (G). Secondly, in line with our expectation, we found an interaction between cue-target association strength and the type of recollective experience. Namely, strongly associated targets triggered higher FOK magnitude compared to both weak and unrelated targets when they were qualified by a “know” response. Conceptual fluency within the distinctiveness/fluency framework (Rajaram, 2000) may explain this finding. The distinctiveness/fluency processing framework suggests that “Remembering is said to be influenced by processing the distinctive properties of the material, and knowing is said to be influenced by the fluency with which materials are processed” (Rajaram, 2000, p. 1070). In Rajaram’s (2000) influential study, participants assigned significantly higher Know responses to targets when using a conceptual fluency manipulation such as priming with an associate instead of an unrelated word. In our

study, because strong pairs had high frequency target words and were more frequently processed together in daily life, leading to higher conceptual processing fluency (Björk, 1999), they may have been thus given higher FOK consequently.¹¹

The interaction between association strength and recollective experience also emerged in higher FOKs for remembered (R) strong and weak pairs compared to remembered (R) unrelated pairs. Distinctiveness/fluency framework may again explain this interaction by virtue of salience or distinctiveness of the cue-target pairs. Rajaram (1998) suggested that experience of remembering is more sensitive to salient and distinctive properties of the encoded stimuli. Manipulating the conceptual salience and perceptual distinctiveness of the stimuli separately, they found that due to its higher semantic frequency, dominant meaning of a homograph became more salient than non-dominant meaning and resulted in higher proportion of remember responses. Related pairs in the present experiment being more salient than unrelated pairs due to its higher semantic frequency might have facilitated the remembering (R) experience.

Evaluated together, these findings suggested that cue-target association may affect FOK magnitude indirectly via type of recollection. When some specific aspect of the encoding episode was recollected, the effect of association strength on FOK was overwritten and strong weak targets did not differ from each other. When the target seemed familiar without being associated to any specific recollection, the association strength modulated the FOK. For instance, a weak target may have

¹¹ Although semantically related, weak targets were produced given the cue word only with .02 to .04 probability. Therefore in contrast to minimum .60 probability that prime word elicits target word in Rajaram's (2000) study, weak pairs in the present study were much less frequently processed and had lower conceptual fluency.

induced higher FOK than a strong target when context information was recollected but lower FOK when context information induced familiarity only.

In the light of these findings, we suggest that recollection is the dominant component of FOK. Independent of being accurate or inaccurate, recollected context information can lead to higher FOK ratings. In previous studies with contradictory findings on accuracy, recollection as the main modulator of FOK might have altered FOK of correct and incorrect information retrieval. This suggestion might also explain findings suggesting that correct information retrieval leads to higher FOK if the to-be-remembered material has a meaningful/conceptual information but not a perceptual information (Thomas et al., 2011; 2012). This specific finding for the semantic information might have been derived from the differential encoding or processing of the conceptual material. Recollective experience, conceptual processing of the material, accuracy of the retrieved information might have simultaneous interaction that subsequently affected FOK magnitude differently compared to perceptual material.

All in all, our study is new in terms of combining Koriat's target-accessibility account and non-criterial recollection hypothesis. Based on our findings, we want to make a general proposition, which needs much further exploration. Because FOK is heavily based on the retrieval process, the recollective experience has a fundamental effect on FOK judgments. Recollection, Familiarity and Guessing experiences had decreasing correlations, respectively, with FOK ratings due to differences in the retrieval quality of context information, which might also be considered as partial information as described by Koriat (1995). Therefore, any additional factor such as accuracy of the partial information or the processing fluency/distinctiveness of the target might create a simultaneous and interactive trade-off with recollective

experience (R/K/G) and might constitute effects in varying weights on FOK magnitude. Similar to Judgment of Learning, which was shown to be affected by the combination of information from multiple cues, FOK is also suggested to be a product of integration from multiple heuristic factors (Undorf, Söllner, & Bröder, 2018). These factors seem to be combined in different weights depending on their relationship to the recollective experience.

APPENDIX A

CUE WORDS

Cue word	Set size	Frequency	Imagery	Concreteness
BELDE (<i>TOWN</i>)	28	24	3.71	5.35
PROTEİN (<i>PROTEIN</i>)	25	64	3.29	5.17
ÇAMAŞIR (<i>LAUNDRY</i>)	28	52	6.04	6.78
METAL (<i>METAL</i>)	30	87	5.32	6.51
SEÇMEN (<i>VOTER</i>)	26	52	4.82	6.20
VATAN (<i>HOMELAND</i>)	28	58	4.06	4.43
KRAL (<i>KING</i>)	28	78	5.51	5.33
ISLAK (<i>WET</i>)	28	50	5.25	5.91
İSHAL (<i>DIARRHEA</i>)	29	32	4.67	5.72
BORÇLU (<i>DEBTOR</i>)	30	32	3.08	4.32
ÇUKUR (<i>PIT</i>)	26	70	5.93	6.39
UZAY (<i>SPACE</i>)	29	62	4.89	4.64
GARSON (<i>WAITER</i>)	26	90	6.24	6.61
MİNDER (<i>CUSHION</i>)	26	24	6.31	6.86
ÖZLEM (<i>MISSING</i>)	29	73	3.17	1.64
HASAR (<i>DAMAGE</i>)	27	62	3.94	4.47
LÜKS (<i>LUXURY</i>)	30	91	3.88	2.89
MAKYAJ (<i>MAKE-UP</i>)	27	79	5.39	5.93
OT (<i>GRASS</i>)	25	70	6.29	6.79
HARİTA (<i>MAP</i>)	26	61	6.26	6.70
TAKSİT (<i>INSTALMENT</i>)	27	89	3.92	4.58
GÖMLEK (<i>SHIRT</i>)	30	73	6.64	6.89
FESTİVAL (<i>FESTIVAL</i>)	28	25	5.04	5.07
ÖZET (<i>SUMMARY</i>)	30	67	3.92	4.73
ESİR (<i>CAPTIVE</i>)	27	30	4.64	5.06
SAHİL (<i>SEASIDE</i>)	29	72	6.29	6.38
EŞEK (<i>DONKEY</i>)	30	52	6.40	6.80
SÜRPRİZ (<i>SURPRISE</i>)	28	49	3.43	2.71
ZEKA (<i>INTELLIGENCE</i>)	26	66	2.92	2.33
YAKIT (<i>FUEL</i>)	28	72	4.98	6.48
ELEŞTİRMEN (<i>COMMENTATOR</i>)	27	22	3.80	5.34
UĞULTU (<i>BLUSTER</i>)	30	23	3.56	4.77
ATOM (<i>ATOM</i>)	28	52	3.16	4.73
DRAM (<i>DRAMA</i>)	25	50	2.82	2.84
KİMYA (<i>CHEMISTRY</i>)	26	50	3.58	4.49
NESİL (<i>GENERATION</i>)	29	64	2.71	3.32

PİLAV (<i>PILAF</i>)	28	53	6.58	6.85
MUZ (<i>BANANA</i>)	25	67	6.73	6.92
PRENSİP (<i>PRINCIPLE</i>)	26	61	2.85	1.98
SEYİRCİ (<i>SPECTATOR</i>)	27	85	6.16	6.47
KÖPÜK (<i>BUBBLE</i>)	25	54	5.78	6.49
PALTO (<i>COAT</i>)	26	25	6.34	6.77
MOBİLYA (<i>FURNITURE</i>)	25	89	6.14	6.76
BİSİKLET (<i>BICYCLE</i>)	27	74	6.51	6.86
BARIŞ (<i>PEACE</i>)	28	67	3.43	2.44
TREN (<i>TRAIN</i>)	25	83	6.45	6.90
MORAL (<i>SPIRITS</i>)	28	55	3.08	1.84
MİRAS (<i>INHERITANCE</i>)	29	52	3.64	5.25
PASTA (<i>CAKE</i>)	28	79	6.48	6.77
REZALET (<i>SCANDAL</i>)	30	31	2.60	2.69
TAVUK (<i>CHICKEN</i>)	27	92	6.69	6.88
CENAZE (<i>FUNERAL</i>)	28	45	5.40	5.51
VALİ (<i>GOVERNOR</i>)	28	80	5.09	6.11
KORKUNÇ (<i>TERRIBLE</i>)	30	91	3.48	2.30
KARTON (<i>CARTON</i>)	30	22	5.46	6.77
FORMÜL (<i>FORMULA</i>)	29	50	4.08	4.58
ATIK (<i>WASTE</i>)	27	49	3.81	6.04

APPENDIX B

STRONG, WEAK, AND UNRELATED TARGET WORDS

Strong target	Frequency	Imagery	Concreteness
ÇÖP (<i>TRASH</i>)	126	6.08	6.37
BOMBA (<i>BOMB</i>)	50	6.00	6.34
KÖY (<i>VILLAGE</i>)	382	5.51	5.76
TEKERLEK (<i>WHEEL</i>)	41	6.38	6.62
ÖLÜM (<i>DEATH</i>)	392	3.56	2.34
MAKİNE (<i>MACHINE</i>)	239	6.04	6.50
DÜŞMEK (<i>FALLING</i>)	871	4.84	4.83
TİYATRO (<i>THEATRE</i>)	139	5.92	5.61
GAZETE (<i>NEWSPAPER</i>)	532	6.51	6.81
SAVAŞ (<i>WAR</i>)	334	5.01	4.71
SEMER (<i>SADDLE</i>)	1	4.38	6.42
EĞLENCE (<i>FUN</i>)	115	3.88	2.71
MATEMATİK (<i>MATHEMATICS</i>)	61	3.91	2.93
LOKANTA (<i>RESTAURANT</i>)	141	6.32	6.71
DÜĞME (<i>BUTTON</i>)	75	6.26	6.72
DÜNYA (<i>WORLD</i>)	69	5.83	5.76
DEPREM (<i>EARTHQUAKE</i>)	102	5.37	5.71
KURU (<i>DRY</i>)	67	4.03	5.38
TUVALET (<i>RESTROOM</i>)	54	6.18	6.58
KUTU (<i>BOX</i>)	126	6.27	6.84
DENEY (<i>EXPERIMENT</i>)	106	4.66	5.08
FİLM (<i>MOVIE</i>)	518	5.88	5.91
SABUN (<i>SOAP</i>)	30	6.38	6.79
KRALİÇE (<i>QUEEN</i>)	21	5.76	5.76
RUJ (<i>LIPSTICK</i>)	10	6.45	6.66
DEMİR (<i>IRON</i>)	135	5.50	6.77
RAHAT (<i>COMFY</i>)	206	3.32	2.57
PARA (<i>MONEY</i>)	1046	6.38	6.41
KOLTUK (<i>COUCH</i>)	219	6.38	6.67
KEYİF (<i>PLEASURE</i>)	159	3.39	2.04
MAYMUN (<i>MONKEY</i>)	33	6.70	6.76
GENÇLİK (<i>YOUTH</i>)	156	3.58	2.96
YEŞİL (<i>GREEN</i>)	204	6.04	5.11
KISA (<i>SHORT</i>)	457	3.86	4.25
HASRET (<i>YEARNING</i>)	37	2.49	1.87
SOĞUK (<i>COLD</i>)	240	4.98	5.43
TATLI (<i>SWEET</i>)	186	5.20	5.22

PİRİNÇ (<i>RICE</i>)	101	6.50	6.69
İLKE (<i>PRINCIPLE</i>)	224	2.03	1.72
ET (<i>MEAT</i>)	259	6.43	6.76
UTANÇ (<i>SHAME</i>)	32	3.11	1.75
DENİZ (<i>SEA</i>)	509	6.49	6.57
OY (<i>VOTE</i>)	128	4.61	4.50
MAÇ (<i>MATCH</i>)	237	5.66	5.78
HEDİYE (<i>GIFT</i>)	88	5.71	5.58
KREDİ KARTI (<i>CREDIT CARD</i>)	74	6.25	6.61
YUMURTA (<i>EGG</i>)	167	6.58	6.72
RAY (<i>RAIL</i>)	20	6.42	6.61
SES (<i>SOUND</i>)	1113	4.33	5.45
BOŞLUK (<i>VACUUM</i>)	158	3.57	3.21
İL (<i>CITY</i>)	132	3.83	4.46
MİLLET (<i>NATION</i>)	211	3.53	3.37
BENZİN (<i>GASOLINE</i>)	37	6.04	6.62
OTOMOBİL (<i>AUTOMOBILE</i>)	367	6.61	6.84
AKIL (<i>CONSCIOUSNESS</i>)	679	3.30	2.05
Weak target	Frequency	Imagery	Concreteness
LAĞIM (<i>SEWER</i>)	8	5.46	6.32
FEN (<i>SCIENCE</i>)	23	3.12	3.66
ÖZGÜRLÜK (<i>FREEDOM</i>)	202	3.13	1.97
ARAZİ (<i>LAND</i>)	106	5.66	6.14
LASTİK (<i>TYRE</i>)	63	6.21	6.55
FAKİR (<i>POOR</i>)	57	4.09	3.68
DÜĞÜN (<i>WEDDING</i>)	65	5.71	5.53
DOLAP (<i>CLOSET</i>)	108	6.36	6.78
DERİN (<i>DEEP</i>)	244	3.93	3.82
KOMEDİ (<i>KOMEDI</i>)	12	3.78	2.55
YAZI (<i>ARTICLE</i>)	579	6.08	5.92
MAHKUM (<i>CONVICT</i>)	43	5.20	5.09
İNEK (<i>COW</i>)	23	6.43	6.71
PARTİ (<i>PARTY</i>)	312	4.96	4.84
DENKLEM (<i>EQUATION</i>)	4	4.58	3.17
KAFE (<i>CAFÉ</i>)	74	6.09	6.34
PANTOLON (<i>TROUSERS</i>)	104	6.47	6.86
YÖN (<i>DIRECTION</i>)	467	3.87	3.41
KAYIP (<i>LOSS</i>)	161	2.85	3.04
DENİZ (<i>SEA</i>)	509	6.49	6.57
AĞRI (<i>PAIN</i>)	101	3.68	3.89
MAKET (<i>MODEL</i>)	4	5.91	6.49
ELEMENT (<i>ELEMENT</i>)	39	3.59	4.80
ŞEYTAN (<i>DEMON</i>)	49	3.17	1.55
ŞAMPUAN (<i>SHAMPOO</i>)	17	6.49	6.78
GÜÇ (<i>POWER</i>)	733	3.13	2.12

BAKIM (<i>CARE</i>)	150	3.66	3.99
ALTIN (<i>GOLD</i>)	168	6.30	6.72
SANDALYE (<i>CHAIR</i>)	89	6.38	6.76
ZENGİN (<i>RICH</i>)	175	4.34	3.75
SALON (<i>LIVING ROOM</i>)	219	5.59	6.33
ÜMİT (<i>HOPE</i>)	36	2.30	1.64
TROPİKAL (<i>TROPICAL</i>)	2	4.46	4.43
DEDE (<i>GRANDFATHER</i>)	118	6.39	6.48
BÖCEK (<i>BUG</i>)	37	6.32	6.75
NOT (<i>NOTE</i>)	130	5.18	5.29
SILA (<i>HOMELAND</i>)	6	2.41	2.28
YAĞMUR (<i>RAIN</i>)	160	6.45	6.55
ŞEKER (<i>SUGAR</i>)	143	6.18	6.63
MAKARNA (<i>PASTA</i>)	27	6.62	6.70
İRRADE (<i>WILLPOWER</i>)	73	2.09	1.64
BESİN (<i>NUTRIENT</i>)	180	4.89	5.67
AYIP (<i>FAULT</i>)	75	3.06	1.97
DALGA (<i>WAVE</i>)	122	5.86	5.84
POLİTİKA (<i>POLITICS</i>)	221	2.86	2.49
ALKIŞ (<i>APPLAUSE</i>)	28	5.74	5.71
ŞAŞKINLIK (<i>AMAZEMENT</i>)	61	3.89	2.13
ÖDEME (<i>PAYMENT</i>)	156	4.04	4.28
KORKAK (<i>COWARD</i>)	8	2.97	2.51
KOMPARTİMAN (<i>COMPARTMENT</i>)	8	5.07	6.01
KALABALIK (<i>CROWD</i>)	145	5.61	4.92
FÜZE (<i>ROCKET</i>)	13	5.99	6.70
BAŞKAN (<i>PRESIDENT</i>)	269	4.33	4.91
MEMLEKET (<i>COUNTRY</i>)	102	3.78	3.57
ODUN (<i>WOOD</i>)	40	6.28	6.66
DAHİ (<i>GENIOUS</i>)	137	3.42	3.00
İSRAF (<i>WASTING</i>)	14	2.84	2.43
Unrelated target	Frequency	Imagery	Concreteness
TÜY (<i>FEATHER</i>)	78	5.51	6.68
BAYİ (<i>RETAILER</i>)	51	4.85	6.26
SERBEST (<i>FREE</i>)	71	2.37	2.09
DEYİM (<i>IDIOM</i>)	60	3.11	2.84
SUÇLU (<i>GUILTY</i>)	58	3.74	4.69
YOĞURT (<i>YOGURT</i>)	71	6.51	6.79
ÇİRKİN (<i>UGLY</i>)	63	4.08	2.61
DAVET (<i>INVITATION</i>)	53	4.26	3.66
ÇIĞLIK (<i>SCREAM</i>)	74	4.60	5.20
FİRÇA (<i>BRUSH</i>)	52	6.11	6.73
KARINCA (<i>ANT</i>)	33	6.44	6.88
LİMON (<i>LEMON</i>)	60	6.57	6.93

DİKİŞ (<i>SEWING</i>)	24	5.52	6.33
KABLO (<i>CABLE</i>)	90	6.07	6.87
VİTRİN (<i>VITRINE</i>)	64	5.99	6.56
BİLEK (<i>WRIST</i>)	42	6.06	6.82
YÜZÜK (<i>RING</i>)	50	6.70	6.81
KUM (<i>SAND</i>)	75	6.31	6.62
YORGUNLUK (<i>FATIGUE</i>)	63	4.20	2.80
BASINÇ (<i>PRESSURE</i>)	63	3.25	4.85
ELMA (<i>APPLE</i>)	64	6.73	6.95
KUŞKU (<i>SUSPICION</i>)	82	2.68	1.58

APPENDIX C

WORD PAIRS OF LISTS 1, 2, AND 3

Cue word	Target		
	List 1 (19 strong, 19 weak, 19 unrelated)	List 2 (19 strong, 19 weak, 19 unrelated)	List 3 (19 strong, 19 weak, 19 unrelated)
BELDE (TOWN)	KÖY (VILLAGE)	ARAZİ (LAND)	TÜY (FEATHER)
PROTEİN (PROTEIN)	ET (MEAT)	BESİN (NUTRIENT)	FIRÇA (BRUSH)
ÇAMAŞIR (LAUNDRY)	MAKİNE (MACHINE)	DOLAP (CLOSET)	SUÇLU (GUILTY)
METAL (METAL)	DEMİR (IRON)	ALTIN (GOLD)	SERBEST (FREE)
SEÇMEN (VOTER)	OY (VOTE)	POLİTİKA (POLITICS)	KARINCA (ANT)
VATAN (HOMELAND)	MİLLET (NATION)	LİMON (LEMON)	MEMLEKET (COUNTRY)
KRAL (KING)	KRALİÇE (QUEEN)	GÜÇ (POWER)	DİKİŞ (SEWING)
ISLAK (WET)	KURU (DRY)	DENİZ (SEA)	VİTRİN (VITRINE)
İSHAL (DIARRHEA)	TUVALET (RESTROOM)	AĞRI (PAIN)	BİLEK (WRIST)
BORÇLU (DEBTOR)	PARA (MONEY)	FAKİR (POOR)	KABLO (CABLE)
ÇUKUR (PIT)	DÜŞMEK (FALL)	DERİN (DEEP)	YORGUNLUK (FATIGUE)
UZAY (SPACE)	BOŞLUK (VACUUM)	FÜZE (ROCKET)	ELMA (APPLE)
GARSON (WAITER)	LOKANTA (RESTAURANT)	KAFE (CAFÉ)	BASINÇ (PRESSURE)
MİNDER (CUSHION)	RAHAT (COMFY)	SANDALYE (CHAIR)	KUŞKU (SUSPICION)
ÖZLEM (MISSING)	HASRET (YEARNING)	SILA (HOMELAND)	BAYİ (RETAILER)
HASAR (DAMAGE)	DEPREM (EARTHQUAKE)	KAYIP (LOSS)	YOĞURT (YOGURT)
LÜKS (LUXURY)	OTOMOBİL (AUTOMOBILE)	ÇIĞLIK (SCREAM)	İSRAF (WASTING)
MAKYAJ (MAKE-UP)	RUJ (LIPSTICK)	BAKIM (CARE)	LİMON (LEMON)
OT (GRASS)	YEŞİL (GREEN)	BÖCEK, (BUG)	YÜZÜK (RING)
HARİTA (MAP)	YÖN (DIRECTION)	VİTRİN (VITRINE)	DÜNYA (WORLD)
TAKSİT (INSTALMENT)	ÖDEME (PAYMENT)	SUÇLU (GUILTY)	KREDİ KARTI (CREDIT CARD)
GÖMLEK (SHIRT)	PANTOLON (TROUSERS)	DEYİM (IDIOM)	DÜĞME (BUTTON)
FESTİVAL (FESTIVAL)	PARTİ (PARTY)	ÇİRKİN (UGLY)	EĞLENCE (FUN)
ÖZET (SUMMARY)	NOT (NOTE)	FIRÇA (BRUSH)	KISA (SHORT)
ESİR (CAPTIVE)	MAHKUM (CONVICT)	KUM (SAND)	SAVAŞ (WAR)
SAHİL (SEASIDE)	DALGA (WAVE)	DAVET (INVITATION)	DENİZ (SEA)
EŞEK (DONKEY)	İNEK (COW)	KUŞKU (SUSPICION)	SEMER (SADDLE)
SÜRPRİZ (SURPRISE)	ŞAŞKINLIK (AMAZEMENT)	BASINÇ (PRESSURE)	HEDİYE (GIFT)
Zeka (INTELLIGENCE)	DAHİ (GENIOUS)	SERBEST (FREE)	AKIL (CONSCIOUSNESS)
YAKIT (FUEL)	ODUN (WOOD)	YÜZÜK (RING)	BENZİN (GASOLINE)

ELEŞTİRMEN (COMMENTATOR)	YAZI (ARTICLE)	YORGUNLUK (FATIGUE)	GAZETE (NEWSPAPER)
UĞULTU (BLUSTER)	KALABALIK (CROWD)	TÜY (FEATHER)	SES (SOUND)
ATOM (ATOM)	FEN (SCIENCE)	ELMA (APPLE)	BOMBA (BOMB)
DRAM (DRAMA)	KOMEDİ (COMEDY)	KABLO (CABLE)	TIYATRO (THEATRE)
KİMYA (CHEMISTRY)	ELEMENT (ELEMENT)	DENEY (EXPERIMENT)	ÇİRKİN (UGLY)
NESİL (GENERATION)	DEDE (GRANDFATHER)	GENÇLİK (YOUTH)	KUM (SAND)
PILAV (PILAF)	MAKARNA (PASTA)	DİKİŞ (SEWING)	PİRİNÇ (RICE)
MUZ (BANANA)	TROPİKAL (TROPICAL)	BİLEK (WRIST)	MAYMUN (MONKEY)
PRENSİP (PRINCIPLE)	TÜY (FEATHER)	İLKE (FUNDAMENTAL)	İRDE (WILLPOWER)
SEYİRCİ (SPECTATOR)	BAYİ (RETAILER)	MAÇ (MATCH)	ALKIŞ (APPLAUSE)
KÖPÜK (BUBBLE)	SERBEST (FREE)	SABUN (SOAP)	ŞAMPUAN (SHAMPOO)
PALTO (COAT)	DEYİM (IDIOM)	SOĞUK (COLD)	YAĞMUR (RAIN)
MOBİLYA (FURNITURE)	SUÇLU (GUILTY)	KOLTUK (COUCH)	SALON (LIVING ROOM)
BİSİKLET (BICYCLE)	DAVET (INVITATION)	TEKERLEK (WHEEL)	LASTİK (TYRE)
BARİŞ (PEACE)	FİRÇA (BRUSH)	SAVAŞ (WAR)	ÖZGÜRLÜK (FREEDOM)
TREN (TRAIN)	VİTRİN (VITRINE)	RAY (RAIL)	KOMPARTİMAN (COMPARTMENT)
MORAL (SPIRITS)	KABLO (CABLE)	KEYİF (PLEASURE)	ÜMİT (HOPE)
MİRAS (INHERITENCE)	LİMON (LEMON)	PARA (MONEY)	ZENGİN (RICH)
PASTA (CAKE)	BASINÇ (PRESSURE)	TATLI (SWEET)	ŞEKER (SUGAR)
REZALET (SCANDAL)	ELMA (APPLE)	UTANÇ (SHAME)	AYIP (FAULT)
TAVUK (CHICKEN)	KUŞKU (SUSPICION)	YUMURTA (EGG)	KORKAK (COWARD)
CENAZE (FUNERAL)	DİKİŞ (SEWING)	DÜĞÜN (WEDDING)	ÖLÜM (DEATH)
VALİ (GOVERNOR)	KUM (SAND)	İL (CITY)	BAŞKAN (PRESIDENT)
KORKUNÇ (TERRIBLE)	YÜZÜK (RING)	ŞEYTAN (DEMON)	FİLM (MOVIE)
KARTON (CARTON)	ÇİRKİN (UGLY)	KUTU (BOX)	MAKET (MODEL)
FORMÜL (FORMULA)	KARINCA (ANT)	MATEMATİK (MATHEMATICS)	DENKLEM (EQUATION)
ATIK (WASTE)	BİLEK (WRIST)	ÇÖP (TRASH)	LAĞIM (SEWER)

APPENDIX D

FREQUENCY, IMAGERY AND CONCRETENESS OF TARGETS

Imagery and concreteness scores were missing for most of the targets. Therefore, we conducted an online survey to 76 psychology students of Bogazici University. We excluded unreliable data of one participant. We asked participants to rate the imagery and concreteness of a word on a 1-7 Likert scale. Three separate 3 (Association Type: strong, weak, unrelated) X 3 (List Type: 1, 2, 3) between-subjects ANOVA for the frequency, imagery and concreteness scores of the targets showed that word frequency of the strong targets ($M = 234.60$; $SD = 263.48$) was significantly higher than weak ($M = 126.42$; $SD = 146.90$) and unrelated targets ($M = 60.93$; $SD = 15.63$). This finding is consistent with the higher accessibility of the first associates found in the literature (Nelson & McEvoy, 2000; Rubin & Friendly, 1986; Howes, 1957). Therefore, we used word frequency as a control variable to sort out the effect of the association variable. Equating word frequencies by picking higher frequency associates for the weak group could risk introducing a concreteness problem because more frequent words tend to be more abstract than less frequent words (Nelson & McEvoy, 2000). Therefore, we opted to keep the frequency difference that comes along with the higher accessibility of the first associate of the words.

APPENDIX E

IMAGERY AND CONCRETENESS OF CUE-TARGET PAIRS

We ran another online survey for collecting imagery and concreteness scores of the pairs, in which 75 participants randomly rated the cue-target pairs in one of the three lists, each list with 66 pairs. After describing imagery and concreteness by giving examples, we respectively asked participants to evaluate the rate of word pairs to reveal a mental imagery when imagined together and then the concreteness of them. We conducted two separate 3 (List Type: 1, 2, 3) X 3 (Association Type: strong, weak, unrelated) between-subjects ANOVA. There was a main effect of the association type for both imagery, $F(2, 162) = 144.698$, $MSE = .641$, $p = .000$, $\eta_p^2 = .64$ and for concreteness $F(2, 162) = 5.896$, $MSE = 2.070$, $p = .003$, $\eta_p^2 = .068$. Post-hoc comparisons using Tukey HSD indicated that semantically unrelated pairs were perceived significantly less imageable and less concrete compared to strong and weak pairs, $ps < .01$, which is consistent with the previous literature (e.g., Paivio, 1965; Day & Bellezza, 1983; Marschark & Hunt, 1989). See Table 3 for descriptives. We also found a positive correlation between imagery and concreteness scores of both words and pairs, $r(171) = .93$, $p < .01$ and $r(171) = .70$, $p < .01$ (for x and y) respectively. Regarding list comparison, the imagery scores of the association types were significantly different between the lists. Unrelated pairs of List 1 ($M = 3.854$; $SD = .735$) had significantly higher imagery scores than unrelated pairs of List 2 ($M = 3.062$; $SD = .72$) and List 3 ($M = 2.977$; $SD = .472$); $F(2, 54) = 10.413$, $MSE = .427$, $p = .000$, $\eta_p^2 = .278$. We equated the lists by switching some of the pairs between the lists.

APPENDIX F

PARTIAL INFORMATION RESULTS

The partial information (PI) phase followed the cued-recall and recognition tests, which already had high accuracy rates (52% for recall and 89% for recognition) and as a result participants reported some targets correctly in the PI phase. Therefore, we calculated PI of targets which were neither recalled in the cued-recall task and nor reported in the open-ended PI phase. Because the number of trials varied between participants, we converted these numbers to percentages based on each participant's eligible trial count. Average trial number was 16.99 (10.80). We calculated the number of total, correct and wrong partial information reported for all of these targets and for each association type. Additionally, we coded whether any wrong partial information was reported for each target, ending up with percentages of strong, weak and unrelated targets given at least 1 wrong partial information (see Table F1).

One-way within-subjects ANOVA analyses showed that unrelated pairs had significantly lower number of correct partial information, $F(2, 68) = 7.11$, $MSE = .14$, $p < .05$, $\eta_p^2 = .17$). The percentage of total wrong partial information was also significantly different between strong, weak and unrelated pairs ($F(2, 68) = 8.25$, $MSE = .08$, $p < .01$, $\eta_p^2 = .20$). Pairwise comparisons showed that participants reported significantly less wrong partial information for strong pairs ($M = .34$, $SD = .42$) compared to weak ($M = .49$, $SD = .56$) and unrelated pairs ($M = .61$, $SD = .61$), $ps < .05$).

Table F1. Partial Information Percentages Across Association Types

	Strong	Weak	Unrelated	<i>F</i>	<i>p</i>	η_p^2
	Mean (SD)	Mean (SD)	Mean (SD)			
Partial information %						
Total partial information	0.77 (0.91)	0.72 (0.61)	0.64 (0.59)	1.37	0.26	0.03
Correct partial information	0.58 (0.72) ^b	0.55 (0.53) ^c	0.27 (0.41) ^{b, c}	7.11	0.00*	0.17
Wrong partial information	0.34 (0.42) ^{a, b}	0.49 (0.56) ^a	0.61 (0.61) ^b	8.25	0.00*	0.20
Wrong report frequency	0.33 (0.42) ^b	0.41 (0.43)	0.47 (0.44) ^b	3.80	0.03*	0.10

Note. Significant findings are indicated with *. Bonferroni correction is applied for multiple comparisons. Pairwise differences are shown with a: strong-weak, b: strong-unrelated, c: weak-unrelated.

Regarding the wrong PI report frequency, one-way within-subjects ANOVA demonstrated again that strong pairs ($M = .33$, $SD = .42$) elicited wrong partial information less frequently than unrelated pairs ($M = .47$, $SD = .44$). This might have resulted from the participants' producing of partial information based on the cue they confronted in the partial information phase. Participants might have guessed PI based on associates of the cue and this might have increased wrong partial information for the unrelated pairs and decreased it for the strong pairs.

Additionally, we averaged FOK magnitudes for targets for those partial information was given, for targets for those no partial information was given, and those for which at least one correct partial information and at least one wrong partial information was given. We found that FOK magnitude significantly differed only between targets given partial information ($M = 49.28$; $SD = 22.24$) compared to targets given no partial information ($M = 35.06$; $SD = 23.01$), $t(52) = 4.81$, $p = .000$, $r = .58$. Analyses showed any FOK difference between targets given one or more correct partial information ($M = 48.21$; $SD = 20.37$) and given one or more wrong partial information ($M = 46.44$; $SD = 18.63$), $t(44) = .83$, $p = .411$, $r = .73$. Targets given 1 correct and 1 wrong partial information did not show any significance ($p > .05$).

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