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Contextual information influences the feeling of knowing in episodic memory

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ABSTRACT

The feeling of knowing (FOK) predicts the likelihood of eventually recognizing currently unrecalled items. Koriat (1993, 1995) showed that retrieval of partial target information influences FOK ratings. Building on Koriat's view, the noncriterial-recollection hypothesis contends that contextual information influences FOKs (Brewer, Marsh, Clark-Foos, & Meeks, 2010). Our study assessed the validity of the noncriterial-recollection hypothesis by controlling the amount of potentially-retrievable contextual information presented to participants. We varied the amount of contextual information accompanying the name and image of imaginary animals. There were three information conditions: minimum (name and image), medium (name, image, and country), and maximum (name, image, country, diet and weight). Information condition did not affect recall accuracy. The minimum condition resulted in greater response output (recall and commission errors together). FOKs for unrecalled items were lower in the minimum condition than the other conditions. Consistent with the noncriterial-recollection hypothesis, FOKs were positively correlated with the retrieval of contextual information.

1. Introduction

Feeling-of-knowing judgments (henceforth, FOKs) have been a mainstay of metamemory research since its inception to the present (Hart, 1965; Hertzog, Fulton, Sinclair, & Dunlosky, 2014; Thomas, Bulevich, & Dubois, 2011). A FOK is a prediction of the likelihood in future of recognizing a currently unrecalled item with respect to both semantic and episodic memory. For example, a person may not be able to recall the capital of Montenegro successfully, but can predict whether or not he or she will be able to recognize the capital (Podgorica) from a list of other European capitals. As regards episodic memory, a participant may encode a word pair (e.g., "captain-carbon"), and later the cue word is provided and the target word must be recalled. When recall fails, FOK judgments predict the likelihood of recognizing that target (Hertzog et al., 2014; Metcalfe, Schwartz, & Joaquim, 1993).

FOKs are typically measured using Hart's recall–judgment–recognition procedure (Hart, 1965, 1966, 1967), which involves asking participants to recall the answer to a question, followed by a feeling-of-knowing judgment and then a recognition test. The recall–judgment–recognition procedure can be applied to both semantic and episodic memory. FOKs can be applied to semantic memory by means of a general-information question. They can address episodic memory, for example, by providing one part of a newly learned cue–target pair and asking for the other. With both episodic and semantic

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memory, if participants cannot recall the target answer, they are asked for a FOK, which can be given on either a Likert scale or a percentage scale (i.e., 0–100). Researchers can introduce variables that affect the magnitude of the FOK judgments. For example, recalling attributes of the target stimulus leads to larger magnitude FOK judgments (Thomas, Bulevich, & Dubois, 2012; Thomas et al., 2011). FOK accuracy is then assessed by means of a recognition test, and the FOK ratings are correlated with the likelihood of recognizing the target answer. Typically, researchers then use gamma correlations to examine the correlation between the FOK and subsequent recognition (Nelson, 1984; but see Benjamin & Diaz, 2008; Masson & Rotello, 2009). In normal participants, the subjective judgments are an accurate prediction of memory performance (Metcalfe et al., 1993; Nelson, 1984; Thomas et al., 2011). It is, of course, an intriguing thought that participants can accurately predict what they do or do not know when their memory fails them. What we are interested in here is what causes FOKs to increase or decrease, that is, the magnitude of FOKs.

Koriat (1993, 1995) proposed that the mechanism underlying FOKs is the accessibility of partial target information. In Koriat's view, FOK estimations do not rely directly on a stored but inaccessible target item. Rather, participants retrieve only parts of the target (e.g., first letter, or number of syllables). Based on the information retrieved, participants make an unconscious inference as to whether or not the whole target is stored in memory as well. According to the accessibility model, the tendency to produce a high or low FOK depends on the total amount of partial information elicited by the question for a given individual.

At present, there are much data to support the Koriat (1993) model. For example, his own experiments involved presenting participants with four-letter combinations of consonants, such as JZST, which they were later asked to recall as best they could. Each individual letter constituted an item of partial information, contributing to the target answer, which consisted of the entire string of letters. Participants were asked to recall the target of parts of it, and they could produce from 1 to 4 letters of the target string. They then gave an FOK for subsequent recognition of the complete letter string if they could only recall part of it. Koriat observed that when participants recalled 1, 2, 3, or 4 of the letters, their FOK was higher than when they had no partial recall. Using a methodology similar to Koriat's (1993), the validity of the accessibility model for FOKs was also demonstrated in pharmacologically-induced amnesia (Izaute & Bacon, 2006) and in schizophrenia patients (Bacon & Izaute, 2009). Koriat (1995) found that partial information (letters, syllables, etc.) also predicted FOKs when general-information questions were used, that is, in a task assessing semantic memory. It is also worth noting that Koriat (1995) also speculated that non-target contextual information would influence FOKs. In another study, Schacter and Worling (1985) found that FOKs were higher when participants could recall the emotional valence (good or bad) of an unrecalled word. To summarize, participants use partial information retrieved about the unrecalled target to determine their FOK.

Koriat's view was expanded upon by Brewer, Marsh, Clark-Foos, and Meeks (2010). Brewer et al. proposed the noncriterial-recollection hypothesis. First, it is important to note that the noncriterial-recollection hypothesis does not contradict the accessibility view, nor are the two mutually exclusive. Rather, according to the noncriterial-recollection hypothesis, FOKs may be influenced by the retrieval of other information from the encoding context. Contextual information can be any information present at encoding that is not specifically target information. Thus, it may be related information, such as the part of speech of the target word, it may relate to the participant's emotional state at encoding, or, as tested here, it may be information associated with, but not identical to the target. Take, for example, the case of being asked whether or not you know the capital of Montenegro. According to Koriat's original view, being able to retrieve the first letter of Podgorica may drive a participant's FOK as regards the capital of Montenegro. According to the noncriterial-recollection hypothesis, retrieving other contextual information about Montenegro (e.g., that the professional basketball player Nikola Vučević comes from Montenegro) may also reinforce the FOK.

To be clear on terminology, "partial target information" is defined as information relating to the target word alone. Thus, if the target word is "Podgorica," partial information includes the first letter of the word, the number of syllables, the last letter, and partial retrieval of certain syllables ("pod"). Contextual information is any information relating in any way to the target, but not actually referring to it. Thus, in the case of Podgorica, contextual information may include its status as the largest city in Montenegro, its proximity to Lake Scutari, and its brief history as Titograd. Of course, there may be situations in which it can be hard to distinguish between partial and contextual information. For example, if the target word is "pulchritude," retrieving the affective valence of the word could be considered either partial or contextual. However, for the purposes of this experiment, contextual information will be clearly differentiated from partial information about the target itself.

The noncriterial-recollection hypothesis is backed up by several studies that correlated retrieved contextual information with the magnitude of FOK judgments. Brewer et al. (2010) found a correlation between the accurate retrieval of source information and the magnitude of FOKs. Hosey, Peynircioğlu, and Rabinovitz (2009) interviewed people about the reasons for their FOKs and found that people self-reported using retrieved information to determine their FOK. In other words, when participants could remember the profession associated with a famous face, they were more likely to give a high FOK. In another study, Thomas et al. (2011) used valenced paired-associate stimuli and found that successful valence retrieval produced higher FOKs, among both younger and older adults. Thomas et al. (2011) showed that there was a positive correlation between retrieved valence information and higher FOKs. It is unclear whether the valence of a target should be considered partial or contextual information – it straddles the boundaries between the two. Nonetheless, Thomas et al. (2012) showed that there was a correlation between the retrieval of conceptual target features, such as whether the target was in same category as the cue, and the magnitude of the FOKs. In addition, they found that not only retrieval of the target font, but also the accuracy of such retrieval likewise correlated with the magnitude of the FOKs. Finally, Hertzog et al. (2014) correlated the magnitude of FOKs with the likelihood of recalling an imagery mediator. They devised an experiment in which participants used interactive imagery to encode noun–noun pairs and found that recall of the image used to encode the pairs was correlated with the magnitude of the FOK. In this particular case, it is likely that the recalled image provided contextual information that boosted the FOK. Thus, research consistently shows that the accessibility of contextual information is correlated with the magnitude of the FOK. In the current study, we attempt with our experimental design to address the noncriterial-recollection hypothesis.

What we were interested in is whether information related to, or contextually bound to the target influences the magnitude of FOKs. In other words, is it possible to show that the accessibility of contextual information leads to higher FOKs, thereby testing the noncriterial-recollection hypothesis (as well as the accessibility heuristic model)? To do so requires a manipulation that provides participants with contextual information rather than relying on a correlation between related information and the FOKs. Of course, one problem with studying the effect of contextual information on FOK ratings is how to devise an experiment capable of controlling the potential for retrieving contextual information. We needed a method that would enable us to control the amount of contextual information related to a specific target answer without influencing the ability to recall the target itself.

The methodology we used was based on a study by Schwartz and Smith (1997) who examined contextual information in relation to what causes tip-of-the-tongue states (TOTs). They asked participants to study the names, drawings, and biographical data of fictional animal species and hypothesized that if it is the amount of accessible related information that precipitates TOTs, the participants should experience more TOTs in the conditions in which they were provided with more related information. The results that they obtained confirmed their hypothesis that retrieval of the related information contributes to TOTs. It remains to be seen if the same is true for FOKs, which may differ from TOTs (see Schwartz, 2006, 2008; Schwartz & Bacon, 2008). Although it is natural to assume that FOKs and TOTs share an underlying mechanism, research suggests that they differ in some respects. Schwartz (2008), for example, found that divided attention decreased the number of TOTs but did not affect FOKs. Accordingly, we included both TOTs and FOKs in the current study to ascertain whether contextual information affects them in a similar fashion or differently.

The aim of this study was to assess the validity of the FOK accessibility model for long-term episodic memory in a way that allows both the quantity and quality of related contextual information to be controlled. In the current study participants viewed imaginary animals as well as the names invented for them (Schwartz & Smith, 1997). In one of the experimental conditions, this was the only information the participants were given. In a second condition, they were given one item of contextual information (the country where the animal lives), and in a third condition three such items (country, weight and diet). Our main hypothesis is that the more contextual information is provided (and recalled), the higher the FOK ratings will be. We predict that this will occur because providing more information gives participants more contextual information to retrieve. This retrieved information then informs the FOK processes, which boosts the extent of the FOK. As a result of this, across conditions, the retrieval of contextual information should also be positively correlated with FOKs. And, as with earlier studies, partial target information should also be correlated with higher FOKs. In other words, if participants can recall the first letter of the animal's name, they should have a higher FOK than if that is not the case. Thus, we also hypothesize that there is a correlation between the retrieval of related information and the extent of the FOK.

In Koriat (1993), FOK judgments were obtained even when participants recalled all target letters, even though FOK judgments are usually made only on unrecalled items. We wanted to build on Koriat's paradigm by also asking participants for their FOKs for recalled items as well. We refer to this judgment as FOKr insofar as it is a prediction of successful recognition in the case of recall. Collecting feeling of knowing on all items regardless of recall is a common measure frequently used to examine different aspects of metacognition (see also Baran, Tekcan, Gürvit, & Boduroglu, 2009; Benjamin, 2005; Boduroglu, Tekcan, & Kapucu, 2014; Souchay, Isingrini, & Gil, 2002).

What is unique here is separating FOK and FOKr, but we think we are justified in doing so. When people make FOKs after successful recall, they may be able to base their judgment on that recall and then may not need to base their judgment on the cues that generally inform FOKs on unrecalled items. Although not all successful recalls may be followed by the highest FOK (see Kornell, 2012), if a person's estimation of his or her future ability to recognize recalled items reflects whether or not he or she has produced an answer, FOKr should track outputted responses. We suspect that the presence or absence of recall as a cue for recognition will overwhelm any other cue. Thus, we do not expect contextual information to influence FOKr. And, if this is the case, we should find that FOK and FOKr respond differently to the amount of information, given that FOK will increase with respect to contextual information, whereas FOKr will increase with respect to outputted answers during the recall phase. Thus, it is wise to consider FOKs and FOKr separately as different factors may influence each one.

2. Method

2.1. Participants

Sixty-three healthy volunteers (42 women and 21 men) were recruited from the University of Strasbourg, France. They were all native French speakers with normal or corrected-to-normal vision. They ranged in age from 21 to 28 years (mean: 23.5 years). The project had the approval of the university ethics committee.

2.2. Materials

We used 18 pictures of imaginary animals. The pictures of the animals were black line drawings against a white background, drawn by a professional artist especially for the purposes of the experiment. Each picture was paired with a two-syllable name of four to five letters and associated with contextual information (Fig. 1), namely country, diet and weight. Twelve countries, 6 diets and 6 weights were randomized for each participant. The first letter of each animal name was unique.

2.3. Design

We manipulated one within-subject independent variable, that is, the amount of contextual information provided at encoding. There were three levels for this variable: minimal information (no contextual information added), medium information (one item of contextual information: the country name), and maximal information (three items of contextual information: country, diet and weight). For each participant, the computer program randomized which animal was in which conditions and the order in which the animals appeared during the learning, recall, and recognition phases.

We collected data concerning 7 dependent measures: recall, FOKs for recalled items (FOKr), TOTs, FOKs, partial information retrieval (first letter and other letters), contextual information retrieval (country, diet, and weight), and recognition. Due to a programming error, TOT data were lost for 20 of the 63 participants, compromising our ability for data analysis on this judgment.

2.4. Procedure

Participants were tested individually on computers in the presence of the experimenter. They were told that they would see imaginary animals and were given the animals' names, which they were instructed to learn. During the initial presentation, the animals appeared on the computer screen one by one. Each animal was accompanied by name of the animal and

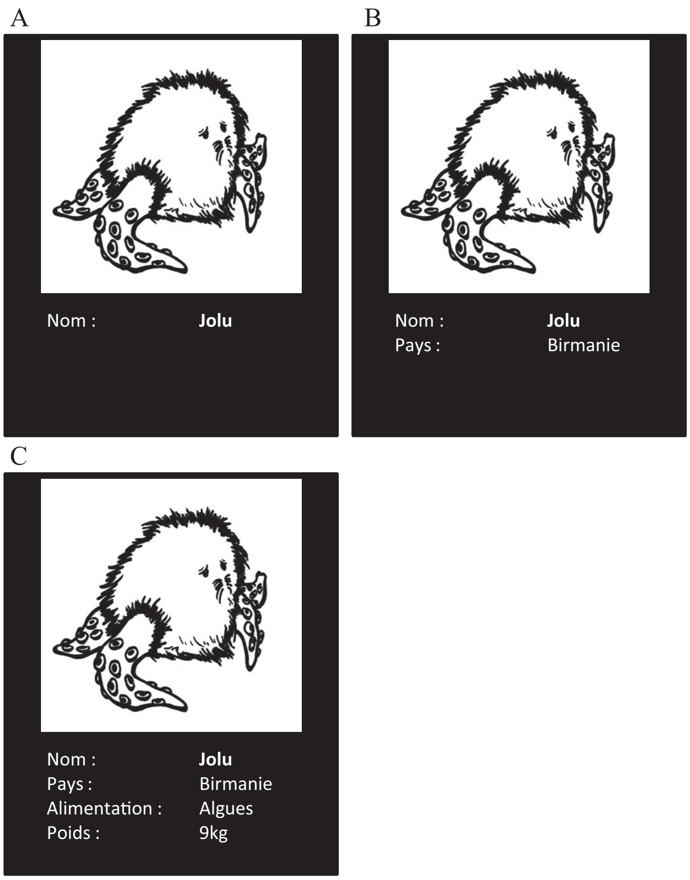

Fig. 1. Illustration of the stimuli used in the present experiment: (A) is the minimum-information condition, (B) the medium-information condition, and (C) the maximum-information condition.

any additional information, which depended on the context condition. There were three presentations during the learning phase to ensure adequate encoding of the picture–name association. Each animal was given an initial 15-s randomized presentation during which the experimenter read the information out loud (name and contextual information, if any) as participants read it silently. Once all the animals had been presented a first time, there was a second 10-s presentation in a different random order, and this time, the participants read it silently to themselves. Finally, there was a last 15-s presentation, during which the participants had to read all the information out loud. We arranged for three presentation trials to ensure that recall would not be at floor. After the learning sessions there was a 4-min non-verbal cancellation test (Weintraub & Mesulam, 1985) to distract participants during a retention interval prior to recall testing.

In the recall phase, the pictures of the animals were displayed on the computer screen one by one as cues, and we asked participants to try to recall the name of the animals. If they were able to recall the name, they then had to spell it. They were then asked to estimate the probability of recognizing the correct name from among four options by selecting their feeling of knowing as regards recognizing the target according to a 6-point scale (0%, 20%, 40%, 60%, 80%, 100% likelihood of predicting the target) presented on the screen. This judgment was referred to as a FOKr (feeling of knowing for recalled items). These ratings were only given to items that had been recalled (both correct and commission errors). We used the 6-point scale because we wanted to encourage participants to evaluate their feeling of knowing the answer rather than to give an estimate based on the probability of guessing. Giving participants options that do not correspond to guessing (i.e., 0%) may encourage them to evaluate experience rather than judge probability. We will draw a distinction between FOKr judgments made on recalled items and those made later on unrecalled items (FOK).

If participants were unable to recall the name of the animal, we asked whether or not they were in a TOT. In the context of the instructions, we explained to participants what was meant by a "tip-of-the-tongue" state. They were told not to confuse a strong feeling-of-knowing with a TOT, and that they might not experience any TOTs at all in the course of the experiment. The experimenter defined a TOT as follows (translation): "A Tip-of-the-tongue state is a very strong feeling that you can recall the answer, and that recall is imminent. You are in a TOT if you feel you are on the verge of being able to recall the answer that is presently missing." TOTs were recorded as a yes/no decision. Participants were then asked to provide all the information they could recall about the animal, either partial information (first letter or other letters) and/or any piece of contextual information that might have been presented (country, diet, weight). They were encouraged to report anything they could remember but asked not to guess. They were then asked to give a FOK judgment regarding their ability to recognize the target answer among 3 distracters. The instructions with respect to FOK were as follows (translation): "Indicate if you feel able to recognize the name from among four names of imaginary animals presented to you." They were then given the same 6-point scale that was used for the FOKr judgments. The FOK judgments were only made in respect of unrecalled items. Participants repeated this procedure for all 18 pictures.

In the final recognition phase, the pictures were once again displayed one by one on the computer screen, and we asked participants to recognize the name of the animal. Below the picture of each animal was a four-alternative forced-choice. The alternatives consisted of the correct name and three other names – the distracters – belonging to animals previously presented. Participants made recognition judgments for all 18 pictures, regardless of whether the target had been recalled earlier or not, and whether it had been recalled correctly or not. In the recognition phase, each animal name appeared once as the correct answer, and three times as an incorrect distracter. The whole procedure lasted approximately 40 min per participant.

3. Results and discussion

Statistical reliability was measured at $p < .05$ in all analyses. We conducted ANOVAs on the memory measures and metamemory measures as a function of context conditions.

3.1. Memory measures

Recall accuracy was defined as the percentage of correct responses among all responses, both correct and incorrect, in the initial recall phase. Total output measured the retrieval of any animal name, regardless of if it was correct or not. Thus, total output included both correct answers and errors of commission because we wanted a variable for total retrieval, rather than just correct retrieval, to be consistent with Koriat's view (1993) that FOKs do not distinguish between correct and incorrect information. Recall accuracy did not vary across condition $F < 1$. Moreover, correct recognition was not affected by the initial

Table 1
Memory results as a function of condition.

	Contextual information condition		
	Minimum info (%)	Medium info (%)	Maximum info (%)
Recall accuracy	66	67	69
Total output	68	57	51
Recognition	90	86	84

contextual information condition $F < 1$. Thus, the information–condition manipulation did not affect either measure of accurate recall. However, the amount of contextual information affected total output, with the results showing that providing more contextual information led to lower total output, $F(2,61) = 13.05$, MSE = .45. In other words, more commission errors occurred in the minimum-information condition. The mean values are given in Table 1.

The retrieval of contextual information was correlated with recognition performance. In this analysis, we conditionalized on the basis of correct and incorrect recognition and then looked at the amount of information retrieved for each condition. Correct recognition was associated with the retrieval of more related and partial information than incorrect recognition, $F(1,36) = 71.6$, MSE = .322. .62 items of information were retrieved for correct recognition, compared with the retrieval of .56 items for incorrect recognition.

3.2. Metamemory measures

3.2.1. Metamemory judgments as a function of the contextual information provided

The minimum condition resulted in lower FOKs than the medium or maximum conditions, $F(2,18) = 102.7$, MSE = 1296 (see Table 2), in keeping with the accessibility hypothesis. FOKr is the feeling of subsequently recognizing the correct answer among a set of distractors for those items that had been recalled. It was higher in the minimum condition than in the medium and maximum conditions, $F(2,61) = 4.2$, MSE = 716 (Table 2), mirroring the recall data. We broke FOKr down as a function of correct responses and commission errors. FOKr was higher for correct items (81) than commission errors (62), $F(1,59) = 78.6$, MSE = 119. However, there was no interaction between whether the response was correct or not and experimental condition ($F < 1$). This lack of an interaction is likely due to the number of empty cells in the analysis, as commission errors were rare, and therefore not in all cells of the analysis. It is important to note that FOKr is influenced by the context variable in the same way as recall, whereas FOK reflects the amount of related information provided.

There was no effect of contextual-information condition on TOTs, $F(2,37) = 3.13$, $p = .056$, though the non-significant trend is consistent with the FOK data and the TOT data of Schwartz and Smith (1997) as well as the current hypotheses. The means, which had a high variance were 7% TOTs in the minimum-information condition, 22% in the medium-information condition, and 11% in the maximum-information condition.

3.2.2. FOK as a function of retrieval of partial/contextual information

We also conducted a number of conditional analyses. There were some empty cells because not all participants had responses in all categories, which accounts for why the degrees of freedom vary in the conditional analyses below. Contextual information was defined as retrieval of the animal's weight, diet or country of origin. Partial information was defined as retrieval of the first letter or other letters of the target. FOK of unrecalled items tracked the amount of contextual information retrieved by participants. When contextual information was retrieved (one or more items of contextual information), FOKs (53) were higher than when no contextual information was retrieved (46), $t(49) = 2.3$. When partial information was retrieved (1 or more items of partial information), FOKs (47) were higher than when no partial information was retrieved (42), but this was not significant, $t(36) = 1.6$. It is likely that our experiment did not have enough power to detect the contribution of partial information. It may also be that there was not sufficient variance in partial information among items to detect such an effect.

FOK accuracy is defined as the relation between the FOK judgment and the likelihood of successful recognition. FOKs were accurate for predicting recognition. The mean FOK for correctly recognized items (57%) was higher than the mean FOK for incorrectly recognized items (41%), $t(29) = 5.05$. We also used the gamma correlation to determine FOK accuracy (Nelson, 1984). The mean gamma was .34, which was significantly better than chance. There were no differences between contextual information conditions with respect to the gamma correlation ($F < 1$).

Given that FOK is accurate at predicting recognition, and that FOK magnitude is predicted by the accessibility of contextual information, we asked if there is a relation between the retrieval of that contextual information and the accuracy of the FOK judgments in predicting recognition. However, there was no apparent effect of the amount of contextual information retrieved on the relationship between FOK and recognition performance (that is, FOK accuracy) ($b^* = 0.118346$; STD err of $b^* = 0.129$; $b = 5.46287$, $t(59) = 0.9154$; $p = .36$). This analysis plots contextual information retrieved against the correlation of FOK to recognition. Thus, recalling contextual information does not seem to mediate the relation between FOK and recognition memory performance. In the real world, there may be a correlation between knowledge of contextual information and stored target information, such that using contextual information to estimate future recognition may be adaptive. But under the controlled situation here, in which we varied the amount of contextual information independent of levels of recall, we did not see this correlation.

Table 2
FOK results as a function of condition.

	Contextual-information condition		
	Minimum info	Medium info	Maximum info
FOK	36	58	56
FOKr	73	67	68

4. General discussion

The aim of this study was to assess the validity of the heuristic accessibility model and noncriterial-recollection hypothesis for explaining FOK in the case of episodic memory (see Brewer et al., 2010; Koriat, 1993). We explored the contribution of contextual information in a paradigm that allowed us into experimentally control the nature and the quantity of contextual information associated with a given memory target.

To summarize the results, we found that the inclusion of related contextual information affected FOK magnitude. Higher FOKs were reported in conditions in which more contextual information had been provided (medium and maximum conditions). Moreover, when participants recalled contextual information, their FOKs were higher than when they did not report contextual information. These data contrast with total output, in which participants recalled more target names (correct and incorrect) for animals for which they had less contextual information. The FOK data also contrast with the recall accuracy data, which did not differ among conditions. Thus, the present study demonstrates a dissociation between total output and FOK as well as recall accuracy and FOK.

Our main finding was that the more contextual information was provided, the higher the FOK. We consider these data to be consistent with the cognitive-heuristic account of metacognitive judgments (Schwartz & Metcalfe, 2011; also see Koriat, 1993, 1995; Metcalfe, 1993; Souchay, Moulin, Clarys, Taconnat, & Isingrini, 2007), according to which metacognitive judgments are based on heuristic information that is correlated with the cognitive processes they seek to reflect. Thus, the better the information, the more accurate the judgments will be at predicting recognition. In the current study, the retrieval of related information is not predictive of better recall accuracy of the target memory. But it is likely that in the real world, if one can remember contextual information, one may be more likely to retrieve the target item. For example, someone who remembers the name of the Montenegrin basketball player may be more likely to recover Montenegro's capital than someone who recalls no information about the country. Moreover, accurate judgments then result in better control over these cognitive processes.

Our data are also consistent with the noncriterial-recollection hypothesis (Brewer et al., 2010), which predicts that retrieved contextual information influences FOK. That is exactly what we found in the present study, namely that biographical information the target animal influences the FOK for recognizing that target name. These data are consistent with Brewer et al. (2010) who found a correlation between the retrieval of source information and FOKs. Our data are also consistent with the results obtained by Thomas et al. (2011, 2012), who found that recalling attributes of the target stimulus – without recalling the stimulus name – led to higher FOKs. The present study differs from other studies that examined the noncriterial-recollection hypothesis by directly manipulating contextual information. Thus, across a wide range of FOK conditions and variants, contextual information affects FOK, even when, as in the present case, the contextual information does not affect accurate memory performance.

One potential criticism of the current methodology is that FOK (but not FOKr) was made after the participants had retrieved partial and contextual information. We did this because we wanted separation between the TOT judgments and the FOK judgments. It is also the standard procedure for such experiments on the relation of retrieved information and FOKs (see Koriat, 1993, 1995). But it also may be that we made the retrieval of partial and contextual information more salient, thus increasing the likelihood that it would be used for making FOKs. If so, we may have overestimated the influence of contextual information on FOK magnitude. However, it was also the case that TOTs followed the same pattern as FOK, and they were made prior to partial and contextual information retrieval. That is, although we lost data and did not have enough data to support the idea that TOTs are also influenced by contextual information, the means were in the expected direction.

In our study, FOK increased from the cases in which there was no partial information retrieved to the situations in which some partial information was retrieved, though not statistically significantly. There was simply a limited amount of partial information about the target name that could be retrieved, as all the names were of two syllables and of five or six letters long. Beyond the first letter of the name and perhaps the last sound, there was no other dimension in which partial information varied among the items. Indeed, we even held syllable length constant across the materials. Thus, with such a limited range of partial information, perhaps it is not surprising that, in this study, we did not find partial information to be predictive of FOK magnitude.

4.1. FOKs and TOTs

There are now data that show that TOTs and FOKs are dissociable, both behaviorally and with respect to brain regions. As such, the two metacognitive judgments should not be considered different levels of the same phenomenon (see Maril, Simons, Weaver, & Schacter, 2005; Schwartz, 2008; Schwartz & Bacon, 2008). In studies that measured both FOKs and TOTs, there is a strong correlation between the two judgments, but certain variables affect them differently (Schwartz, 2006). Schwartz (2008), for example, found that dividing attention did not affect FOKs but resulted in fewer TOTs. Maril et al. (2005), for their part, found that different areas of the prefrontal lobe were active during FOKs and TOTs. In other words, studies that examine TOTs do not necessarily generalize to those that examine FOKs. However, because an assessment of whether a participant was in a TOT always preceded the FOKs, there remains the possibility that TOTs were influencing subsequent FOKs.

4.2. Output and contextual information

An interesting finding was that total output was lower when more contextual information was provided, meaning that more answers were given during the recall phase when less related information was provided at the outset. Although this was not the main focus of the present study, we suspect that insofar as participants had the same study time in all conditions, they had more time in the minimum condition to study the target, resulting in a higher expectation of recalling the fictional animal's name. This may have created an expectation of recalling the target name in response to the animal's picture. This may have led to a lowering of the threshold to output an answer. Thus, it was not that the name was learned better under the experimental conditions, but, rather, that the threshold for producing any answer was lowered, resulting in more commission errors. This is an interpretation backed up by the finding that the FOKr data reflected total output, demonstrating that the participants' metacognition reflected this belief that more study time will be memory enhancing. Nonetheless, the interpretation remains speculative, and this issue will continue to be an interesting puzzle for future research.

The present study adds to a growing body of research that suggests that metacognitive judgments, such as FOKs, are based on heuristics, which are normally correlated with the cognition they are intended to measure (Hertzog et al., 2014; Schwartz & Metcalfe, 2011). Ina laboratory setting, it is possible to alter conditions in such a way that FOKs respond to variables, such as contextual information, which may not be correlated with target recognition. In this case, the greater the amount of related information that was provided and recalled, the larger the FOK, although this variable did not affect recall accuracy or recognition. This dissociation between recall and FOK lends support to the idea that metamemory is heuristic in nature.

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References

Bacon, E., & Izaute, M. (2009). Metacognition in schizophrenia: Processes underlying patients' reflections on their own episodic memory. *Biological Psychiatry, 66*, 1031–1037.
Baran, B., Tekcan, A. İ., Gürvit, H., & Boduroglu, A. (2009). Episodic memory and metamemory in Parkinson's disease patients. *Neuropsychology, 23*(6), 736.
Benjamin, A. S. (2005). Response speeding mediates the contribution of cue familiarity and target retrievability to metamnemonic judgments. *Psychonomic Bulletin & Review, 12*, 874–879.
Benjamin, A. S., & Diaz, M. (2008). Measurement of relative metamnemonic accuracy. In J. Dunlosky & R. A. Bjork (Eds.), *Handbook of memory and metamemory* (pp. 73–94). New York: Psychology Press.
Boduroglu, A., Tekcan, A. İ., & Kapucu, A. (2014). The relationship between executive functions, episodic feeling-of-knowing, and confidence judgments. *Journal of Cognitive Psychology, 26*, 333–345.
Brewer, G. A., Marsh, R. L., Clark-Foos, A., & Meeks, J. T. (2010). Noncriterial recollection influences metacognitive monitoring and control processes. *The Quarterly Journal of Experimental Psychology, 63*, 1936–1942.
Hart, J. T. (1965). Memory and the feeling-of-knowing experience. *Journal of Educational Psychology, 56*, 208–216.
Hart, J. T. (1966). A methodological note on feeling-of-knowing experiments. *Journal of Educational Psychology, 57*, 347–349.
Hart, J. T. (1967). Memory and the memory-monitoring process. *Journal of Verbal Learning & Verbal Behavior, 6*, 685–691.
Hertzog, C., Fulton, E. K., Sinclair, S. M., & Dunlosky, J. (2014). Recalled aspects of original encoding strategies influence episodic feeling of knowing. *Memory & Cognition, 42*, 126–140.
Hosey, L. A., Peynircioğlu, Z. F., & Rabinovitz, B. E. (2009). Feeling of knowing for names in response to faces. *Acta Psychologica, 130*, 214–224.
Izaute, M., & Bacon, E. (2006). Effects of the amnesic drug lorazepam on complete and partial information retrieval and monitoring accuracy. *Psychopharmacology, 188*, 472–481.
Koriat, A. (1993). How doe we know that we know? The accessibility account of the feeling of knowing. *Psychological Review, 100*, 609–639.
Koriat, A. (1995). Dissociating knowing and the feeling of knowing: Further evidence for the accessibility model. *Journal of Experimental Psychology: General, 124*, 311–333.
Kornell, N. (2012). A stability bias in human memory. In N. Seel (Ed.), *Encyclopedia of the sciences of learning* (pp. 4–7). New York: Springer.
Maril, A., Simons, J. S., Weaver, J. J., & Schacter, D. L. (2005). Graded recall success: An event-related fMRI comparison of tip of the tongue and feeling of knowing. *Neuroimage, 24*, 1130–1138.
Masson, M. E. J., & Rotello, C. M. (2009). Sources of bias in the Goodman-Kruskal gamma coefficient measure of association: Implications for studies of metacognitive processes. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 35*, 509–527.
Metcalfe, J. (1993). Novelty monitoring, metacognition, and control in a composite holographic associative recall model: Interpretations for Korsakoff amnesia. *Psychological Review, 100*, 3–22.
Metcalfe, J., Schwartz, B. L., & Joaquim, S. G. (1993). The cue familiarity heuristic in metacognition. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19*, 851–861. http://dx.doi.org/10.1037/0278-7393.19.4.851.
Nelson, T. O. (1984). A comparison of current measures of the accuracy of feeling-of-knowing predictions. *Psychological Bulletin, 95*, 109–133.
Schacter, D. L., & Worling, J. R. (1985). Attribute information and the feeling of knowing. *Canadian Journal of Psychology, 39*, 467–475.
Schwartz, B. L. (2006). Tip-of-the-tongue states as metacognition. *Metacognition and Learning, 1*, 149–158.
Schwartz, B. L. (2008). Working memory load differentially affects tip-of-the-tongue states and feeling-of-knowing judgment. *Memory & Cognition, 36*, 9–19.
Schwartz, B. L., & Bacon, E. (2008). Metacognitive neuroscience. In J. Dunlosky & R. Bjork (Eds.), *Handbook of metamemory and memory* (pp. 355–371). New York: Psychology Press.
Schwartz, B. L., & Metcalfe, J. (2011). Tip-of-the-tongue (TOT) states: Retrieval, behavior, and experience. *Memory & Cognition, 39*, 737–749.
Schwartz, B. L., & Smith, S. M. (1997). The retrieval of related information influences tip-of-the-tongue states. *Journal of Memory and Language, 36*, 68–86.
Souchay, C., Isingrini, M., & Gil, R. (2002). Alzheimer's disease and feeling-of-knowing in episodic memory. *Neuropsychologia, 40*, 2386–2396.
Souchay, C., Moulin, C. J. A., Clarys, D., Taconnat, L., & Isingrini, M. (2007). Diminished episodic memory awareness in older adults: Evidence from feeling-of-knowing and recollection. *Consciousness and Cognition: An International Journal, 16*, 769–784.

Thomas, A. K., Bulevich, J. B., & Dubois, S. (2011). The role of contextual information in episodic feeling of knowing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 38*, 96–108.
Thomas, A. K., Bulevich, J. B., & Dubois, S. J. (2012). An analysis of the determinants of the feeling-of-knowing. *Consciousness and Cognition, 21*, 1681–1694.
Weintraub, S., & Mesulam, M. M. (1985). Mental state assessment of young and elderly adults in behavioral neurology. In M. M. Mesulam (Ed.), *Principles of behavioral neurology* (pp. 71–123). Philadelphia: Davis Company.