The Retrieval of Related Information Influences Tip-of-the-Tongue States

BENNETT L. SCHWARTZ

Florida International University

AND

STEVEN M. SMITH

Texas A & M University

The sources underlying tip-of-the-tongue (TOT) states were examined by manipulating the amount of information provided at encoding. Using imaginary animals (TOTimals) as targets, we presented participants with three encoding conditions; a minimum-information condition (the country and the animal name, such as ''Panama-Yelkey''), a medium-information condition (country, animal name, picture of TOTimal), and a maximum-information condition (country, animal name, picture, and description). Medium and maximum-information conditions resulted in more reported TOT states than the minimum-information condition when the country was the cue at test. The encoding conditions did not differ in recall. In Experiments 2 and 3, we manipulated cue familiarity by priming the countries, leading to an increase in reported TOT states only in the minimum-information condition. In Experiment 3, we found that TOT states were associated with more retrieved pictorial information than non-TOT states. Results suggest that participants use the products of retrieval as a source of information for TOT states. © 1997 Academic Press

The tip-of-the-tongue (TOT) phenomenon refers to the subjective feeling that the retrieval of an unrecalled target is imminent (Brown, 1991; Brown & McNeill, 1966). In their classic study, Brown and McNeill (1966) introduced a technique that is now common among researchers for studying tip-of-the-tongue states. Definitions of low-frequency words were read (e.g., caduceus, zither), and if participants could not recall the word that matched the definition, they indicated whether or not they were in a TOT state. The instructions for defining a TOT state in the study were as follows: ''If you are unable to think of the word but feel sure that you know it and that you feel sure that is on the verge of com-

ing back to you then you are in a TOT state. . . .'' (Brown & McNeill, 1966, p. 327). If participants were in TOT states, they reported partial information about the target word such as first letter, number of syllables, words that sounded similar, or were synonymous with the target. Finally, participants were provided with the correct answer and asked whether the correct word was the word they thought they were seeking.

Our interest in this study is the nature of the subjective experience of the TOT state, and not in the processes that lead to temporary memory failure. Other researchers (e.g., Burke, MacKay, Worthley, & Wade, 1991; Jones, 1989; Meyer & Bock, 1992; Perfect & Hanley, 1992; Rubin, 1975) have sought to use the TOT state as a ''window'' into word retrieval. Their argument is based on the assumptions that (a) TOT states reflect an unretrieved but activated target, and (b) that the TOT state may be indicative of a broken, aborted, or slowed retrieval process. Thus, studying retrieval while participants are experiencing TOT states provides ''slow-motion

photography'' of word retrieval (Brown, 1991). However, we urge caution in studying memory retrieval by examining the subjective TOT state because the data suggest that memory and TOT states are dissociable (e.g., Koriat & Lieblich, 1977; Metcalfe, Schwartz, & Joaquim, 1993).

Because most previous research using TOT states focuses on the TOT state as a window on retrieval (Burke et al., 1991; Jones, 1989), we draw our hypotheses not from that domain, but from recent research on feeling-of-knowing judgments (Koriat, 1993; Metcalfe, 1993). TOT states and feeling-of-knowing judgments differ in the operational definitions given to participants (Brown, 1991). Feeling-of-knowing judgments generally ask whether participants think that they will recognize an item, whereas TOT states indicate the subjective feeling that recall is imminent. Thus, they differ in the test being predicted (recognition vs. recall), and in the sense of ''imminence'' that is emphasized in TOT states (Smith, 1994). Much of the recent research on feeling of knowing concerns what sources of information cause feeling-of-knowing judgments to go up or down (see, Koriat, 1993, 1994, 1995; Metcalfe, 1993, Miner & Reder, 1994; Schwartz, 1994). We will borrow the hypotheses generated for feeling of knowing and use them to study the TOT state. We think this transfer is justified because of the similarities between TOT states and feeling-of-knowing judgments (see Metcalfe et al., 1993; Miner & Reder, 1994, but see Widner, Smith, & Graziano, in press, for differences).

What Causes the TOT State?

The two traditional and competing explanations of the TOT phenomenon are incomplete activation and blocking (Brown, 1991; Smith, 1994). Incomplete activation implies that a to-be-retrieved target is of insufficient memory strength to be actually recalled, but that participants have enough access to the target to produce a TOT state. In contrast, blocking views suggest that retrieval of the target is prevented or delayed by the retrieval of related items, but the presence of these retrieved blockers leads to TOT states (Jones, 1989; Jones & Langford, 1987; Meyer & Bock, 1992; Perfect & Hanley, 1992; Smith, 1994). The data that support these hypotheses are ambiguous (see Brown, 1991; Schwartz, 1994; Smith, 1994 for a review of this literature). However, these two hypotheses are more concerned with why a target word is not retrieved when participants are experiencing a TOT than what causes the subjective experience of the TOT itself.

In contrast, Koriat (1993, 1994) suggested a new way to look at the sources of information that people use for TOT states and feeling of knowing. Koriat (1993) argued that the judgment process in TOT states does not have special access to the unretrieved target. Rather, he argued that TOT states are based on any information retrieved while searching for a target, regardless of whether the information is related to or unrelated to the actual target. The more partial target or related information that is retrieved, the more likely it is that a TOT state will occur. In the present context, partial information refers to incomplete retrieval of a target name (e.g., the first letter or number of syllables), whereas related information refers to anything else that might be retrieved when a given cue is presented. In Koriat's view, the TOT state is not directly linked to the strength of the target memory, and the retrieved information is not necessarily related to the target except via a common cue. The analysis suggests that TOT states may be dissociable from memory performance. Normally, the related information is correct, and the likelihood of TOT states will be correlated with later recall or recognition (e.g., Brown & McNeill, 1966; Koriat & Lieblich, 1974; see Brown, 1991). However, this hypothesis leaves open the possibility that if the retrieved information is incorrect, TOT states will be followed by later incorrect performance (e.g., Koriat, 1995).

Koriat's theory is supported by correlations between metamemory (both TOT states and feeling-of-knowing judgments) and the retrieval of information. Brown and McNeill (1966) showed that participants who reported

TOT states were able to correctly produce the first letter of the target and the correct number of syllables at better-than-chance rates. Koriat and Lieblich (1974) followed a similar procedure, but also asked participants to produce partial information on questions for which they did not report a TOT state. Participants reported the correct first letter more often when in a TOT state than when not in one. Similarly, participants reported the correct number of syllables more often when in a TOT state than when not in one. The data support the notion that TOT states *may accompany* retrieved partial information (see Brown, 1991), but do not show that partial information *causes* TOT states. The current experiments provide causal evidence to support Koriat's (1993) products-of-retrieval view (also known as the accessibility heuristic).

Methodological Considerations

Generally, tip-of-the-tongue studies have required retrieval of semantic knowledge, such as words from their definitions (Brown & McNeill, 1966; Koriat & Lieblich, 1974; 1977, Jones, 1989; Meyer & Bock, 1992), names of famous people from their descriptions (Brennan, Baguley, Bright, & Bruce, 1990), or answers to general-information questions (Finley & Sharp, 1989; Freedman & Landauer, 1966). Metcalfe et al. (1993) used experimentally-learned word pairs, tapping episodic memory. Differences in the subjective states, accuracy levels, or mechanisms between TOT states in semantic and episodic memory paradigms are not known.

Smith (1994) has pointed out methodological problems with the semantic knowledge paradigms. Smith (1994) wrote ''one of the most basic problems concerns a fundamental issue in empirical research on memory, namely, mechanisms for controlling and/or observing acquisition and retention factors'' (p. 30). In semantic knowledge paradigms, the experimenter does not have control over participants' pre-experimental history, limiting the conclusions that can be drawn from semantic memory experiments. The use of experimentally-learned word pairs, by contrast, may fos-

ter experimental control, but may limit ecological validity and with respect to the current hypotheses, limit retrieved information that participants can use.

The current experiments use the TOTimal method (Smith, 1994; Smith, Balfour, & Brown, 1994; Smith, Brown, & Balfour, 1991). The method asks participants to learn the names and biographies of imaginary animals (referred to as TOTimals). Participants study a picture of the animal in conjunction with its name, country, diet, and size. Participants are asked later to recall the name of the animal, given any of the other information as the cue. In the past, Smith and his colleagues have focused on using the *picture* as the cue. Here, however, we will use the animal's *country* (habitat) as the cue for name retrieval. The TOTimal method allows for the careful control of encoding and retrieval variables, simulates more naturalistic (i.e., semantic memory) stimuli, and may facilitate multiple retrieval routes. It also provides the same level of experimental control that is obtained with paired associates.

Smith et al. (1991, 1994) found that recall of the names of TOTimals learned in the laboratory produced high levels of TOT experiences. Each imaginary animal consisted of a 3-syllable name, a picture, and a brief description. The target materials were similar to exemplars of a common category (animals), and were pronounceable names that slightly resembled actual animals names so that they could be easily learned. Smith et al. (1991) found that TOT states for these fictional animals were similar to TOT states for naturalistic stimuli, and thus were appropriate for testing the effects of variables on TOT states.

Hypotheses

Using a modified TOTimal methodology, the present experiments tested the effects of the amount of related information studied at the time of encoding on the subsequent rate of TOT states. Three within-subject conditions were compared. In the minimum-information condition, participants studied the name of a country (e.g., ''Panama''), and the name of

the animal found there (e.g., ''Yelkey''). In the minimum-information condition, participants did not see a picture of the animal. In the medium-information condition, participants studied the name-country pair in conjunction with a picture of the animal. In the maximum-information condition, participants studied the name-country pair in conjunction with the picture and information about the size and diet of the animal. At the time of test, participants in all three conditions saw the country name as the retrieval cue for the animal name. Thus, we could observe the effects of providing related information at encoding on the number of reported TOT states at retrieval. Koriat's (1993) theory states that products of retrieval influence the TOT state. The more information that can be retrieved with a given cue, the more likely a TOT state will be reported. Therefore, we predicted that the inclusion of picture and a description of the animal at input would lead to a higher rate of TOT states than in the condition without the inclusion of the picture of the animal.

EXPERIMENT 1

Method

Participants. The 82 participants were volunteers from an introductory psychology class at Florida International University. They fulfilled part of a class requirement by participating in the experiment. Participants were run in six groups of approximately 15 participants each.

Materials. We used 12 TOTimals (see Fig. 1). These TOTimals were similar to those used by Smith et al. (1991; 1994), and were used throughout the experimental series. The TOTimal pictures were line drawings that were printed onto transparencies for use in the experiment. These pictures were then paired with a two-syllable name, country (the animal's ''habitat''), size, and diet. The name and country pairs were the same throughout the experiment, but the picture, size, and diet varied as a function of the counterbalancing conditions (see below). The names, pictures, and descriptions were created to resemble real

Examples of TOTimals

Maximum-Information Condition

PANAMA-YELKEY
2'
BERRIES

Medium-Information Condition

FRANCE - RITTLE

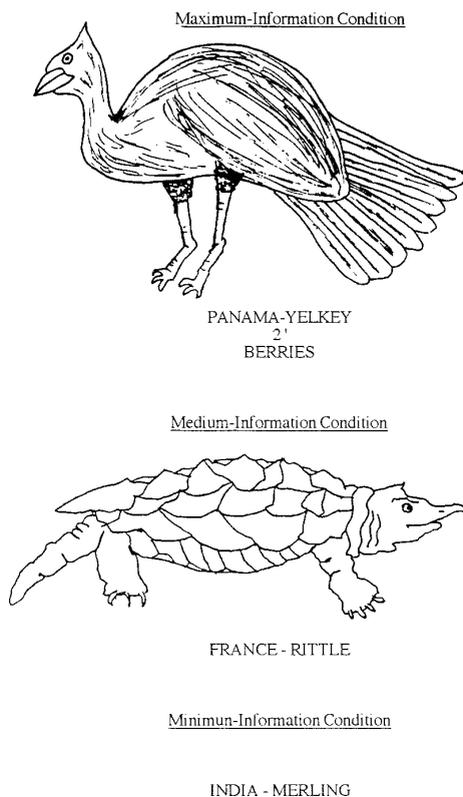Minimun-Information Condition

INDIA - MERLING

FIG. 1. Examples of stimuli used in Experiments 1 and 2.

animals in order that the TOTimals could be learned more easily. The first letter of the name of each TOTimal was unique. The descriptions, countries, and diets were unique for each TOTimal.

Design. One within-subject independent variable was manipulated—the amount of information provided at encoding. There were three levels of this variable; minimal information (country only), medium information (country and picture) and maximum information (country, picture, size, and diet). Five dependent measures were observed; recall, TOT rates, first letter recall, recall of related information, and recognition.

We counterbalanced stimuli across conditions in the following manner. The names and countries were divided into three sets of four stimuli. We then ran six groups of partici-

pants, with the three sets of stimuli appearing in all possible combinations of the experimental conditions. For example, in one counterbalancing condition, ''Canada-Vithon'' was presented alone, in another condition it appeared with a picture, and in a third condition, it appeared with a different picture and biographical information. Another pair, ''Panama-Yelkey'' appeared with a picture with one group of subjects and with a picture and biographical information with another group of subjects when ''Canada-Vithon'' was presented alone. The pairs that were in the medium or maximum-information condition were randomly assigned a particular TOTimal picture and description (from eight used in this experiment). Once a pair was assigned to a picture-included condition, the actual TOTimal picture chosen was varied randomly across the name-country pairs. Descriptions were also assigned randomly to the name-country pairs. Some deviations from strict random assignment were made when the description did not match the animal or its country in the maximum-information condition (e.g., ''Canada-Vithon'' was never paired with a diet of bananas).

Procedure. The procedure consisted of three phases: target learning, recall testing/ TOT judgments, and recognition testing. Instructions prior to the learning phase directed participants to learn the names of imaginary animals. Participants were explicitly told that they would receive later the countries as cues to recall the names of animals. They were not told at the time of study, however, that they would later make TOT judgments.

Participants were given an initial 10-s presentation of each TOTimal. The experimenter showed the TOTimal on an overhead projector and read the information aloud as the participants read it silently. After participants viewed each of the 12 TOTimals, the experimenter presented the TOTimals again, exposing each one for an additional 5 s. Both presentation orders were the same. Thus, participants saw each TOTimal twice for a total of 15 s each. The order was switched for the next group of participants. Six different orders were used in all.

If a TOTimal was in the minimum-information condition, participants saw the name of the TOTimal and its country only (e.g., *Canada-Vithon*). If a TOTimal was in the medium-information condition, a picture of an animal was included. If a TOTimal was in the maximum-information condition, diet and size information (*mice, 2′*) were included as well as the country and the picture.

After completion of the study session, the experimenter handed out a written test to the participants. The test had 12 sets of questions, one for each TOTimal. The name of the country was provided for each TOTimal (e.g., Canada _?), and the participants were required to write the name of the animal that came from the country indicated. Participants did not see the picture of the TOTimal during the testing phase. Underneath the cue, a prompt for a TOT state was included. If participants were unable to recall the correct name, they indicated whether or not they were experiencing a TOT state. The experimenter defined a TOT state in the following manner; ''A tip-of-the-tongue state is a feeling that you can recall the answer. Its the feeling of being on the verge of being able to recall the answer that you cannot now recall.'' If participants could not recall the name of the TOTimal, they were given the option of reporting the first letter and providing any other information they could remember about the TOTimal. They were asked to guess at the first letter when they could not recall it or when they were not in a TOT state (although few participants complied with this request). Participants were also given the option of reporting any related information concerning the target animal's name, its size, diet, or appearance. Participants were encouraged to report anything they remembered, but were not required to guess. They made their TOT judgment before they reported first-letter information. Participants then attempted recall of the next target item. The test phase was self-paced. After all participants had completed the recall/TOT phase, the recognition test was distributed to the participants. A four-alternative forced-choice recognition test was used. Again, participants

TABLE 1

MEAN PERCENTAGE OF RECALL, PERCENTAGE OF LIKE-
LIHOOD OF A TOT STATE PER UNRECALLED TARGET, MEAN
PERCENTAGE OF FIRST LETTER RECALL, PERCENTAGE REC-
OGNIZED, AND PERCENTAGE OF REPORTED INFORMATION
PER ITEM, AS A FUNCTION OF PRESENTATION OF RELATED
INFORMATION IN EXPERIMENT 1

	Related information		
	Minimum	Medium	Maximum
TOT	.10	.15	.16
Recall	.37	.38	.37
First letter	.07	.08	.07
Recognition	.73	.75	.74
Other info	.06	.14	.21

saw the country as a cue, and were provided with four potential names for each stimulus. The correct answer was always present, and the other choices were names of other TOT-imals. Participants made recognition judgments for all 12 items, regardless of whether the target had been recalled correctly earlier. Each name appeared once as a correct answer and three times as an incorrect distractor.

Results

Statistical reliability was measured at $p \leq .05$, as adjusted by Greenhouse-Geisser epsilon, in all the experiments discussed here. The Greenhouse-Geisser epsilon measures the extent to which the correlation between observations violates the assumption of sphericity, required for a univariate-repeated-measures-hypothesis test (Stevens, 1986, p. 413). Violations of the assumption for univariate tests were minor in all of the analyses reported. To further examine data when a significant omnibus F was found, we used Newman–Keuls post-hoc tests.

TOT states. TOT states varied as a function of encoding condition, $F(2,162) = 3.72$, $MS_e = .02$ (see Table 1). Post-hoc tests indicated that there were more reported TOT states in the picture-included conditions (medium and maximum-information conditions) than in the country-alone condition (minimum-informa-

tion). In addition, recognition was more accurate following TOT states (.81) than when TOT states did not occur (.70), $F(1, 57) = 5.93$, $MS_e = .06$ (note for this F value, 24 participants were not included because they failed to report any TOT states). Because TOT states were relatively rare (just over 1.5 per participant), we did not look at accuracy as a function of condition because there would have been insufficient data in each cell to make such a conclusion.

Measures of retrieval. The mean rate of recall in Experiment 1 was 37%.[1] There were no reliable differences between conditions with respect to recall ($F < 1$); (see Table 1). First letter identification was extremely low (7%), and did not vary as a function of condition ($F < 1$). Finally, recognition performance was relatively high, (74%), and also did not vary as function of condition ($F < 1$).

We looked at the total amount of related information reported by participants. This includes anything the participant may have written about the diet (e.g., ''berries,'' ''bananas,'' or ''mice'') and size of the animal (''7′ long,'' ''as big as a large dog''), or what kind of animal it was (''fish,'' ''lizard,'' ''some kind of reptile''), or what it looked like (''looked like an elephant with his nose chopped down,'' ''something between a monkey and a raccoon''). We also included reports such as ''no picture shown'' to be related information. We did not score the information as correct or incorrect because Koriat's theory is about the total amount of retrieved information, regardless of its status as correct. There was a significant main effect of encoding con-

---

[1] Recall was scored by a loose criterion. The participant's response was required to have only the first three letters of the target name correct to be counted as correct. We also scored by a stricter criterion in which all letters had to be correct. There was still no statistical difference between conditions when the stricter criterion was used. Moreover, we did not look at commission error rates. Because our interest was in TOT states, and commission errors, by definition, are those that, although incorrect, are believed by the subject to be correct, commission errors were not followed by TOT judgments. Thus, all TOT judgments follow errors of omission.

dition on amount reported, $F(2, 162) = 12.51$, $MS_e = .04$ (see Table 1). Post-hoc tests showed that more information was retrieved in the maximum condition than the medium condition, and that more information was retrieved in the medium condition than the minimum condition. Not surprisingly, participants reported more information in those conditions in which they were presented with more information.

Another prediction based on the retrieval-of-information hypothesis is that participants who retrieve information will be more likely to enter a TOT state than those who do not. However, there were no differences in reported TOT states between those who reported related information (1.46 TOT states) and those who did not (1.56 TOT states). This result was puzzling. According to Koriat's hypothesis, TOT states should be accompanied by more retrieved information. It is possible that participants may have perceived that the reporting of related information was not crucial to the experimenter, and many may have consequently withheld related information when they indeed possessed it. In fact, inspection of Table 1 suggests that very little information was actually reported. We adjusted the procedure in Experiment 3 to place greater demands on participants to report related information if it was accessible. In Experiment 3, more elaborate instructions were given about the importance of reporting related information, and the information was divided into categories such that participants could report all retrieved information. As we will report later, with the procedural improvements, the TOT contingent analyses support Koriat's theory.

Discussion

It was found that studying additional information at the time of encoding led to more reported TOT states for target items. Even though pictures were not part of the retrieval cue, their presence at encoding influenced reported TOT states. This finding supports the view that retrieval of related information can influence the TOT experience, consistent with our original hypotheses and Koriat's (1993) theory.

One unexpected result needs to be explained. Whereas we predicted that the minimum-information condition would show the lowest number of TOT states, we also predicted that the maximum-information condition would result in more TOT states than the medium-information condition because more information was provided. No differences, however, were observed between TOT rates in the medium and maximum-information condition. Moreover, participants did not retrieve more related information when in a TOT state than when not in one. This finding represents a challenge to the products-of-retrieval view. We will pursue this in Experiment 3.

Although all retrieved information may be potentially used for TOT states, some information may be weighted more heavily than other information. Retrieved pictorial information may be heavily weighted, and, therefore, any retrieval of what the animal looks like is likely to produce a TOT state. However, the retrieval of biographical information may not receive as high a weighting, and under the current circumstances may not influence a participant's decision at all. Thus some information may ''outshine'' other retrieved information as a cue for TOT states (see Smith, 1988). Thus, we suspect that under conditions in which pictorial information is not present, other sources of information may play a larger role. Alternatively, TOT states may be sensitive to only some kinds of retrieved information. It is possible that related pictorial information, but not related descriptive information, leads to a greater likelihood of reporting a TOT state. We will address this issue in Experiment 3.

EXPERIMENT 2

Because of the accessibility of partial information and the strong subjective experience associated with the TOT state, most theorists have dismissed the possibility of cue-based sources of the TOT state. Although only two studies have addressed this issue, both point

towards a possible role for the use of cue information in TOT states (Koriat & Lieblich, 1977; Metcalfe et al., 1993). Cue familiarity appears to be important in other metamemory judgments made at the time of retrieval. These judgments include speeded strategy decisions (Reder, 1987; Reder & Ritter, 1992) and feeling-of-knowing judgments (Metcalfe et al., 1993; Schwartz & Metcalfe, 1992; Widner, 1995).

Koriat and Lieblich (1977) looked at reported TOT states for targets as a function of characteristics of the questions, or pointers, that elicited the TOT states. Koriat and Lieblich (1977) analyzed the pointers along several dimensions, but the most relevant finding in the present context is that question redundancy led to more reported TOT states for unrecalled items. For example, definitions with repetitive elements, such as ''a circle, or any indication of radiant light, around the heads of divinities, saints, sovereigns in pictures, medal, etc.'' (answer: nimbus) produced more TOT states than did shorter and more concise definitions, such as ''the science of coins'' (answer: numismatics). This pattern of more TOT states in questions with repetitive elements was constant across TOT states that were resolved (i.e., eventually recalled or recognized), and those that were not. Koriat and Lieblich (1977) labeled another pointer characteristic ''specificity,'' a variable that accounts for whether a given pointer elicits the actual target. Thus, Koriat and Lieblich's results suggest that cue factors, in addition to target factors, play a role in determining TOT states.

Metcalfe et al. (1993) tested the respective roles of cue-based sources and target-based sources in TOT states with experimentally learned word-pairs. Participants studied cue-target pairs. In one condition, both the cue and the target were repeated (A-B A-B; e.g., captain-carbon, captain-carbon). In a second condition, the cue was repeated, but with a new unrelated target (A-B, A-D; e.g., pasture-dragon, pasture-canoe). In a third condition, neither the cue nor the target was repeated (A-B, C-D; e.g., carol-purple, cotton-pepper).

Consistent with predictions from interference paradigms, Metcalfe et al. (1993) found that the A-B A-D condition showed the lowest recall whereas recall was highest in the A-B A-B condition. If reported TOT states are based on the strength of the representation, the A-B A-B condition would also show the highest number of TOT states. Consistent with the cue familiarity hypothesis, conditions in which the cue was repeated (A-B A-B and A-B A-D) showed more reported TOT states than the condition in which the cue was presented once (A-B C-D).

To test whether cue familiarity influences TOT states with TOTimals, we adapted Reder's (1987) cue priming procedure. She found that priming terms from the question led to more ''will know'' responses in a speeded decision of knowledge. Schwartz and Metcalfe (1992) found that cue priming led to an increase in feeling-of-knowing judgments in a paired-associate experiment. Widner (1995) found that cue priming also led to an increase in feeling-of-knowing judgments for general-information questions. In Experiment 2, we used a cue priming procedure to look at cue familiarity effects on TOT states. Prior to the learning of TOTimals, participants were asked to rate a list of countries for perceived pleasantness. Participants rated a list of countries, some of which would later be country-cues in the TOTimal experiment. The cue familiarity hypothesis states that cue priming should increase the number of reported TOT states.

Method

Participants. The 96 participants were volunteers from an introductory psychology class at Florida International University. They fulfilled part of a class requirement by participating in the experiment. Participants were run in groups varying in size from 6 people to 24 people. Because of the varying sizes of the groups, most counter-balanced conditions were repeated in several groups, although one counterbalanced condition only had to be tested once.

Materials. The materials were the same as Experiment 1.

Design. A 2×2 within-subject design was employed. Two independent variables were manipulated—the amount of information provided at encoding and cue priming. There were two levels of amount of information; minimal information (country only) and medium information (country and picture). Cue priming had two levels; cue primed, and unprimed. Four dependent measures were collected: percent recalled, percent reported TOT states, recall of the first letter, and a final recognition measure. Stimuli were counterbalanced across conditions via a Latin-square design, such that each set of stimuli was seen in each of the four experimental conditions.

Procedure. Participants were given a list of 24 countries, six of which would later be the country of TOTimals. Participants made pleasantness judgments for these countries. The instructions specified that participants were to give high pleasantness judgments to those countries that would make nice places to spend a vacation, and to give lower judgments to less desirable vacation destinations. Participants made their ratings on a 1–5 scale. Participants were not yet informed about the nature of the TOTimal experiment. Following the pleasantness task, participants were given instructions about the study phase.

Participants were then given the study session with the TOTimals as described in Experiment 1. Participants were exposed to each of 12 TOTimals for one 10-s trial. After the participants saw all of the TOTimals, a second presentation was given for 5-s. Each presentation of TOTimals was done in a new random order. Information was presented on an overhead projector, and the experimenter read the name and country of each animal.

Participants were then given a written recall/TOT test similar to the one used in Experiment 1. Participants wrote down the correct answer if they knew it, and if they did not, they indicated whether or not they were in a TOT state for that item. They were also given the option of guessing the first letter for unrecalled items. Participants were encouraged, but not required, to guess. Subjects were not asked to recall related information.

To assess the accuracy of the TOT states, we included a final recognition test. The experimenter handed out a final test form on which were the 12 country names, each followed by four animal names, one of which was always the correct answer. The distractors were drawn from items presented in the experiment. Each TOTimal was used as a correct target once, and as a distractor three times.

Results

TOT Reports. The medium-information condition showed more TOT states than did the minimum-information condition, $F(1,95) = 4.48$, $MS_e = .03$ (see Table 2). Cue priming did not lead to a higher rate of reported TOT states than the unprimed condition, $F(1,95) = 3.07$, $MS_e = .03$, $p = .08$. There was, however, a significant interaction, $F(1,95) = 4.83$, $MS_e = .03$. Post-hoc tests confirmed that a lower rate of TOT states were reported in the unprimed minimum-information condition than the other three conditions. Recognition was higher following a TOT (.83) than otherwise (.74), $F(1,71) = 5.94$, $MS_e = .05$.

Measures of retrieval. Neither cue priming nor information condition affected the rate of recall (F's < 1), nor was there an interaction ($F = 1.76$) (see Table 2). Cue-primed items were no more likely to elicit first-letter recall than unprimed items, $F(1,95) = 3.24$, $MS_e = .16$, $p = .01$. Information condition did not affect first letter report ($F < 1$), nor was the interaction significant, $F(1,95) = 2.70$, $MS_e = .02$, $p = .10$ (see Table 2). Neither cue priming ($F < 1$) nor information condition ($F = 1.70$), nor the interaction ($F < 1$) affected the rate of successful name recognition (see Table 2). We did not ask participants to report related information in this Experiment.

Discussion

As in Experiment 1, the present results support the view that the products of retrieval are used to form TOT states. Once again, more TOT states were reported following the presentation of picture information than when it was not present. In addition, cue priming increased the reported TOT states in the mini-

TABLE 2

Mean Percentage of Recall, Percentage of Likelihood of a TOT State per Unrecalled Target, Percentage of First Letter Recall, and Percentage Recognized as a Function of Presentation of Cue Priming and Related Information in Experiment 2

	Cue primed		Unprimed	
	Minimum	Medium	Minimum	Medium
TOT	.17	.16	.09	.17
Recall	.33	.37	.36	.34
First letter	.06	.11	.07	.07
Recognition	.75	.76	.72	.73

mum-information condition. However, cue priming did not affect reported TOT states in the picture-included condition. We now consider the significance of this finding.

Schwartz (1994) argued that participants can and do use a variety of sources of information when making metamemory judgments. The accuracy of such judgments indicates that participants usually select the appropriate source of information (see Nelson, 1988). Because more correct than incorrect information is retrieved, TOT states will be usually accurate (Koriat, 1993). When no partial or related information is accessible, other sources of information may be critical. It is possible that when no retrieved information is accessible, participants rely on cue information. When more diagnostic information becomes accessible, such as retrieved related information, participants no longer consider cue familiarity relevant. This admittedly post-hoc explanation accounts for the interaction between cue priming and information condition in which cue priming only increases the rate of TOT states in the minimum-information condition. By what mechanism, then, does cue priming work?

Priming the cue increases its relative familiarity. By cue familiarity we mean non-target information available without any retrieval. Metcalfe et al. (1993) argued that participants assess the familiarity of a cue when they indicate TOT states and when they make feeling-of-knowing judgments. These cue familiarity-based judgments are made on the basis of information in the cue without or before the retrieval of any information (see Reder & Ritter, 1992). Therefore, prior exposure to a cue increases the familiarity of the cue regardless of its status as an effective retrieval cue.

Koriat (1993, 1995) argued that cue priming may increase feeling-of-knowing (and TOTs) by increasing the amount of information retrieved in response to the cue. In the theory, a familiar cue allows more information to be retrieved more fluently. It is this retrieved information, then, not the cue familiarity per se, that increases the likelihood of a TOT state. Koriat's view then predicts that cue priming should increase the likelihood of a TOT state in both the maximum and minimum-information conditions. However, as indicated above, this was not observed. It is also possible to apply this logic to explain the null differences between medium and maximum-information conditions—some information is better than others. When specific information about how an animal looks is accessible, this outshines all other information. However, when no such information is available, then retrieved related information about a country presented as a cue may become important.

Therefore, there are at least two potential explanations for cue priming. One focuses on cue familiarity without the need for retrieval of related information (e.g., Metcalfe et al., 1993; Reder & Ritter, 1992). The second hypothesis suggests that primed cues elicit more information, and the greater amount of retrieved information induces TOT states. Be-

cause we did not ask participants to report related information, we could not distinguish these two hypotheses. In Experiment 3, we look again at cue priming, but also ask participants to report related information.

EXPERIMENT 3

Encoding conditions influenced the rate of TOT states in both Experiments 1 and 2. However, we did not find a reliable association between retrieved information and the likelihood of a TOT state in Experiment 1. Furthermore, in Experiment 1, the TOT rates were the same in the maximum-information condition and the medium-information condition, even though more related information was retrieved in the maximum condition. Both of these observations cloud the interpretation that the retrieval of related information causes the differences in TOT rates. Therefore, we have modified our hypotheses slightly. We now advance the hypothesis that some information (e.g., pictorial information) is more important than other information. Koriat (1993) argued that all retrieved information was likely to influence TOT rates. We, however, have found that only pictorial information influences TOT rates. It appears that not all retrieved information is equal—participants consider some retrieved information more valuable than other retrieved information. In Experiment 3, we examine the retrieval of pictorial and biographical information separately. We predict that only pictorial information will influence reported TOT rates. Moreover, we suspect that when we look at participants in TOT states, we will find them reporting pictorial information more often than when they are not in a TOT state.

In Experiment 2, we demonstrated a cue priming effect on TOT rates. However, the experiment did not provide insight concerning the mechanism by which cue priming works. In Experiment 3, we test two hypotheses concerning the locus of the cue priming effect. Koriat (1993, 1995) argued that cue priming may work because participants recover more information from primed cues. Consequently, we advance the hypothesis that participants

should retrieve more related information in the cue-primed conditions. In contrast, Metcalfe (1993) argued that participants are directly sensitive to cue familiarity, and that cue familiarity judgments precede retrieval. This hypothesis suggests that cue priming may occur independently of the retrieval of information, and will be supported if we find that cue priming increases TOT rates without affecting retrieval of related information.

In Experiment 3, we addressed both the issue of the selective value of different kinds of information and the mechanism underlying cue familiarity. To accomplish this, we again crossed encoding conditions with cue priming, but included all three information conditions. We also asked participants to report related information, pertaining to the size of the animal, the diet, and its appearance (pictorial information). Each category of related information was asked separately. Instructions given at the time of retrieval stressed the importance of reporting any retrieved information. If Koriat's view of cue priming is correct, more retrieved information should be reported in the cue primed conditions. If our view of the relative importance of retrieved information, the reporting of pictorial information should correlate with the likelihood of a TOT state.

Method

Participants. The 112 participants were volunteers from an introductory psychology class at Florida International University. They fulfilled part of a class requirement by participating in the experiment. Participants were run in groups varying in size from 20 people to 40 people.

Materials. The materials were the same as Experiment 1.

Design. A 3×2 within-subject design was employed. Two independent variables were manipulated—the amount of information provided at encoding and cue priming. There were three levels of amount of information; minimal information (country only), medium information (country and picture), and maximum (country, picture, diet, and size). Cue priming had two levels; cue primed, and un-

primed. Seven dependent measures were collected: percentage recalled, percentage reported TOT states, recall of the first letter, recall of diet, recall of size, recall of general appearance, and a final recognition measure.

We counterbalanced stimuli across condition in the following manner. The names and countries were divided into three sets of four stimuli. We then ran four groups of participants, with the three sets of stimuli appearing in each of the information conditions. Two items from each information condition were then chosen randomly from each group to be the to-be-primed cues. Two different sets of priming sheets were distributed to different participants within each group. The assignment of pictures, diets, and size was then done in the same fashion as Experiment 1.

Procedure. The procedure was identical to Experiment 2 with the following exceptions. First, participants studied each of the 12 TOT-imals three times (instead of two). The first exposure was for ten seconds, the following two for 5 s. Thus, each participant viewed each stimuli for 20 s. This was expected to increase the rate of TOT states (see Smith, 1994). Second, the maximum-information condition was included. Third, during the recall phases, participants were given specific questions asking them to report on the diet, size, and appearance of the TOTimals shown. Participants were also specifically asked to report ''not given'' if they remembered that biographical information or a picture was not given for one of the to-be-remembered names.

Results

TOT states. TOT states varied as a function of encoding condition, $F(2,222) = 8.93$, $MS_e = .05$ (see Table 3). Planned comparisons indicated that there were more reported TOT states in the picture-included conditions (medium and maximum-information conditions) than in the country-alone condition (minimum-information). Secondly, cue priming and encoding conditions interacted, $F(2,222) = 3.31$, $MS_e = .05$. Planned comparisons demonstrated that the cue priming effect was statistically significant only in the minimum-infor-

mation condition, replicating Experiment 2. It is worth noting that the direction of the means is consistent with an overall cue priming effect, but this was not statistically significant, $F(1,111) = 3.38$, $MS_e = .06$, $p = .07$. Recognition was more accurate following TOT states (.84) than when TOT states did not occur (.64), $t(90) = 2.33$, (21 participants were not included because they failed to report any TOT states).

Measures of target retrieval. Even though subjects were allowed an extra study trial, correct recall remained approximately the same (35%). Neither cue priming ($F < 1$) nor encoding condition ($F < 1$) nor the interaction ($F = 1.28$) affected recall (see Table 1). Furthermore, despite the extra study trial, recognition was lower than the first two experiments (67%). For correct recognition, neither cue priming ($F < 1$) nor encoding condition ($F = 2.17$) nor the interaction ($F < 1$) affected recognition. Overall correct identification of the first letter was quite low (.07), and there were no differences as a function of experimental conditions or their interaction (all F's < 1).

Measures of retrieval of related information. When we turned our analyses to the report of related information, a different story emerged. Here we analyzed the data as a function of amount of information reported in any particular condition, regardless of its correctness. Indeed, most information was correct (91%), but in keeping with Koriat's hypothesis, we looked at total information reported, rather than correct information. Because there is more information that can be reported in the maximum information condition than the medium-information condition, and more in the medium-information condition than the minimum, standard analyses of variances are potentially misleading. We chose to use them because our instructions were specific about reporting ''no-information given'' whenever possible. Therefore, to facilitate the analysis of the data, we first report the 3 × 2 ANOVAs, and then look specifically for cue-priming effects within appropriate information condition using planned comparisons.

TABLE 3

MEAN PERCENTAGE RECALL, PERCENTAGE LIKELIHOOD OF A TOT STATE PER UNRECALLED TARGET, MEAN PERCENT-
AGE OF FIRST LETTER RECALL, MEAN PERCENTAGE OF DIET INFORMATION, MEAN PERCENTAGE OF SIZE INFORMATION,
MEAN PERCENTAGE OF APPEARANCE INFORMATION, PERCENTAGE RECOGNIZED, AS A FUNCTION OF PRESENTATION OF
RELATED INFORMATION AND CUE PRIMING IN EXPERIMENT 3

	Cue primed			Unprimed		
	Minimum	Medium	Maximum	Minimum	Medium	Maximum
TOT	.16	.20	.18	.06	.18	.19
Recall	.33	.31	.34	.35	.35	.31
First letter	.08	.08	.06	.07	.08	.06
Diet	.17	.09	.34	.14	.11	.23
Size	.17	.07	.29	.15	.10	.22
Appearance	.21	.31	.35	.16	.28	.29
Recognition	.66	.69	.62	.65	.69	.67

Diet information was only given in the maximum-information condition. Therefore, a good strategy would have been to indicate "no-information given" except when participants specifically remembered what the TOT-imals ate. However, few subjects adopted such a strategy and overall reported information was low. However, the experimental variables did affect report of diet information. First, and not surprising, information conditions affected the report of diet information, $F(2,222) = 32.64$, $MS_e = .06$ (see Table 3). Planned comparisons showed that more information was reported in the maximum-information condition than in the other two. Cue priming, moreover, increased the likelihood of reporting diet information, $F(1,111) = 4.86$, $MS_e = .05$. The interaction was statistically significant as well, $F(2,222) = 5.08$, $MS_e = .05$. Post-hoc tests indicated that this difference was largest in the maximum-information condition.

The means for the recall of size information are almost identical to the diet recall (see Table 3). Encoding conditions affected recall of size information, $F(2,222) = 21.05$, $MS_e = .07$. Planned comparisons indicated that participants were more likely to recall size information in the maximum-information than in the other two conditions. For size information, cue priming did not yield a significant effect ($F = 1.7$), but there was a significant interaction between information conditions and cue

priming, $F(2,222) = 3.46$, $MS_e = .05$. Post-hoc tests showed that cue priming was effective in increasing the amount of size information reported in the maximum-information condition.

Retrieval of picture-related information followed a different pattern because retrieval information was included in both picture-included conditions. Encoding conditions affected the amount of picture-related information reported, $F(2,222) = 12.02$, $MS_e = .10$. Planned comparisons demonstrated that less information was reported in the minimum-information condition than the picture-included conditions. Moreover, more picture-related information was reported in the cue-primed condition than in the unprimed condition, $F(1,111) = 4.29$, $MS_e = .08$. The two variables did not interact ($F < 1$).

TOT contingent analyses. Another prediction based on the accessibility hypothesis is that participants who retrieve information may be more likely to enter a TOT state than those who do not. We tested this prediction by looking at the amount of information retrieved by subjects when they were in TOT states and when they were not in TOT states. We again divided retrieved information into the three categories; diet, size, and picture-related information. Whereas a strict interpretation of Koriat's accessibility-heuristic hypothesis suggests that all three categories of information
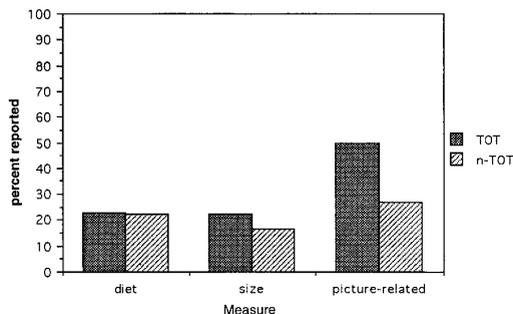
FIG. 2. Retrieval of related information as a function of whether a TOT state was reported or not. N-tot means that items for which TOT states were not reported.

should be higher in TOT states, our previous results suggest that only the picture-related information should be higher. Recall of diet-related information was 22.7% for TOT states and 22.3% for non-TOTs. This difference was not statistically significant ($t < 1$). Recall of size-related information was 22.3% for TOT states and 16.7% for non-TOTs. This difference was not statistically significant, $t(90) = 1.48$. Recall of picture-related information was 49.9% for TOT states and 26.9% for non-TOT states, $t(90) = 4.77$ (see Fig. 2). Thus, these data support the idea that the retrieval of picture-related information is used in producing TOT states.

Discussion

We begin by summarizing the major findings. First, we replicated the major findings of the first two experiments. Encoding conditions affected the likelihood of a TOT state in the absence of any effect on target-name memorability. TOT states increased only when picture information was included and was not higher when additional biographical information about the TOT was given. Cue priming affected the likelihood of a TOT state only in the minimum-information condition.

The new findings in this experiment concern the retrieval of related information. We looked at the three kinds (diet, size, and appearance) of related information separately. Cue priming increased the retrieval of both diet-related information and appearance-re-

lated information. Cue priming also increased retrieval of size-related information in the maximum-information condition. This finding is consistent with Koriat's (1993, 1995) view that cue priming affects metamemory judgments by bringing to mind more related information about the target.

An interesting question is why cue priming increases the retrieval of related information. The current data do not shed light on this topic, but it may be important in delineating the differences between the indirect and direct nature of cue priming. One possibility is that participants retrieve the priming episode when they study the TOTimal. This may allow participants to establish more elaborate connections between the features of the TOTimal. Alternatively, participants may retrieve the priming episode at the time of test. Either of these possibilities, however, suggest that cue priming should increase recall of the target name, which it does not. One explanation is that it may be easier to associate the priming episode with meaningful information (picture and biography) than with meaningless new names (''Vithon,'' ''Yelkey''). At the same time, cue priming may increase TOT states because information about the country itself is retrieved (e.g., name of the capital, why its a nice vacation destination, etc.).

An important finding in Experiment 3 is that participants were more likely to report appearance-related information, but not size and diet-related information, when they were experiencing a TOT state. In fact, participants were twice as likely to report information about the appearance of the TOTimal when they reported a TOT state than when they did not. We argue that this finding supports the data from the experimentally-manipulated variables. First, including pictorial information at encoding was followed by a higher TOT rates. Second, retrieved pictorial information and the likelihood of a TOT state are correlated. These two findings suggest that the encoding conditions affect TOT rates by allowing for pictorial information to be retrieved at the time of test. In addition, we found the retrieval of the biographical infor-

mation was not associated with the likelihood of a TOT state, confirming the idea that retrieval of other non-pictorial information is not critical.

GENERAL DISCUSSION

The results of these experiments supported Koriat's (1993) hypothesis that participants use retrieved information to determine their TOT states. In each experiment, it was found that increasing the amount of information presented to participants at the time of study increased the likelihood that they would report a TOT for that item. This effect was found even though the added information did not increase the likelihood of successfully recalling the to-be-remembered name. We also found that more related pictorial information was reported in the high-information conditions, and that retrieval of pictorial information was associated with TOT states, further bolstering the claim that retrieved information is critical for TOT states. Koriat's hypothesis was not completely supported because some information (e.g., pictorial) did affect TOT rates, but other information (e.g., diet and size) did not affect TOT rates.

Alternatively, increases in reported TOT states may result as a consequence of bias to report them (Nelson, Gerler, & Narens, 1984; Widner et al., in press). Participants may have felt that because they were provided with more information about some targets, then they should be more likely to recall those. To compensate for this ''pressure to perform,'' participants report more TOT states. Indeed, Widner et al. (in press) reports that demand characteristics do increase the likelihood of a TOT state. In order to make this decision, however, participants must be able to retrieve the related information that was presented at encoding. Therefore, even with a bias interpretation, participants are relying on the products of retrieval to inform their decision. Although this explanation may implicate a different mechanism of TOT states than the one proposed by Koriat, the bias interpretation is still consistent with Koriat's theory that TOT states are based on retrieved information.

However, the demand-characteristics explanation has another level. An anonymous reviewer suggested that the demands characteristics may have changed the criterion for reporting a TOT state without affecting the subjective experience. Because participants expect their recall to be better in some conditions, they lower the threshold at which they report a TOT state. Therefore, only the likelihood of a reported TOT state changes, not the subjective experience of one. This interpretation does not contradict Koriat's view either. Nonetheless, we still claim that it is the subjective experience not the criterion that has changed.

We ran an additional experiment to test the criterion-bias hypothesis. We tested 61 participants with an encoding procedure identical to that of Experiment 1. Participants studied minimum-information, medium-information, and maximum-information TOTimals. However, instead of the tests of recall, TOT states, and recognition, we asked the participants to indicate for each country-cue whether the animal had been seen without a picture, with only a picture, or with a picture and biographical information. We ran three groups of participants in order to present each set of stimuli in each condition. We found that participants were above-chance at identifying the conditions-at-encoding for each country-cue came in all three experimental condition (.64 correct for minimum-information condition, .52 for medium-information condition, and .69 for maximum-information condition, .33 equals chance). This suggests that participants were aware of the conditions of each stimuli. Therefore, participants potentially could have been using demand characteristics to report TOT states. We think, however, that the recall and TOT data from Experiments 1 and 3 do not support this view. If participants' criteria were shifted by explicit knowledge of experimental condition, one might expect that more TOT states would be reported in those conditions in which participants expected good memorability. If participants believe that memorability is improved by the presentation of related information, then we would expect more TOT

states in the maximum-information condition than in the medium-information condition. Alternatively, participants might expect that when more related and potentially interfering information is presented, their memory performance will be poor, and thus one might expect the criterion-bias effect to push participants to report fewer TOT states in the maximum-information condition. Neither pattern was found in either Experiment 1 or Experiment 3. Therefore, we think a more parsimonious explanation is that the retrieval of pictorial information is linked to the subjective experiencing of a TOT state.

This explanation is bolstered by the results from the TOT-contingent analyses. Participants who reported a TOT state were also more likely to report pictorial information for that item. A priori, there is no reason to suspect that participants would be more likely to report that they were experiencing a TOT state because they thought that the retrieval of pictorial information should be associated with a TOT state. Indeed, it is more likely that when participants retrieve related pictorial information, they also ''feel'' a TOT state.

A third explanation of TOT states centers on the strength of the memory trace of the target name. If participants have direct access to the strength of a memory, reported TOT states should be highest in conditions with the strongest memory trace because it is activation of the target that causes the TOT (see Koriat, 1994; Nelson et al., 1984; Schwartz, 1994). In this view, strengthening the activation of a particular target increases the likelihood of a TOT state. The present results are not consistent with this view because the medium and maximum-information conditions (in Experiments 1 and 3) and the medium-information conditions (in Experiment 2) showed higher reported TOT states, but did not produce better recall of the target names than the minimum-information condition. However, because we did not manipulate retrievability of the target, we cannot rule out that target activation is partially responsible for TOT states. Nonetheless, it cannot account for the data in the present studies.

Cue Priming: Retrieval of Related Information or Cue Familiarity?

A second finding in this experiment was that cue priming led to an increase in the number of reported TOT states. This finding is consistent with many of studies that show that cue priming increases the magnitude of meta-memory judgments made at the time of retrieval (e.g., Metcalfe, 1993; Metcalfe et al., 1993; Miner & Reder, 1994; Reder, 1987; Reder & Ritter, 1992; Schwartz & Metcalfe, 1992). These retrieval judgments range from speeded decisions of knowing (Reder, 1987; Reder & Ritter, 1992) to feeling-of-knowing judgments (Schwartz & Metcalfe, 1992) to TOT states (Metcalfe et al., 1993). The results of Experiment 2 extend these findings to a new set of stimuli.

Cue priming was observed only in the minimum-information condition and not in the condition in which picture information was included. Interestingly, Reder (1987) found a similar interaction with speeded decisions of knowing. She asked participants to decide as quickly as possible whether they would be able to recall an answer of a general-information question. She found that cue priming resulted in a higher proportion of ''will know'' responses, but only for difficult questions. It is possible that for the easy questions, target information was quickly retrieved, and participants did not have to rely on cue familiarity. For the difficult questions, however, no such information was forthcoming, and participants made use of cue information. Similarly, in Experiments 2 and 3, participants may have used cue familiarity in the absence of picture information, but used the more diagnostic picture information when it was provided in the picture-included conditions.

The interaction between cue priming and the information conditions rule out some explanations of TOT states that focus exclusively on cue familiarity as an explanation (Metcalfe et al., 1993; Miner and Reder, 1994). Miner and Reder (1994) noted that TOT states may occur when ''an early judgment of retrievability is discordant with the

results of the subsequent retrieval attempt''
(p. 51). Although this explanation may ac-
count for speeded knowing decisions (e.g.,
Reder & Ritter, 1992), it is not a viable expla-
nation for the present results. With TOT states,
participants seem to be sensitive to retrieval-
related variables as well as cue-related vari-
ables.

We observed in Experiment 3 that partici-
pants were more likely to report related infor-
mation in the cue-primed condition than in the
unprimed condition. This supports Koriat's
hypothesis that the mechanism underlying cue
priming effects is that it allows more related
information to be retrieved. Cue priming may
act to increase retrieved information, that, in
turn, increases the rate of TOT states. How-
ever, it does not rule out the idea that partici-
pants are directly sensitive to cue familiarity,
and that this boost in familiarity may partially
drive the TOT response. Indeed, Schwartz and
Metcalfe (1992) found that cue priming in-
creased the magnitude of feeling-of-knowing
judgments without increasing the likelihood of
a commission error. However, Schwartz and
Metcalfe used experimentally-learned word
pairs, and did not measure the retrieval of re-
lated information. Therefore, we consider the
retrieval of information view of cue priming
as the more parsimonious explanation.

Either explanation can allow for the interac-
tion between encoding and priming. Ac-
cording to our outshining explanation, the re-
trieval of pictorial information dominates all
other sources of information. It appears as if
all other sources of information are ignored
when pictorial information is retrieved. How-
ever, in the minimum-information condition,
no pictorial information is presented, and
therefore, we should expect to see the effects
of other kinds of information. Indeed, cue
priming affects TOT rates in the absence of
pictorial information.

TOT States as Subjective Experience

In the past, TOT research has focused on
the accuracy of the TOT state at predicting
memory performance (Brown & McNeill,
1966; Koriat & Lieblich, 1974), and what the

TOT states tells us about retrieval processes
(Burke et al., 1991; Jones, 1989; Meyer &
Bock, 1992; Perfect & Hanley, 1992). Our
focus, however, was exploring the nature of
the subjective experience involved in TOT
states. In investigating the subjective experi-
ence, we identified two experimental vari-
ables, amount of information at encoding and
cue priming, that influence people's likelihood
of experiencing a TOT state without affecting
their objective memory performance. There-
fore, we have (1) identified variables that af-
fect the TOT state and (2) demonstrated a dis-
sociation between the TOT state and target
retrieval.

Several studies have documented that pro-
cesses other than retrieval may be involved in
TOT states. First, Koriat and Lieblich (1974)
found that TOT states did not always led to
correct performance in recognition. Second,
Widner et al. (in press) found that TOT rates
were affected by demand characteristics, such
as incentive to perform. Third, Smith et al.
(1994) found that TOT rates were affected by
the learning histories of the targets. Fourth,
Metcalfe et al. (1993) found that cue repetition
affected TOT states, but interference condi-
tions did not. Finally, in the present studies,
we have identified another variable, the
amount of related information provided at en-
coding, that affects reported TOT states but
not memory retrieval of a target name. For
these reasons, we argue that the phenomeno-
logical experience of a TOT occurs, at least
partially, by different processes than those that
accomplish retrieval.

Recent empirical data from a variety of para-
digms now suggest that memory awareness and
the processes of retrieval are not identical (e.g.,
Kelley & Lindsay, 1993; Richardson-Klavehn,
Gardiner, & Java, 1996; Schwartz, 1994).
Thus, a growing body of data now supports
Tulving's (1989) attack on the *doctrine of con-
cordance.* Tulving argued that memory re-
searchers have ignored the issue of conscious-
ness in memory because of an assumption that
behavior, cognition, and conscious experience
are perfectly correlated. In the present context,
past research on TOT states has tacitly fol-

lowed the doctrine of concordance in assuming that TOT states reflect difficulties in the process of memory retrieval. Koriat's (1993) theory challenged that assumption, by asserting that TOT states are inferred based on retrieval of any related information. Thus, the present data support Koriat's view of TOT states and Tulving's view of consciousness.

REFERENCES

BRENNAN, T., BAGULEY, T., BRIGHT, J., & BRUCE, V. (1990). Resolving semantically-induced tip-of-the-tongue states for proper nouns. *Memory & Cognition,* **18,** 339–347.

BROWN, A. S. (1991). A review of the tip-of-the-tongue experience. *Psychological Bulletin,* **109,** 204–223.

BROWN, R., & MCNEILL, D. (1966). The ''Tip of the Tongue'' Phenomenon. *Journal of Verbal Learning and Behavior,* **5,** 325–337.

BURKE, D. M., MACKAY, D. G., WORTHLEY, J. S., & WADE, E. (1991). On the tip of the tongue: What causes word finding failures in young and older adults? *Journal of Memory and Language,* **30,** 542–579.

FINLEY, G. E., & SHARP, T. (1989). Name retrieval by the elderly in the tip-of-the-tongue paradigm: Demonstrable success in overcoming initial failure. *Educational Gerontology,* **15,** 259–265.

FREEDMAN, J. L., & LANDAUER, T. K. (1966). Retrieval of long-term memory: ''Tip-of-the-tongue'' phenomenon. *Psychonomic Science,* **4,** 309–310.

JONES, G. V. (1989). Back to Woodworth: Role of interlopers in the tip-of-the-tongue phenomenon. *Memory & Cognition,* **17,** 69–76.

JONES, G. V., & LANGFORD, S. (1987). Phonological blocking in the tip of the tongue state. *Cognition,* **26,** 115–122.

KELLEY, C. M., & LINDSAY, D. S. (1993). Remembering mistaken for knowing: Ease of retrieval as a basis for confidence in answers to general knowledge questions. *Journal of Memory and Language,* **32,** 1–24.

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

KORIAT, A. (1994). Memory's knowledge of its own knowledge: The accessibility account of the feeling of knowing. In J. Metcalfe & A. P. Shimamura (Eds.), *Metacognition: Knowing about knowing* (pp. 115–136). Cambridge: MIT press.

KORIAT, A. (1995). Dissociating knowing and the feeling of knowing: Further evidence for the Accessibility model. *Journal of Experimental Psychology: General,* **124,** 311–333.

KORIAT, A., & LIEBLICH, I. (1974). What does a person in a ''TOT'' state know that a person in a ''don't know'' state doesn't know. *Memory & Cognition,* **2,** 647–655.

KORIAT, A., & LIEBLICH, I. (1977). A study of memory pointers. *Acta Psychologica,* **41,** 151–164.

METCALFE, J. (1993). Novelty monitoring, metacognition and control in a composite holographic associative recall model: Interpretations for Korsakoff amnesia. *Psychological Review,* **100,** p. 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.

MEYER, A. S., & BOCK, K. (1992). The tip-of-the-tongue phenomenon: Inhibition or facilitation of word retrieval? *Memory & Cognition,* **20,** 715–726.

MINER, A. C., & REDER, L. M. (1994). A new look at feeling of knowing: Its metacognitive role in regulating question answering. In J. Metcalfe & A. P. Shimamura (Eds.), *Metacognition: Knowing about knowing.* (pp. 47–70) Cambridge: MIT press.

NELSON, T. O. (1988). Predictive accuracy of the feeling of knowing across different criterion tasks and across different subject populations and individuals. In M. Gruneberg, P. Morris, & R. Sykes (Eds.), *Practical aspects of memory: Current research and issues* (Vol. 1, pp. 190–196). New York: Wiley.

NELSON, T. O., GERLER, D., & NARENS, L. (1984). Accuracy of feeling of knowing judgments for predicting perceptual identification and relearning. *Journal of Experimental Psychology: General,* **113,** 282–300.

PERFECT, T. J., & HANLEY, J. R. (1992). The tip-of-the-tongue phenomenon: Do experimenter-presented interlopers have any effect? *Cognition,* **45,** 55–75.

REASON, J. T., & LUCAS, D. (1984). Using cognitive diaries to investigate naturally occurring memory blocks. In J. Harris & P. E. Morris (Eds.), *Everyday memory, actions, and absent mindedness* (pp. 53–70). London: Academic Press.

REDER, L. M. (1987). Selection strategies in question answering. *Cognitive Psychology,* **19,** 90–138.

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

RICHARDSON-KLAVEHN, A., GARDINER, J. M., & JAVA, R. I. (1996). Memory: Task dissociations, process dissociations and dissociations of consciousness. In G. Underwood (Ed.), *Implicit Cognition* (pp. 85–158). Oxford Univ. Press.

RUBIN, D. C. (1975). Within word structure in the tip-of-the-tongue phenomenon. *Journal of Verbal Learning and Verbal Behavior,* **14,** 392–397.

SCHWARTZ, B. L. (1994). Sources of information in metamemory: Judgments of learning and feelings of knowing. *Psychonomic Bulletin and Review,* **1,** 357–375.

SCHWARTZ, B. L., & METCALFE, J. (1992). Cue familiarity

but not target retrievability enhances feeling-of-knowing judgments. *Journal of Experimental Psychology: Learning, Memory, and Cognition,* **18,** 1074–1083.

SMITH, S. M. (1988). Environmental context-dependent memory. In G. M. Davies & D. M. Thomson (Eds.), *Memory in context: Context in memory* (pp. 13–34). Chicester England: Wiley.

SMITH, S. M. (1994). Frustrated feelings of imminent recall: On the tip-of-the tongue. In Metcalfe, J., & Shimamura, A. P. (Eds.), *Metacognition: Knowing about knowing.* (pp. 27–46). Cambridge: MIT press.

SMITH, S. M., BROWN, J. M., & BALFOUR, S. P. (1991). TOTimals: a controlled experimental method for observing tip-of-the-tongue states. *Bulletin of the Psychonomic Society,* **29,** 445–447.

SMITH, S. M., BALFOUR, S. P., & BROWN, J. M. (1994). Effects of practice on TOT states. *Memory,* **2,** 47–53.

TULVING, E. (1989). Memory: Performance, Knowledge, and Experience. *European Journal of Cognitive Psychology,* **1,** 3–26.

WIDNER, R. L., SMITH, S. M., & GRAZIANO, W. G. (in press). The effects of demand characteristics on the reporting of tip-of-the-tongue states and feeling-of-knowing states. *American Journal of Psychology.*

WIDNER, R. L. (1995). *The effects of deliberately retrieved information on question-answering.* Manuscript under review.