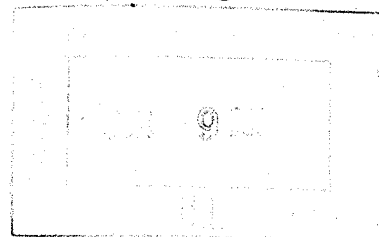




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## **Frustrated Feelings of Imminent Recall: On the Tip of the Tongue**

Steven M. Smith

In the course of recalling names or words, people sometimes find themselves in a "tip-of-the-tongue" (TOT) state, a discomfiting experience in which a seemingly well-known term appears to be blocked from conscious awareness. R. Brown and McNeill (1966) described such TOT states as similar to the feeling of an impending sneeze, a description that emphasizes that TOT states are frustrating, and that resolution of such states (i.e., finally remembering the target) is a relief. Other similar states might include a variety of commonplace phenomena in which responses that typically function automatically are thwarted, such as trying to speak after dental anesthesia, or trying to read with pupils dilated by an ophthalmologist. Each of these experiences is caused by malfunctioning of a usually reliable system, and is treated as a momentary predicament that will be eventually resolved.

Like *déjà vu* or slips of the tongue, the TOT state is a commonly experienced oddity of everyday cognition, and is therefore an interesting phenomenon to study in and of itself, according to naturalistic or ecological approaches to the study of memory (e.g., Neisser, 1982). Methods for systematically inducing and observing TOT states are important for demystifying such phenomena, helping us understand them in terms of scientific mechanisms.

R. Brown and McNeill (1966) reported a now classic method for inducing TOT experiences in the laboratory. Subjects were given definitions of rare words, and were asked to retrieve the objects of

the definitions. For example, for the definition, "An ornamental stoppered glass vessel used for serving wine," the target would be "decanter." In many cases subjects reported TOT experiences; that is, they were unable to immediately recall a target, but believed that they knew the target, and would successfully recall it at any moment. That R. Brown and McNeill's subjects could often report the first letter and the number of syllables of an unrecalled target suggests that subjective TOT reports elicited by rare word definitions are valid indicators of subjects' knowledge.

Another method for eliciting TOT states under laboratory conditions involves naming famous people from pictures or descriptions (e.g., Brennen, Baguley, Bright, & V. Bruce, 1990; Yarmey, 1973). For example, for the description, "The actor who played Captain James T. Kirk in 'Star Trek'," the target would be "William Shatner." The efficacy of this technique for inducing TOT states reflects the high frequency of naturally occurring TOTs that result from attempts to recall names (e.g., A. Brown, 1991; Burke, MacKay, Worthley, & Wade, 1991).

From the theoretical point of view, the TOT experience may be a key phenomenon for understanding memory retrieval. One reason for this is that retrieval proceeds slowly, if at all, when the subject enters a TOT state. This slowed, or even halted retrieval has been likened to "slow-motion photography" (A. Brown, 1991), because it may facilitate observations of retrieval by slowing down the process. The slow, piecemeal retrieval of target-related information that sometimes accompanies TOT states has been cited as evidence related to the nature of factual or semantic memory (R. Brown & McNeill, 1966).

Alternatively, TOT states may represent memory retrieval blocks (e.g., Jones, 1989; Jones & Langford, 1987), providing a paradigm for studying the induction and dissipation of such blocks. That is, when an initial search for a retrieval target fails, subjects sometimes recall "interlopers," incorrect items related to the target. Although R. Brown and McNeill (1966) believed that such retrievals mediated successful resolution (i.e., retrieval of the correct target) of TOT states, Jones (1989) hypothesized that these interlopers may block target recall, thus causing TOT states, rather than helping to resolve

them. Some evidence has shown that, along with definitions used to elicit TOT states, the frequency of TOT states (Jones, 1990). For example, the frequency of TOT states to accompany the definition "the number of times in which it exists" (the number of times in which it exists)

Both the slow retrieval and the reports are based on the concept that the target is truly available in memory. Do these experiences reflect retrieval failures or are they just coincidences? Many studies show that definitions can be misleading, that subjects do not always know the target to be "on the tip of the tongue." The definition of TOT states created by researchers acknowledges the difficulty of distinguishing positive vs. negative TOTs. Negative TOT states occur when the subject believes that an experimenter-defined target is on the tip of the tongue, but the subject cannot retrieve it. Objective evidence might include the number of syllables in the target word, the number of letters in the target word, or the number of syllables in the target word. Objective evidence might include the number of syllables in the target word, the number of letters in the target word, or the number of syllables in the target word.

Given this background, there are several interesting questions: (1) How can we observe TOT states under controlled laboratory conditions? (2) How are TOT states related to the number of times a retrieval is attempted? (3) How are TOT states related to the number of reports a TOT state? These are some of the questions in a growing literature on TOT states, focusing on recent experimental methodology for observing TOT states.

definition, "An ornamental wine," the target would be reported TOT experiences; that all a target, but believed that fully recall it at any moment. could often report the first in unrecalled target suggests are word definitions are valid

ates under laboratory conditions from pictures or descriptions (Bruce, 1990; Yarmey, 1973). The actor who played Captain would be "William Shatner." Missing TOT states reflects the TOTs that result from attempts (Burke, MacKay, Worthley, &

the TOT experience may be a memory retrieval. One reason, if at all, when the subject halted retrieval has been (A. Brown, 1991), because it is slowing down the process. Related information that some cited as evidence related to memory (R. Brown & McNeill,

ent memory retrieval blocks (1987), providing a paradigm of such blocks. That is, when target fails, subjects sometimes related to the target. Although that such retrievals mediated (the correct target) of TOT these interlopers may block rather than helping to resolve

them. Some evidence has shown that if "blocker" words are presented along with definitions used to cue recall, there is an increase in the frequency of TOT states (Jones, 1989; Jones & Langford, 1987; Maylor, 1990). For example, the blocker "abnormality" might be given to accompany the definition, "Something out of keeping with the times in which it exists" (the correct target is "anachronism").

Both the slow retrieval and retrieval block explanations of TOT reports are based on the commonly held assumption that the retrieval target is truly available in memory. Is this really the case that all TOT experiences reflect retrieval difficulties rather than storage deficiencies? Many studies show clearly that at least some TOT reports are misleading, that subjects do not know some targets they believe to be "on the tip of the tongue." Categories of TOT experiences delineated by researchers acknowledge this possibility of storage deficits, distinguishing positive vs. negative TOTs and subjective vs. objective TOTs. Negative TOT states are those in which the subject indicates that an experimenter-defined retrieval target differs from the target of the subject's search, whereas a positive TOT is one in which the subject and experimenter agree on the same target (e.g., Koriat & Lieblich, 1974). For example, if a subject in a reported TOT state searches for the target "carafe" when given the definition of "decanter," the event is referred to as a negative TOT. Furthermore, a TOT is defined as objective rather than merely subjective only when there is some objective evidence that the subject knows the correct target. Objective evidence might include correctly reporting the first letter or the number of syllables of an unrecalled target. Thus, a correct target may not be known when TOTs are negative or subjective.

Given this background, the present chapter will address the following questions: (1) How can TOT states be elicited and examined under controlled laboratory conditions? (2) What causes TOT states? (3) How are TOT states resolved? (4) Are people aware of how imminent a retrieval is? and (5) What does it mean when a subject reports a TOT state? These questions will be considered in regard to a growing literature on the subject of TOTs, with the discussion focusing on recent experiments I have conducted using a new methodology for observing TOT experiences.

### How Can TOT States Be Elicited and Examined under Controlled Laboratory Conditions?

Beyond anecdotal accounts of TOT experiences, there have been three basic methods for systematically studying TOTs: diary studies (e.g., Read & D. Bruce, 1982; Reason & Lucas, 1984), questionnaires (e.g., Burke et al., 1991), and experimental laboratory methods for inducing the states (e.g., R. Brown & McNeill, 1966; Yarmey, 1973). Although there are advantages to each of these methods, the present chapter will consider only laboratory methods.

As previously noted, the primary method for experimental elicitation of TOTs has been naming rare words from their definitions (e.g., R. Brown & McNeill, 1966; Burke et al., 1991; Jones & Langford, 1987; Koriatic & Lieblich, 1974; Kozlowski, 1977; Yaniv & Meyer, 1987). Other methods have included naming famous people from pictures (Brennen et al., 1990; Yarmey, 1973), and answering trivia questions (Finley & Sharp, 1989). Although there are variations in the way that TOT experiences have been defined in these studies, the typical definition given to subjects is that the target cannot be currently retrieved, but it is known, and recall of the target (i.e., resolution of the TOT) seems imminent (A. Brown, 1991).

A. Brown (1991) noted a number of common findings in experimental laboratory studies of TOTs. In such experiments TOT levels have been fairly low; overall, TOTs are reported for approximately 13% of the memory cues (plus or minus 5%). Many of these are negative TOTs; positive TOT rates, when reported, are considerably lower. Subjects often recall the first letter and the number of syllables of the target when subjects report a TOT state. Names of famous people, acquaintances, and famous landmarks are especially susceptible to TOT states.

Although much has been learned with existing methods of eliciting TOT states in controlled laboratory conditions, there are a number of problems and limitations with them. 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. When subjects are tested for their memories of rare words, names, or general knowledge, observations are for memories acquired preexperimentally. An experimenter cannot

know such an item's learning encounters with targets or the item's level of processing, memory, the appropriateness of the test question in relation to the way(s) in which the target is used in reading, writing, or speaking, the occurrence of TOTs, and the factors that lead to understanding the cause(s) of the state. These states can be resolved, and the item can be retrieved from memory.

A second problem in experimental studies of TOTs at these levels have been fairly low, and attempts to reduce already low levels of TOTs in light of floor effects, if successful, may be limited.

A related problem is that the definition of TOTs that test preexperimental levels of knowledge. The frequency of subjective TOTs may vary, and it is difficult to differentiate positive and negative TOTs. Some questions concern characteristics such as frequency, or concreteness of the target, or familiarity from consideration, because the target is not currently known. To use an earlier example, the definition of "decanter" vs. "carafe" may be judged to be different. If the target were given as the first letter of the target, the target would represent correct partial knowledge of the target. In this case, guesses that are counted as correct partial knowledge are not correct for the subject's intention.

Another problem with methods of TOT induction is that the target is often phonological and semantic targets. Choosing targets that are possible or impossible in many cases may not be a good idea. Common knowledge may not be a good target. Similarly, if one wishes to test for TOTs as in Jones and Langford's

### Examined under Controlled

experiences, there have been studies of TOTs: diary studies (Lucas, 1984), questionnaires (McNeill, 1966; Yarmey, 1973). If these methods, the present methods.

Method for experimental elicitation of words from their definitions (Jones et al., 1991; Jones & Langford, 1977; Yaniv & Meyer, 1987). Famous people from pictures and answering trivia questions are variations in the way that in these studies, the typical target cannot be currently the target (i.e., resolution of 1991).

Common findings in experimental studies: TOT levels reported for approximately 5%. Many of these are reported, are considerably and the number of syllables TOT state. Names of famous marks are especially suscep-

Existing methods of eliciting conditions, there are a number of. One of the most basic problems in experimental research on memory, and/or observing acquisition of words tested for their memories. In addition, observations are for. An experimenter cannot

know such an item's learning history. The frequency and recency of encounters with targets cannot be known, nor can one know an item's level of processing, its associative or relational structure in memory, the appropriateness of processing and contextual similarity of the test question in relation to the item's acquisition context, or the way(s) in which the target has been used as a response, such as in reading, writing, or speaking. Such factors may be critical in the occurrence of TOTs, and their roles may need clarification if we are to understand the cause(s) of TOT states, the ways in which such states can be resolved, and what TOT reports tell us about the nature of memory.

A second problem in experimental studies has been that TOT levels have been fairly low, particularly for positive TOTs. Failed attempts to reduce already low TOT rates would need to be interpreted in light of floor effects, if such attempts were made.

A related problem is that of observing negative TOTs in studies that test preexperimental knowledge. If one is interested in the frequency of subjective TOT experiences, there is no real need to differentiate positive and negative TOTs. If, however, the experimental questions concern characteristics of the target, such as its spelling, frequency, or concreteness, then negative TOTs must be removed from consideration, because the subject's intended target cannot be known. To use an earlier example of a negative TOT, a subject given a definition of "decanter" who is searching for the unintended target "carafe" may be judged to have incorrect partial knowledge if "c" were given as the first letter of the unrecalled target, even though it would represent correct partial knowledge of the subject's intended target. In this case, guessing that the first letter is "d" would be counted as correct partial knowledge, even though it would be incorrect for the subject's intended target.

Another problem with most of the existing experimental methods of TOT induction is that the experimenter lacks control over the phonological and semantic information contained in the experimental targets. Choosing targets with specific characteristics is difficult or impossible in many cases because our existing language and common knowledge may not contain targets with the desired qualities. Similarly, if one wishes to present "blockers" along with recall cues, as in Jones and Langford's (1987) study, it is not possible to control

the phonological or semantic similarity of blockers and targets beyond what is available in the natural language.

Experiments reported by Smith, J. Brown, and Balfour (1991) were motivated by the need for an experimental paradigm that can induce high levels of TOT states using stimuli whose acquisition and retention can be controlled, and that refer unambiguously to experimenter-designated recall targets. The occurrence of TOT states was examined for recently learned names and concepts. Conceptually realistic targets with names were created that were new for all subjects, but that could be learned in a controlled laboratory setting. Whether or not a target had ever been encountered could be experimentally controlled, as could the recency and frequency of the encounters. Each target name referred unambiguously to a specific imaginary animal, referred to as a "TOTimal." The efficacy of TOTimals for inducing TOT states was tested in two experiments reported by Smith et al. (1991).

Twelve TOTimals were created for the experiments (figure 2.1). Each consisted of a three-syllable name, a picture of the imaginary animal, a brief description of the TOTimal, its size, what it eats, and where it lives. Each TOTimal name began with a different first letter. The descriptions, habitats, and diets were unique for each TOTimal.

After studying two sets of six TOTimals, subjects were given cued recall tests, with each test cue consisting of a picture of one of the TOTimals. For each picture cue subjects were asked the name (or any part of the name) of the imaginary animal, whether they experienced a TOT state when trying to recall the name, and whether they would recognize the name if it were mixed in with other similar names. This last question was a feeling-of-knowing (FOK) judgment. A recognition test was given after all 12 cues had been tested.

In question was whether the procedure would induce TOT states when subjects attempted to recall the TOTimal names. It was expected that if an unrecalled name were in a TOT state, as compared with those not in TOT states, the subject would be more likely to recognize the name, and to recall the correct first letter of the name. FOK was a measure intended to augment the TOT judgment; it was expected that FOK would be greater for unrecalled items in TOT states than for those not in TOT states. Such results would support the idea that subjective TOTs for TOTimals relate empirically to

### **Boshertin**

**Chubby carnivore**    **2.5'**  
**Eats mice**            **Canada**



### **Rittlefin**

**Amphibian**            **3"**  
**Eats flies**            **Congo River**



**Figure 2.1**  
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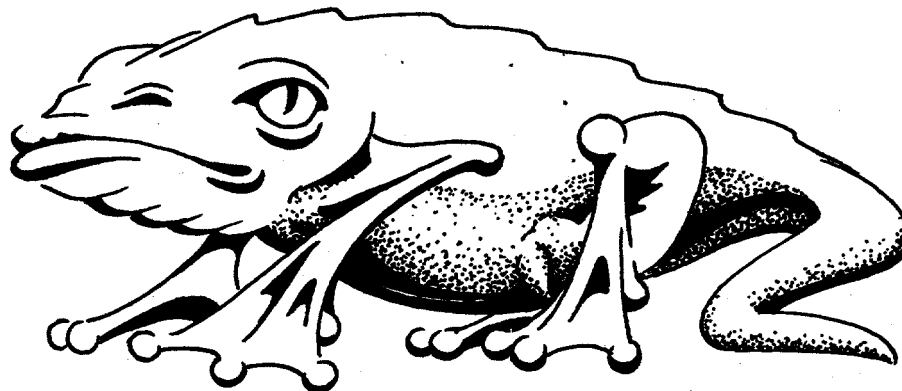
### ***Boshertin***

**Chubby carnivore    2.5'**  
**Eats mice            Canada**



### ***Rittlefin***

**Amphibian            3"**  
**Eats flies            Congo River**



**Figure 2.1**

Black-and-white versions of the TOTimals used by Smith et al. (1991).



measures of memory (recall and recognition) and metamemory (FOK).

Acquisition involved an initial input of the TOTimals, followed by a number of study trials. Instructions directed subjects to learn the imaginary animals as well as they could for a test to be explained later. A second list was then presented in the same way as the first, except that there were more study trials for list 2 than for list 1.

After both lists 1 and 2 had been studied, the critical cued recall test over the TOTimal names was given. For the recall test subjects were shown a picture of a TOTimal for 20 seconds, during which time they were instructed to indicate the answers to four questions: (1) What is the imaginary animal's name? (2) What is the first letter of the name? (3) Would they be able to recognize the name if it were mixed in with other similar sounding names? and (4) Are they in a TOT state? A TOT state was described as one in which the subject knew the name, felt that they might recall it at any time, but could not think of the name at that moment. All 12 TOTimals were tested, examining both list 1 and list 2.

After the recall test subjects were given a four-alternative forced-choice recognition test over the TOTimal names. One of the four words was the correct name of a TOTimal, and the other three were similar sounding names. All four choices for a recognition test item had three syllables, all began with the same letter, and all four had the middle syllable in common. For example, for the TOTimal named "BOSHERTIN," the foils on the recognition test were "BOSH-ERGEN," "BANTERTIN," and "BANTERGEN." The experimental methodology appears to have been very successful for inducing high levels of validated TOTs. The overall proportion of retrieval targets for which subjects reported TOT states was 0.25 in experiment 1 and 0.34 in experiment 2. TOTs were reported 32% of the time for list 1 items in experiment 1 and on 42% of the list 1 recall trials in experiment 2. This is considerably higher than previously reported TOT rates in published experimental studies.

Smith et al.'s evidence supported the idea that reported TOT states were genuine TOT experiences, rather than whimsical subjective reports. FOK rates were greater for unrecalled TOT items than for unrecalled non-TOT items. More compellingly, objective measures of memory (first letter recall and recognition) of unrecalled items

validated the reported TOT overall very high (93% hit rate) for recalled TOT names than for unrecalled TOT names. FOK recall was also significantly higher for unrecalled non-TOT names. Other studies, which have gone farther to validate TOT states, indicate that TOT states served in other studies.

In both of Smith et al.'s studies, TOT rates were higher, and TOT rates were higher in experiment 2 than in the first. These findings indicate that TOT rates, improvements in recall rates, improvements in FOK rates in TOT reports. If the range of TOT rates is too narrow, a reverse might be observed; that is, targets may be known for an extended period of time, whereas slightly better learning of targets, thereby increasing the number of successful TOTs, as successes. This question comes from Smith et al.'s (1991), because TOT states are known and manipulated.

#### What Causes TOT States?

Theoretical accounts of TOT states have offered different explanations: retrieval failures (e.g., A. Brown, 1991; Jones & Brainerd, 1985). Blocking refers to the idea that retrieval failures are similar to the target compared to the target, searched, suppressing target retrieval. The main point of account of TOT states is that a target word or name enough to be recalled. Other explanations assume that such unrecalled targets are truly known but not retrieved. Activation theories have been proposed that describe TOT states as retrieval failures.

The blocking theory of TOT states suggests that search can be diverted at some point during the search process.

validated the reported TOT states. Recognition rates, which were overall very high (93% hit rate), were significantly higher for unrecalled TOT names than for unrecalled non-TOT names. First letter recall was also significantly higher for unrecalled TOT names than for unrecalled non-TOT names. Therefore, these observations, which have gone farther to validate the TOT reports than have many TOT studies, indicate that TOTimal induced TOTs resemble TOTs observed in other studies.

In both of Smith et al.'s experiments, recall was significantly higher, and TOT rates were lower for the second presented list than the first. These findings indicate that within a particular range of recall rates, improvements in memory are associated with decreases in TOT reports. If the range of recall levels were somewhat lower the reverse might be observed; at too low a level of learning, too few targets may be known for any to reach even TOT levels of activation, whereas slightly better learning would increase the pool of known targets, thereby increasing the possibility of retrieval failures as well as successes. This question can be investigated with methods such as Smith et al.'s (1991), because learning of targets can be observed and manipulated.

#### What Causes TOT States?

Theoretical accounts of TOT experiences have centered around two different explanations: retrieval blocking and incomplete activation (e.g., A. Brown, 1991; Jones, 1989; Meyer & Bock, 1992). Retrieval blocking refers to the idea that activation of items in memory that are similar to the target compete with the target when memory is searched, suppressing target retrieval. The incomplete activation account of TOT states is that an initial memory cue may not activate a target word or name enough for retrieval of the target. Both of these explanations assume that subjective TOT reports indicate that unrecalled targets are truly known. After the blocking and incomplete activation theories have been briefly discussed, explanations will be considered that describe TOTs as failures of metacognition, rather than retrieval failures.

The blocking theory of TOT experiences states that a memory search can be diverted at some point when a related word or name,

rather than the intended target, is initially retrieved. Such a related word, referred to as a "blocker" or "interloper" (Jones, 1989), becomes temporarily activated when it is mistakenly retrieved. Subsequent search attempts may then have an increased chance of finding the same interloper rather than the correct target, creating at least momentarily a retrieval "trap" that effectively blocks access to the target. This increasingly stronger retrieval block resembles output interference in free recall (e.g., Rundus, 1973), in which recalled list items are theorized to increase in accessibility once they are retrieved, thus blocking recall of other list words.

The other major explanation of TOTs is the incomplete activation theory (e.g., A. Brown, 1991; R. Brown & McNeill, 1966). This theory states that when a retrieval cue does not bring a known target immediately to mind, the subject often becomes aware of general information related to the target, activating, for example, the target's first letter, or related words that are similar to the target. R. Brown and McNeill (1966) referred to this retrieval of general information as "generic recall." According to this explanation, retrieval in these cases proceeds iteratively, initially producing generic information, and gradually narrowing in scope until the correct target is successfully retrieved.

Both the blocking and incomplete activation theories of TOTs are based on the observation that when recall is not immediate, subjects often generate related words in lieu of the target. The critical difference between the explanations is that the incomplete activation theory states that the related words facilitate eventual retrieval of the target, whereas the blocking theory states that the related words serve to block the correct target.

Evidence testing the blocking and incomplete activation theories has been somewhat equivocal. The partial recall often exhibited by subjects in TOT states was initially taken as support for generic recall and incomplete activation of the target. Jones and Langford (1987) and Jones (1989), however, pointed out that those related words could be blocking recall rather than facilitating it. As a test of the blocking theory, Jones and Langford (1987) read subjects definitions of rare words, accompanied by related "blockers," words similar to the targets. Some blockers were phonologically related to the accom-

panying target, some were related. More TOTs were reported for phonologically related blockers than for semantically related blockers. Jones' (1989) logical interpretation of the results was supported by Jones (1989) and Maylor (1991). Jones and Langford's (1987) results also supported the blocking theory.

Unfortunately, there were several problems with the methods used in these three studies. One problem was that the type of related words used in particular definitions was not controlled. Another problem was that the TOT levels that were reported were not significantly higher than caused by the blocker conditions. In a paradigm very similar to the balanced blocker type so that the results could be compared to the blocker types. Contrary to the blocking theory, we found no evidence of blocking in the balanced blocker conditions. Furthermore, the recalled blockers actually facilitated recall rather than suppressing it. They were also accompanied by rare word definitions, which is consistent with the incomplete activation theory.

An unpublished study done by Jones (1991) provided some support for both theories. It is possible that subjects tend to recall related words when they are intended as blockers. The amount of processing given to blockers was not controlled. We found, consistent with Meyer's (1989) results, that words increased recall without related words, however, increased recall. These results support the idea that the cause of TOT states, but whether it is blocking or incomplete activation.

Consistent with Balfour's (1991), who examined TOTs in children, Jones (1991) examined TOTs in adults, as described earlier. Jones (1991) examined TOTs by presenting a picture of the

ally retrieved. Such a related interloper" (Jones, 1989), be- mistakenly retrieved. Subse- increased chance of finding rrect target, creating at least ectively blocks access to the evel block resembles output (1973), in which recalled list bility once they are retrieved,

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panying target, some were semantically related, and some were un- related. More TOTs were reported for definitions accompanied by phonologically related blockers than for those with unrelated or semantically related blockers. This result, which supports a phono- logical interpretation of the blocking hypothesis, has been replicated by Jones (1989) and Maylor (1990), whose materials were drawn from Jones and Langford's (1987).

Unfortunately, there were some problems with the materials and methods used in these three blocking studies. One of the main prob- lems was that the type of related word/blocker that accompanied a particular definition was not counterbalanced. Consequently, the TOT levels that were reported may have been specific to items, rather than caused by the blocker conditions. Meyer and Bock (1992) used a paradigm very similar to that used by Jones (1989), but counter- balanced blocker type so that each definition could be tested with all blocker types. Contrary to Jones (1989), Meyer and Bock (1992) found no evidence of blocking. TOT rates did not differ for different blocker conditions. Furthermore, Meyer and Bock found that the so- called blockers actually facilitated correct recall of targets, rather than suppressing it. They concluded that the related words that accompanied rare word definitions supported target retrieval, con- sistent with the incomplete activation theory of TOTs.

An unpublished study done in my laboratory (Balfour, 1992) found some support for both blocking and incomplete activation theories. It is possible that subjects tend to code blockers phonologically, even when they are intended as semantic blockers. Controlling the type of processing given to blockers, and the input modality, Balfour found, consistent with Meyer and Bock, that phonologically related words increased recall without affecting TOT rates. Semantically re- lated words, however, increased both recall and TOT rates. Balfour's results support the idea that semantically related interlopers can cause TOT states, but whether the increased TOTs were due to block- ing or incomplete activation is not clear.

Consistent with Balfour's (1992) findings are those of Smith (July 1991), who examined TOT blocking in TOTimals. After learning TOTimals, as described earlier, subjects were tested for name recall by presenting a picture of the imaginary animal. Accompanying the

picture cue was a phonologically related word, an unrelated word, or else the name of another TOT item. Although phonologically related words decreased TOTs, inappropriate TOT items increased TOT rates, indicating a TOT blocking effect.

Although the blocking and incomplete activation theories have typically been posed as mutually exclusive explanations of TOTs, such is not necessarily the case. There is no reason that subjective TOT reports must all have a single common cause, any more than recall or recognition of a word can be traced to a unitary cause. Evidence is clearly available that refutes either theory as "the" only cause of TOT states. Diary studies showing that subjects often experience repeated unwanted recall of "blockers" when trying to resolve a TOT, and experimental studies that show blocking effects refute the incomplete activation theory. Studies that show a large portion of TOTs are not accompanied by unwanted recall of blockers, and those showing that related words cause facilitation of retrieval rather than blocking weaken the blocking theory. Future research on TOT states should consider the possibility that some TOTs may be caused by blocking, whereas others are caused by incomplete activation, and should search for ways of distinguishing between the two different types of TOTs.

Another theory of TOTs resembles the incomplete activation theory, but is more specific about the cause of the initial retrieval failure (Burke et al., 1991). This explanation states that associative links that typically interconnect semantic and phonological codes in word representations are weak or missing. This "missing link" explanation provides a mechanism for the possibility that a word's phonological code could be less than fully activated by the word's semantic code. Burke et al. (1991) used this theory to explain the increase in TOTs seen in older adults, conjecturing that links between semantic and phonological codes may be lost or weakened with age.

Nelson, Gerler, and Narens (1992) divided reasons for subjects' metacognitive reports into the categories of trace access mechanisms, such as priming information without fully activating it, and inferential mechanisms, such as judging one's knowledge on the basis of domain familiarity. Most theoretical explanations of TOT reports, including those just reviewed, utilize trace access mechanisms to ex-

plain TOT states. It is important to consider that other mechanisms may be the cause of the TOT report (e.g., Metcalfe, Schwartz, & Shimamura, 1994). Sometimes one infers the presence of a TOT when TOTs are reported even when one does not know the target. For example, if one's neighbor or colleague is on the tip of one's tongue but is not truly known, one could believe one ought to know a person's face, occupation, or name.

I propose a modification to the traditional TOT theory, the incomplete activation theory, and incomplete associations to a target's name. Incomplete activation or incomplete storage or incomplete retrieval of a target. Activation of a truly stored target may lead one to believe that a target is completely stored and might lead one to believe that a failure would not yield TOT. Incomplete activation of a target's name could cause a TOT.

Smith (July 1991) reported that the theory is differentially based on incomplete activation of different types and amounts of information. The methodology described earlier in this article and traditional methods of TOT research are different from their definitions, or not possible to manipulate or even test. TOT items and TOT items are learned before they are tested and provide the means for retrieval.

Manipulating the degree of incomplete activation (Smith 1991) found that less complete activation of the rate of TOT experiences. The theory that some TOTs (i.e., completely stored) may result in a TOT although the findings do not support the theory of storage and Burke et al.'s version of the theory. These results suggest that the way in which such questions are asked may influence the results.

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plain TOT states. It is important to consider, however, that inferential mechanisms may be the cause of some portion of TOTs that subjects report (e.g., Metcalfe, Schwartz, & Joaquim, 1993). If subjects sometimes infer the presence of a TOT state, then there may be cases when TOTs are reported even though the subject does not actually know the target. For example, feeling that the name of a new neighbor or colleague is on the tip of one's tongue, even though the name is not truly known, could be inferred from the type of information one believes one ought to know, or from rapid retrieval of the target person's face, occupation, or other relevant information.

I propose a modification of Burke et al.'s (1991) "missing link" TOT theory, the incomplete storage theory, which states that missing associations to a target's name (i.e., the verbal label of a concept) or incomplete storage or integration of a name's components can prevent retrieval of a target. Activation of the partial information that is truly stored may lead one to infer that one is in a TOT state. Whereas complete storage might lead to successful recall, and a total storage failure would not yield TOT reports, an incomplete storage of a target's name could cause an inferentially based illusory TOT.

Smith (July 1991) reported some evidence in support of this inferentially based incomplete storage theory, testing the effects of different types and amounts of name practice, using the TOTimal methodology described earlier. This theory cannot be tested with traditional methods of TOT research, such as recalling rare words from their definitions, or naming famous people, because it is not possible to manipulate or even to observe learning of such targets. TOTimal targets are learned within the laboratory setting, and therefore provide the means for manipulating storage factors.

Manipulating the degree of name storage at input, Smith (July 1991) found that less complete storage of TOTimal names increased the rate of TOT experiences. These results are consistent with the theory that some TOTs (i.e., those for targets whose names are incompletely stored) may result from illusory inferential processes, although the findings do not clearly distinguish between incomplete storage and Burke et al.'s version of an incomplete activation theory. These results suggest that the TOTimal methodology may provide a way in which such questions can be more thoroughly investigated.

### How Are TOT States Resolved?

Resolution of a TOT state refers to the eventual successful recall of an intended retrieval target. If trace access mechanisms underlie TOT reports, then one might expect that nearly all TOTs are eventually resolved. Burke et al. (1991) found exactly that; 96% of the naturally occurring TOTs reported by their subjects were resolved, according to the subjects' own diaries. This high level of resolution, however, could result in part from a recording bias; resolvable TOT experiences might have been more accessible to subjects than unresolvable TOT experiences when they made their diary entries, thus underestimating unresolved TOTs. Consistent with this possibility are results reported by Read and D. Bruce (1982), who tracked resolutions of TOTs induced in the laboratory, an induction procedure that is less likely to omit observations of TOT experiences. Read and D. Bruce found that 74% of the TOTs that were not initially resolved were resolved within 2 days. Although this figure is still high, the possibility remains that 26% of the TOTs in Read and Bruce's (1982) study could have been illusory, caused, for example, by inferential mechanisms.

Of the TOTs observed by Read and D. Bruce (1982) that were correctly resolved or recognized, many more resolutions occurred when subjects varied their search strategies, rather than sticking with a single strategy. For example, subjects in TOT states were encouraged to try to recall contextual material related to unrecalled targets, or to run through the alphabet, trying each letter as a possible cue. This appears to be consistent with the idea of a narrowing search process using generic recall (e.g., R. Brown & McNeill, 1966).

Brennen et al. (1990) examined resolutions of TOTs induced when subjects named famous people and landmarks from pictures and verbal descriptions. On retests subjects were given extra information to facilitate resolution of TOTs, either a picture of the target or the correct initials. Pictures of targets yielded no better resolution levels than did retests using the original cues; both produced resolution rates of approximately 13%. Initials of targets, however, improved resolution rates to 44–47%. These results, like those of Read and D. Bruce (1982), indicate that extra information, in this case phonological cues, helps narrow a memory search. It might also be

noted that resolution rates were high, it is possible that some of the reported resolutions were for items that were not actually recalled.

A question rarely asked in the literature is whether subjects actually retrieved items for which no TOT report was given (i.e., non-TOT items). Are non-TOT items retrieved on subsequent attempts or extra retrieval attempts? Would feeling-of-knowing judgments be useful in predicting subsequent recall? If so, knowing the absolute likelihood of recalling a target, based on reports, it would be useful to compare non-TOT items to TOT items to predict subsequent recall.

### What Awareness of Retrieval?

Feeling-of-knowing reports are often used to predict performance following initial recall (e.g., Smith & Brown, 1986a), a correlation that gives rise to the idea of imminent recall. TOT reports also have been found to be associated with correct recall of syllables in the target (A. Brown, 1991). It has been found to predict recalled targets (e.g., Smith & Brown, 1986a) between TOT reports and correct recall. The validity to the measure, an index of the prediction of imminent recall, typically defined for subject reports, is that a target seems like it will be recalled. Can we predict imminent recall?

Evidence from several laboratories has shown that approximately 40–50% of reported TOT items are recalled (A. Brown, 1991). Although the idea of imminent recall, based on TOT reports, is that 50–60% of the TOT items will be recalled, it is distinguished between imminent recall and noting a recovery plateau in the frequency distribution of TOT items. The onset of the TOT state.

eventual successful recall of access mechanisms underlie that nearly all TOTs are even- and exactly that; 96% of the their subjects were resolved, This high level of resolution, recording bias; resolvable TOT possible to subjects than un- made their diary entries, thus istent with this possibility are (1982), who tracked resolu- ry, an induction procedure TOT experiences. Read and at were not initially resolved this figure is still high, the in Read and Bruce's (1982) for example, by inferential

D. Bruce (1982) that were more resolutions occurred ies, rather that sticking with in TOT states were encour- related to unrecalled targets, each letter as a possible cue. idea of a narrowing search wn & McNeill, 1966). olutions of TOTs induced d landmarks from pictures ects were given extra infor- ither a picture of the target ielded no better resolution cues; both produced reso- als of targets, however, im- e results, like those of Read a information, in this case ry search. It might also be

noted that resolution rates were far from perfect. As in other studies, it is possible that some of Brennen et al.'s TOTs were illusory.

A question rarely asked in TOT studies concerns the fate of un-retrieved items for which no TOTs are reported (i.e., unrecalled non-TOT targets). Are non-TOT recall failures also resolved with extra retrieval attempts or extra retrieval cues, as are TOT recall failures? Would feeling-of-knowing judgments be as good as TOT reports for predicting subsequent recall of initially unrecalled targets? Besides knowing the absolute likelihood of subsequent recall following TOT reports, it would be useful to know whether TOT recall failures, in comparison to non-TOT recall failures, are relatively more likely to predict subsequent recall.

#### **What Awareness of Retrieval's Imminence Exists?**

Feeling-of-knowing reports are often good predictors of recognition performance following initial retrieval failures (e.g., Metcalfe, 1986a), a correlation that gives face validity to the FOK measure. Do TOT reports also have face validity? TOT experiences are often associated with correct recall of a target's first letter, and the number of syllables in the target (A. Brown, 1991). In addition, TOT reports have been found to predict subsequent recognition memory of unrecalled targets (e.g., Smith et al., 1991). Although these associations between TOT reports and objective memory measures lend some validity to the measure, an important issue of face validity concerns the prediction of imminent recall. The way that the TOT state is typically defined for subjects includes the idea that an unrecalled target seems like it will be recalled at any moment. Do TOT reports predict imminent recall?

Evidence from several laboratory studies indicates that approximately 40-50% of reported TOTs are resolved within a few minutes (A. Brown, 1991). Although these resolutions appear consistent with the idea of imminent recall, it is also the case that in the same studies 50-60% of the TOT items were not resolved in a brief time. A. Brown distinguished between immediate and delayed resolution of TOTs, noting a recovery plateau in Burke et al.'s (1991) cumulative frequency distribution of TOT resolutions at about 1 or 2 minutes after the onset of the TOT state. The TOTs that were not resolved right



away (i.e., a majority of the TOTs in Burke et al.'s study) often took hours or days to resolve, a result clearly at odds with the idea that recall is imminent.

This distinction between immediate and delayed resolutions might correspond to the distinction between blocked TOTs (i.e., TOT targets that are blocked by activated competitors) and mediated ones (i.e., TOT targets whose resolutions are mediated or facilitated by related words), which was described earlier in this chapter. Persistent attempts to retrieve mediated TOT targets may succeed within a minute or two, whereas persistent retrieval of blockers in a blocked TOT may prevent immediate resolution. Resolution of blocked TOTs may require a period of incubation, which would allow blockers to decay and decrease in accessibility, therefore weakening their blocking effect.

Smith (November 1991), using the TOTimal methodology described earlier, examined incubation effects for unrecalled items in TOT and non-TOT states. After several study trials with the imaginary animals, subjects were given two 30-second recall tests for each TOTimal name. The second recall test was given either immediately after the first, or delayed by an incubation interval of 6 minutes. For items not recalled in the first 30 seconds, few were resolved if the retest was given immediately; only 9% of TOT items and 3% of non-TOT items were resolved without an incubation interval. Considerably more resolutions of initial recall failures were found when the retest followed an incubation interval, with subjects resolving 43% of TOTs and 19% of non-TOTs. This memory incubation effect was equivalent for both TOT and non-TOT items. These results show that (1) TOTs were more likely to be resolved than non-TOTs, although many non-TOTs were resolved, and (2) incubation effects were just as likely to occur for non-TOT items as for TOTs.

The TOT reports in Smith's (November 1991) study predicted target accessibility, but not the imminence of target access, because patterns of immediate vs. delayed resolutions were the same for both TOTs and non-TOTs. Although it is speculative, it may be that TOT reports consist of two components combined into a single judgment. One component, analogous to a feeling-of-knowing judgment, may predict an estimate of one's own knowledge. Whether based on trace access or inferential mechanisms, this putative metamemory com-

ponent is predictive of recall. A second component, a "warmth" judgment (e.g., Medinger, 1993), may be a prediction of imminence. Medinger (1993) predicted the imminence of solutions to word problems which are solved in incremental steps. In a study of the imminence of solutions to word problems, mediated TOTs correspond to insight solutions, which are solved in incremental steps. Because both are resolved incrementally, imminence may be predicted by TOT judgments. In contrast, blocked TOTs correspond to insight solutions, which neither can be predicted by TOT judgments. Incubation may promote successful resolutions. Incubation implies that solutions are not immediately blocked, perhaps by inappropriate competitors. Conditions of imminence guide successful resolutions (Smith, 1993).

#### What Does It Mean When a Solution is Imminent?

The subjectivity of metacognitive judgments may lead to suspect if they are used as criteria for success. Reports are often found to be unreliable when used as measures, indicating that they are not valid in these instances. To state that an unretrieved item is imminent implies at the very least that the item will be retrieved very soon. Do TOT reports predict knowing and imminence? If not, what do TOT reports predict?

Koriat and Lieblich (1974) examined the multiplicity of TOT reports, and found that TOTs based on whether (1) the subject's stated target is the same as the target, (2) the target, and (3) the target was even stated by the experimenter. This analysis suggests a different interpretation of TOT reports.

As previously noted, TOTs are not a measure of targets. However, research

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nition. A second component of a TOT report may be analogous to a  
"warmth" judgment (e.g., Metcalfe, 1986b; Metcalfe & Wiebe, 1987),  
a prediction of imminence. Metcalfe found that warmth ratings pre-  
dicted the imminence of solutions only for noninsight problems,  
which are solved in incremental steps. Warmth ratings did not predict  
the imminence of solutions to insight problems in her studies. In this  
analogy, mediated TOTs correspond to noninsight problems, be-  
cause both are resolved incrementally, and the imminence of both  
may be predicted by TOT judgments and warmth ratings. Blocked  
TOTs correspond to insight problems, because the imminence of  
neither can be predicted by TOT or warmth judgments, and incu-  
bation may promote successful resolutions in both cases. This expla-  
nation implies that solutions to insight problems often get initially  
blocked, perhaps by inappropriate approaches, and further, that pre-  
dictions of imminence guided by inappropriate approaches are in-  
accurate (Smith, 1993).

#### What Does It Mean When a Subject Reports a TOT State?

The subjectivity of metacognitive monitoring reports makes them  
suspect if they are used as observational data. Nonetheless, the re-  
ports are often found to be reliable predictors of certain performance  
measures, indicating that they can be useful under some circum-  
stances. To state that an unrecalled target is on the tip of one's tongue  
implies at the very least that the target is known, and that recall will  
occur very soon. Do TOT experiences reported by subjects accurately  
predict knowing and imminent recall? When such predictions are  
not correct, what do TOT reports mean?

Koriat and Lieblich (1974) were among the first to point out the  
multiplicity of TOT reports, noting several different categories of  
TOTs based on whether (1) the TOT is quickly resolved (2) the  
subject's stated target is the same as that intended by the experimen-  
ter, and (3) the target was eventually supplied by the subject or the  
experimenter. This analysis marks an important beginning in the  
interpretation of TOT reports.

As previously noted, TOTs may not always reflect actual knowledge  
of targets. However, researchers have not typically acknowledged this

possibility. Even "negative" TOTs (Brown & McNeill, 1966), that is, cases in which the experimenter's intended target is not the same as the subject's, have generally been regarded as retrieval confusions rather than knowledge deficits. The clear indication in the feeling-of-knowing research literature, however, is that inferential mechanisms (such as cue familiarity; Schwartz & Metcalfe, 1992) rather than trace access may often be responsible for metamemory judgments. Therefore, we must consider the possibility that although TOT feelings are thought of as stronger and more compelling metamemory predictors than FOK judgments, they may nonetheless be illusory, at least in some cases.

Examples of inferential mechanisms that could lead to TOT reports are cue familiarity, retrieval of related information, or domain familiarity. Furthermore, the demand characteristics of an experiment may evoke illusory TOTs. Most TOT studies have presented subjects with long lists of definitions of rare words or trivia questions (e.g., R. Brown & McNeill, 1966; Jones & Langford, 1987; Read & D. Bruce, 1982). Recall levels are often not reported, but it is clear that the test questions are chosen to be difficult. Subjects who are embarrassed when they repeatedly fail to answer questions may occasionally opt to report a TOT because of such demand characteristics.<sup>1</sup> Many studies of TOT states have been careful to eliminate negative TOTs from data analyses so that their conclusions are not contaminated by such cases. Nonetheless, when considering the meaning of a subjective TOT report, in the absence of objective memory performance measures, one must take into account that TOTs do not necessarily signal either knowledge or imminent recall.

### Conclusions and Directions for Future Research

Although a great deal of research has taught us much about TOT states, many studies have had low TOT levels, and exercise minimal control over the learning history, phonological components, and semantic components of targets and blockers. The TOTimal method (Smith et al., 1991) has been successful enough in preliminary studies to warrant further research because it provides a means of controlling target storage factors as well as blockers.

Tip-of-the-tongue states have various causes, deriving from a variety of features, and resolved by simple strategies. These strategies, in turn, seem tenuous, yet they are logical or empirical ground. In cases of partial recall, subsequent retrieval of targets, they often do not.

Positive TOT states may be resolved by a few iterations of a retrieval process. In some cases, TOTs may indicate that retrieval is blocked by similar words or names. Future research should explore the differences between TOTs from blocked TOTs, rather than having a single cause.

Negative TOT states, which are often distinguishable from positive ones, may have different inferential mechanisms, such as cue familiarity. Information, should be tested to determine the role of demand characteristics.

There may be two components to a feeling-of-knowing and a sense of wariness. Feelings-of-knowing may be more accurate than TOTs. Prominence may be accurate on some occasions.

### Acknowledgment

This work was supported by a grant from the National Science Foundation to Steven Smith.

### Note

1. The possible effects of demand characteristics on TOTs are being tested by Steven Smith, who is currently testing the hypothesis.

own & McNeill, 1966), that is, the intended target is not the same as the word that is retrieved. It is regarded as retrieval confusions rather than as a feeling-of-knowing indication in the feeling-of-knowing literature. One reason, is that inferential mechanisms (e.g., Roediger & Metcalfe, 1992) rather than direct retrieval is responsible for metamemory judgments. The possibility that although the feeling-of-knowing is a more compelling measure, they may nonetheless be

that could lead to TOT related information, or domain specific characteristics of an experiment. Many TOT studies have presented rare words or trivia questions (e.g., Roediger & Langford, 1987; Read & D. ... reported, but it is clear that ... difficult. Subjects who are ... answer questions may occur ... such demand characteristics.<sup>1</sup> ... careful to eliminate negative ... conclusions are not contaminated ... considering the meaning of ... of objective memory performance ... account that TOTs do not ... eminent recall.

## Research

taught us much about TOT levels, and exercise minimal psychological components, and blockers. The TOTimal method is enough in preliminary studies it provides a means of controlling blockers.

Tip-of-the-tongue states have typically been treated as unitary phenomena, deriving from a single cause, characterized by common features, and resolved by similar means. These assumptions, on inspection, seem tenuous, yet they are rarely challenged, either on logical or empirical grounds. Although TOT reports often predict partial recall, subsequent resolution, and recognition of unrecalled targets, they often do not.

Positive TOT states may result from initially incomplete activation, in which retrieval is slower because target resolution is mediated by iterations of a retrieval process. Alternatively, or additionally, positive TOTs may indicate that retrieval is blocked by activation of competitors, similar words or names in memory that are not correct targets. Future research should explore methods of distinguishing mediated TOTs from blocked TOTs, rather than treating all positive TOTs as having a single cause.

Negative TOT states, which are often not distinguished (or distinguishable) from positive ones, occur frequently. The role of inferential mechanisms, such as cue familiarity, or retrieved related information, should be tested in regard to TOT states, as should the role of demand characteristics.

There may be two components to TOT judgments: a feeling-of-knowing and a sense of warmth or imminence of recall. Whereas feelings-of-knowing may be somewhat accurate, predictions of imminence may be accurate only for mediated TOTs, not for blocked TOTs.

## Acknowledgment

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## Note

1. The possible effects of demand characteristics was suggested by Robert Widner, who is currently testing the hypothesis.