What Is a TOT?
Cognate and Translation Effects on Tip-of-the-Tongue States in Spanish–English and Tagalog–English Bilinguals

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The authors induced tip-of-the-tongue states (TOTs) for English words in monolinguals and bilinguals using picture stimuli with cognate (e.g., vampire, which is vampiro in Spanish) and noncognate (e.g., funnel, which is embudo in Spanish) names. Bilinguals had more TOTs than did monolinguals unless the target pictures had translatable cognate names, and bilinguals had fewer TOTs for noncognates they were later able to translate. TOT rates for the same targets in monolinguals indicated that these effects could not be attributed to target difficulty. Two popular TOT accounts must be modified to explain cognate and translatability facilitation effects, and cross-language interference cannot explain bilinguals’ increased TOT rates. Instead the authors propose that, relative to monolinguals, bilinguals are less able to activate representations specific to each language.

Cognates are translation equivalents that are similar in form (e.g., the Spanish word for microphone is microfon) and noncognates are translation equivalents that are not similar in form (e.g., the Spanish word for bumblebee is colmena). Cognates are often used to constrain models of bilingual language processing (e.g., de Groot, Dannenburg, & van Hell, 1994; Dijkstra, Grainger, & van Heuven, 1999; Gerard & Scarbrough, 1989; Kroll & Stewart, 1994; Sánchez-Casas, Davis, & García-Albea, 1992) and can also have important implications for monolingual models of language processing. For example, Hebrew–English cognate effects in the masked-priming paradigm indicate that such priming effects are not just visual (Gollan, Forster, & Frost, 1997). Similarly, Costa, Caramazza, and Sebastián-Galles (2000) used cognate effects in picture naming to argue, like many recent researchers (e.g., Colomé, 2001; Cutting & Ferreira, 1999; Jescheniak & Schriefers, 1998; Peterson & Savoy, 1998), that models of language production must incorporate cascading activation (i.e., unrestricted feed-forward activation flow). In this study we adopted a similar approach and manipulated cognate status to constrain accounts of the TOT phenomenon in monolinguals and bilinguals.

Models of TOT

The predicted effects of cognate status on bilingual TOTs depend on the locus of retrieval failure in models of the TOT state. Researchers of language production agree that semantic, syntactic, and phonological information are represented in independent systems and that these are accessed sequentially (in that order during speech production). One major debate in research on language production focuses on the degree of interactivity within this multistage system (Goldrick & Rapp, 2002; Rapp & Goldrick, 2000). Some argue for discrete processing (Levitt, Roeelofs, & Meyer, 1999) in which activation can flow to subsequent stages only after processing is complete at the previous stage. Others argue that activation flows freely but only in a forward direction (Caramazza,
1997), and still others argue that activation flows freely in both forward and backward directions (Dell, 1986; Dell, Schwartz, Martin, Saffran, & Gagnon, 1997; MacKay, 1987; Stemberger, 1985).

A second and more recent debate concerns the number of layers of whole word representations. Some propose two (Garrett, 1975; Levetl et al., 1999; Roelofs, Meyer, & Levetl, 1998), and others propose only one (Caramazza, 1997; Caramazza & Miozzo, 1998; Caramazza, Costa, Miozzo, & Bi, 2001; Dell et al., 1997). In such single-lexical-layer models, a single lexical representation mediates the connections among semantics, syntax, and phonology. In two-lexical-layer models, first an amodal lemma representation is activated, and only when lemma selection is complete is a modality specific lexeme representation retrieved. Lemmas mediate access to lexical syntax and lexemes, and lexemes represent word form features (e.g., word frequency) and mediate access to individual phoneme representations.

The specifics of the debate regarding the number of lexical layers are not critical in the current investigation; however, what are critical are the distinct accounts of the TOT phenomenon proposed within these different models of language production. Traditionally, the existence of TOTs was used as one of several arguments in favor of the lemma–lexeme distinction in the two-lexical-layer model; the most widely cited, and computationally implemented, version of this model is called WEAVER ++ (Bock & Levetl, 1994; Levetl, 1989; Levetl et al., 1999; Meyer & Bock, 1992). According to this view, TOTs entail intact lemma selection but failed lexeme selection. This account led to the prediction that participants in a TOT state should be able to report the grammatical gender (a syntactic feature) of the target word at greater than chance probability (Levetl, 1989), and this prediction was confirmed (Badecker, Miozzo, & Zanuttini, 1995; Vigliocco, Antonini, & Garrett, 1997; but see Friedmann & Biran, in press; Gollan & Silverberg, 2001; Silverberg, Gollan, & Garrett, 1999). We call this the selected-lemma account. In the selected-lemma account, access to information about the TOT target word (e.g., the first phoneme) arises from the partial activation of the target lexeme. Lemma selection must be completed in this TOT account because it is part of the discrete WEAVER ++, in which form aspects cannot become active until the previous processing stage is completed.

Recently, Miozzo and Caramazza (1997; Caramazza & Miozzo, 1997) questioned the use of TOTs as evidence for two independent levels of lexical representation and instead argued that TOTs reflect a complete failure of lexical selection. We call this the failed-single-selection account. This account is couched within the independent representation model, which is a single lexical layer model that allows activation to cascade forward to subsequent processing stages before processing in earlier stages has been completed. In this account, TOTs occur "... when activation of the [single] lexical node is very high but not sufficient to allow selection" (Caramazza & Miozzo, 1997, p. 332). This account uses cascading activation to explain how TOTs are characterized by access to syntactic and sound information (e.g., grammatical gender and the first phoneme).

Yet a third model of the TOT phenomenon is both different from and similar to the selected-lemma and the failed-single-selection accounts. Burke et al.'s (1991; James & Burke, 2000; Rastle & Burke, 1996) transmission deficits account is unique in that it is the only account that does not identify TOTs as a failure to select some type of whole-word representation. Instead, TOTs occur at a later locus of retrieval; specifically, TOTs entail a difficulty activating phonological representations. The transmission deficits account is similar to the selected-lemma account in that TOTs arise after lexical selection. It is similar to the failed-single-selection account in that it is incorporated into a model of language production, in this case the node structure theory (MacKay, 1987), that assumes only one layer of lexical representations and includes cascading activation (and feedback, a topic we discuss in the General Discussion). The transmission deficits account was developed to explain why older adults report more TOTs. In older age, all connections throughout the lexical system are hypothesized to weaken (Burke et al., 1991). Although all connections weaken, TOTs arise specifically after lexical selection because phonological nodes are one-to-one connections (i.e., a single lexical node must by itself activate each phonological node) and hence are particularly vulnerable. In contrast, the selection of lexical nodes is supported by multiple converging connections from the semantic system and as such is less vulnerable to both TOTs in general and the age-related weakness.

Using Cognate Effects to Constrain Models of TOT

In their currently articulated forms, only the transmission deficits account predicts an effect of cognate status on TOT rates in bilinguals. Understanding this prediction first requires an account of cognate effects in bilingual language production. Costa et al. (2000) provided the most explicit account of cognate effects in language production. They demonstrated that bilinguals name pictures with cognate names more quickly relative to pictures with noncognate names and suggested that cognate effects arise at the sublexical level when activation flows from semantic representations to lexical nodes in both languages and then on to individual phonological representations that are shared across languages. Because cognate translations are similar in phonological form across languages, this produces a facilitation effect in picture naming. A similar facilitation effect, reducing TOTs, should occur on TOTs if the locus of retrieval failure during a TOT is postlexical as in Burke et al.'s (1991) transmission deficits account. In contrast, both the selected-lemma and the failed-single-selection accounts predict no effect of cognate status on TOT rates because in both accounts TOTs entail a failure to select a lexical node and phonological effects are not allowed to spread backward to affect earlier processing stages (e.g., lexical selection). Thus, cognate status, which is a phonological aspect of translation equivalents, could not operate to influence lexical selection in either of these accounts. In this way, the cognate manipulation provides a test of different accounts of the TOT phenomenon.

Using Translatability Effects to Constrain Accounts of the Increased TOT Rate in Bilinguals

A second goal of the current study was to test two different accounts of the increased TOT rate in bilinguals. Gollan and Silverberg (2001) demonstrated that proficient Hebrew–English bilinguals had more TOTs than did age-matched monolinguals. To explain this result, they suggested that weaker links arise in the bilingual lexical system because bilinguals split their time using
word forms in two different languages. This mechanism is similar to that explaining the increased TOT rate in older adults. A subtle but important difference in the bilingual version is that it does not assume that bilingualism weakens connections in the lexical system. Instead, bilingualism leads to decreased use of language-specific connections relative to monolinguals, and because connection strength depends on the frequency (and recency) of use (Burke et al., 1991), bilinguals are relatively less able to activate representations in each language. To distinguish the two proposals, we use the term transmission deficits when referring to Burke et al.’s proposed postlexical locus of retrieval failure during a TOT and the term weaker links when referring to the cause of the increased TOT rate in bilinguals.

The weaker links account assumes a very indirect effect of bilingualism on TOTs. Over time, bilingual patterns of language use lead to differences in connection strength relative to that of monolinguals. An alternative account of the increased TOT rate is that bilinguals must override direct competition from the nontarget language (Gollan & Silverberg, 2001). We call this the cross-language interference account, and it is consistent with a number of recent studies demonstrating that (under some conditions) overt presentation of words in the nontarget language interferes with retrieval. In a now oft-cited study, Hermans, Bongaerts, De Bot, & Schreuder (1998) demonstrated that relatively fluent Dutch–English bilinguals were slower to name a picture in English (their second language) when distractor words (in either language) were phonologically related to the target’s translation equivalent. It is important to note that the effect was obtained even when the task required production in English only. That is, the English distractor bench delayed the retrieval of the target word mountain presumably (but see below) because it resembles the Dutch word for mountain, which is berg. These findings suggested that the Dutch name for the picture (berg) was active and competing for selection during the retrieval of the target (mountain) and that the presentation of the Dutch distractor increased the translation’s ability to compete for activation (one should note that in contrast with cognate effects, phonological similarity in this study [i.e., bench and berg] was manipulated only to activate noncognate translation equivalents [i.e., mountain and berg]). These results are compelling because they suggest that translation equivalents compete for selection even when only one language is overtly being used. This account leads to an interesting prediction about TOT states in bilinguals. If cross-language competition for activation increases TOT rates, then, all other factors being equal (i.e., target difficulty), bilinguals should be more likely to have a TOT for words that they know in both languages. Similarly, bilinguals should only have more TOTs than do monolinguals for targets that the bilinguals know in both languages.

Other findings are inconsistent with the cross-language interference hypothesis and lead to different predictions. Costa, Miozzo, and Caramazza (1999; see also Costa & Caramazza, 1999) showed that translation equivalents actually facilitated retrieval during the picture–word interference task. For example, Catalan–Spanish bilinguals named a picture of a duck (which is anec in Catalan) more quickly when it was presented with the Spanish word for duck (which is pato) as a distractor than when it was presented with an unrelated distractor (lechuga, the Spanish word for lettuce). These findings created a mystery as to the mechanism of the Dutch distracter effect reported by Hermans et al. (1998), in which presentation of a word like bench produced an inhibitory effect on the retrieval of mountain, presumably through activation of the translation equivalent berg. Sorting out how to explain both findings is clearly a topic for further research focusing on the mechanism of translation effects. To explain their translation facilitation effects, Costa et al. (1999) suggested that although nontarget language translation equivalents are active during production in a single language, such activation does not delay selection. In other words, translation equivalents do not compete for selection. This assumption, in combination with the weaker links proposal, lead to the predictions that (a) bilinguals should be equally likely to have a TOT for (difficulty matched) words that they do and do not know how to translate, and (b) bilinguals should have more TOTs than monolinguals whether or not they know the target word in both languages.

Obviously, the proposal that translations do not compete for selection requires rejecting the cross-language interference account of the increased TOT rate in bilinguals. However, by itself it does not lead automatically to a prediction of translation facilitation effects like those observed in picture–word interference. As with cognate effects, the predicted effects of target translatability on TOT rates depend critically on the locus of retrieval failure during the TOT state. Because noncognate translation equivalents are related only in meaning, a translation facilitation effect on bilingual TOT rates would pose a particularly difficult problem for the selected-lemma account. This is because there is no mechanism in this model for semantic factors to affect TOTs (the model is discrete, and TOTs arise after lemma selection, which is the only lexical processing stage that is sensitive to semantics in this model). Thus, in addition to constraining accounts of the increased TOT rate in bilinguals, the translatability manipulation is a further test of TOT accounts in general and in particular of the notion that TOTs reflect a state in which a lemma representation has already been retrieved.

In summary, we aimed to identify the effects of cognate status and target translatability on TOTs. Our two main goals were to constrain accounts of the TOT phenomenon and of the increased TOT rate in bilinguals. First, cognate facilitation effects on TOT rates are only predicted by Burke et al.’s (1991) transmission deficits account, in which TOTs reflect a failure to activate individual phoneme representations (with cognate effects arising at the sublexical level), and the presence or absence of cross-language competition for selection is irrelevant in this account because TOTs arise after lexical selection has already occurred. In contrast, the selected-lemma and failed-single-selection accounts predict no effect of cognate status on TOT rate because these accounts assume an earlier locus of TOT failure and are couched within models of language production (i.e., WEAVER++ and the independent representation model, respectively) that do not allow activation at the phonological level to flow backward to affect earlier processing stages (i.e., lexical selection).

Second, the cross-language interference account of increased TOTs in bilinguals predicts that the ability to produce a TOT target’s translation equivalent should result in increased TOTs and that bilinguals should have more TOTs relative to monolinguals only for targets that they are able to translate. In contrast, the weaker links account predicts no effect of translatability on TOT rates and an increased TOT rate in bilinguals for both translatable and nontranslatable targets. Finally, by asking bilinguals to name
pictures in English only, we also tested whether overt activation of both languages is necessary to obtain an increased TOT rate in bilinguals and whether the nondominant language can influence production in the dominant language in a task that requires activation of the dominant language only.

To test these predictions, we conducted two experiments comparing bilinguals to age- and education-matched monolinguals. We hypothesized that the predicted effects of cognate status and target translatability should apply only to bilinguals. Thus, monolingual TOT rates for the same stimuli served as a powerful control that the materials were well matched for difficulty in the cognate and noncognate groups, and in most versus least translatable groups. In Experiment 1 we tested Spanish–English bilinguals who learned both languages at an early age but who spent most (or all) of their lives immersed in an English-speaking environment. In Experiment 2 we tested Tagalog–English bilinguals who had spent a more balanced number of years living in both English- and Tagalog-speaking environments.

**Experiment 1: Spanish–English Bilinguals**

**Method**

Thirty Spanish–English bilinguals and 30 age-matched monolingual English speakers, currently studying at the University of California, San Diego, volunteered and received course credit for their participation. There were 17 women and 13 men in each group. Participants completed the experiment in 1–2 hr. All participants completed a language history questionnaire in which they estimated their daily use of Spanish (for bilinguals) or some language other than English (for monolinguals) and their proficiency level in each language on a scale of 1–7 with 1 being "little to no knowledge" and 7 being "like a native speaker." Table 1 shows a breakdown of participant characteristics. Participants in each group were matched for age (t < 1) and did not differ in the average number of years spent living in the United States, t(58) = 1.17, p = .25, reflecting the fact that most of the bilinguals learned Spanish at home and English at school. In contrast, on average, bilinguals reported higher current use of another language, learned English at an older age, learned to speak two languages at an earlier age, rated themselves as having a higher level of proficiency in a language other than English, and rated themselves as having a lower level of proficiency in English. All of these differences were tested in two-tailed t tests and were significant at the p < .05 level. Sixteen of the bilinguals (53%) reported speaking primarily Spanish with their parents, 11 (37%) reported speaking both Spanish and English, and only 3 (10%) reported speaking only English with their parents. All monolinguals reported speaking only English at home. A characteristic of the bilinguals that does not appear in Table 1 is that 9 (30%) did not rate themselves as a 7 on either Spanish or English, suggesting that they believed their abilities in any of the languages they knew to be weak relative to the abilities of native speakers. There were 2 monolinguals who rated themselves as high as a 5 or good on speaking a language other than English; however, these participants did not begin to learn this language until age 13 (or older). Moreover, every one of the bilinguals was able to translate more words correctly than either of these monolinguals. Among the monolingual participants who were not fluent in any language other than English (see Table 1), strictly speaking, most of the monolinguals in this study were not purely monolingual; many studied another language in school. In the United States, such participants typically never attain proficiency beyond the minimum needed to fulfill academic requirements. Investing considerable effort to recruit pure monolinguals is not advised because such individuals may differ from the bilinguals tested in systematic ways. For example, individuals with no exposure to another language may include those who purposefully avoided language study (i.e., perhaps indicating the presence of a subtle or even obvious cognitive disadvantage or deficit).

**Table 1**

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<th>Characteristic</th>
<th>Experiment 1</th>
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<td>Age</td>
<td>20.4</td>
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<td>2.5</td>
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<td>37.1</td>
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<tr>
<td>Daily use of language other than English (%)</td>
<td>24.2</td>
<td>19.4</td>
<td>0.9</td>
<td>1.6</td>
<td>19.8</td>
<td>18.9</td>
<td>1.3</td>
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<td>Age of first exposure to English</td>
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<td>2.7</td>
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<td>4.3</td>
<td>3.4</td>
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<tr>
<td>Age of first exposure to language other than English</td>
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<td>1.9</td>
<td>12.3</td>
<td>4.2</td>
<td>1.2</td>
<td>2.7</td>
<td>13.0</td>
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<td>Self-rated English proficiency</td>
<td>6.4</td>
<td>1.0</td>
<td>7.0</td>
<td>0.0</td>
<td>5.8</td>
<td>1.2</td>
<td>6.9</td>
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<tr>
<td>Self-rated proficiency in language other than English</td>
<td>5.8</td>
<td>1.1</td>
<td>3.4</td>
<td>1.1</td>
<td>6.3</td>
<td>1.2</td>
<td>2.2</td>
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<tr>
<td>Years lived in the United States</td>
<td>19.4</td>
<td>3.8</td>
<td>20.2</td>
<td>2.6</td>
<td>14.4</td>
<td>8.7</td>
<td>36.7</td>
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<tr>
<td>Proportion of stimulus names translated correctly</td>
<td>53.5</td>
<td>12.1</td>
<td>7.6</td>
<td>6.8</td>
<td>42.1</td>
<td>17.1</td>
<td>7.2</td>
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participants, 22 reported knowledge of Spanish only, 3 of French only, 2 of French and Spanish, 2 of French, Spanish, and German, and 1 reported not knowing words in any other language. After participating in the TOT portion of the task (see below), on average, monolinguals translated 8% (SD = 7) of the target words into some other language correctly, and bilinguals translated 54% (SD = 12) into Spanish correctly. The bilinguals’ ability to translate only 54% of the words on average may seem low; however, it is important to recall that the target English words were designed to be difficult to produce even in the dominant language (otherwise, there would have been no TOTs). Moreover, translation into the second language is notoriously more difficult than is the reverse (e.g., Kroll & Stewart, 1994).

Materials

An English–Spanish bilingual assistant selected the target words and the pictures used to elicit TOTs. Pictures were all black-and-white line drawings selected from Snodgrass and Vanderwart’s (1980) study, the Internet, and other databases at the Center for Research in Language at the University of California, San Diego. An attempt was made to avoid using pictures with extremely rare names, to include cognates and noncognates across a range of frequencies, and to include a majority of noncognate targets to reduce the possibility that participants would notice this manipulation. The resulting item set included 217 pictures with 65 cognate and 152 noncognate names. The mean frequency count for the target picture names was 29.08 (SD = 45.71) per million according to the CELEX lexical database (Baayen, Piepenbrock, & Gulikers, 1995). The 108 picture names with the lowest frequency counts had an average frequency count of 3.43 (SD = 3.36), and the 109 picture names with the highest frequency counts had an average frequency count of 54.50 (SD = 53.64), which is higher than that of a typical TOT study (the higher frequency materials made it possible to manipulate cognate status and translatability with TOTs as the dependent variable in the same experiment). Name length was distributed as follows: 98 (45%) one-syllable words, 86 (40%) two-syllable words, 23 (11%) three-syllable words, and 10 (5%) four-syllable words. Cognates were paired with the closest available frequency-matched noncognate (taken from the 152 noncognates) for subsequent comparisons of cognates to noncognates. The very highest frequency cognate item, paper, was not included in this matching procedure, so that the number of cognates and noncognates could further be divided into two groups (see Results) with an equal number of items in each. Cognates (n = 64) and noncognates (n = 64) had average frequency counts of 26.70 (SD = 42.54) and 26.90 (SD = 43.00), respectively. This difference was not significant (t < 1).

Procedure

Participants were tested individually. They were told that a TOT state is “When you try to recall a particular word that you are sure you know but cannot recall at the moment.” They were also told that sometimes during a TOT experience, a person can report certain physical characteristics of the word (e.g., starts with a b). A monolingual English-speaking assistant presented the pictures to each participant in a fixed random order. Pictures were presented one at a time on a Macintosh computer screen using PsyScope (Cohen, MacWhinney, Flatt, & Provost, 1993). Figure 1 summarizes the procedure and scoring criteria. Participants were asked to try to name each target picture. Most bilingual participants assumed correctly that they should name in English only and were not specifically instructed to do so. Whenever participants could not produce the target name, they were asked whether they were having a TOT, to report the number of syllables, and to choose one of two possible initial target phonemes. The experimenter produced correct versus incorrect phonemes either first or second in a random order. Distracter phonemes were created by randomly replacing each target’s first phoneme with one of the first phonemes of other targets. If the name did not then come to mind, the experimenter told participants the target word and asked whether this word was familiar, and, if the participant had been in a TOT, whether this was the word she or he had had in mind during the TOT.

Preresolution Scoring Criteria

Participants’ responses were recorded by the experimenter on a response sheet and were scored as follows: (a) a GOT (“Got it,” as in Koriat & Lieblich, 1974) was scored when the participant was able to retrieve the target name, (b) a TOT was scored if a participant reported feeling that she or he would know the target word after hearing it, (c) a preresolution don’t know (pre-DK) was scored if the participant reported feeling certain that she or he would not know the word after hearing it, and (d) a target unclear was scored if the participant was not in a TOT state and reported being unsure of what the target picture was.

Postresolution Scoring Criteria

The postresolution scoring criteria were as follows: (a) A self-resolved was scored when participants spontaneously retrieved the target word prior to hearing the two forced-choice initial phonemes; (b) a cued resolve was scored when participants retrieved the target word after hearing the two possible initial target phonemes; (c) a recognize was scored when participants reported knowing the target word after it was presented; and (d) a postresolution don’t know (post-DK) was scored when the participant reported not recognizing the target name after it was presented.

TOTs corresponding to experimentally intended target names were scored as +TOTs. Other TOTs (e.g., for gnome instead of dwarf) were scored as −TOTs. To compare monolinguals to bilinguals in TOT rate, we used only the +TOTs. To compare participant groups on TOT quality, we analyzed resolution rates (spontaneous and cued) and reports about the targets’ characteristics (i.e., first phoneme and syllables) in +TOTs relative to control states. The latter included target unclears, DKs (both pre- and postresolution), and −TOTs; these provided a control because in all of these cases participants did not have the target word form in mind and thus should not have had greater than chance access to target word characteristics. A missing data point was recorded when the experimenter (by mistake) did not record a response. One should note that many responses were scored into multiple categories (reflecting responses given before and after the targets were retrieved or revealed). For example, a participant could start out thinking that he or she would not know a word (pre-DK) and subsequently retrieve it nevertheless after hearing the phoneme choices (hence it would also be a cued resolve).

After completing the TOT task, all participants attempted to translate (in paper and pen format) as many of the target names as they could from English into Spanish. Words in this posttest appeared in a different random order than that used during the experiment. The data from the translation test made it possible to test the predictions of the cross-language interference account (and to obtain an objective measure of the participants’ level of bilingualism).

Results

Throughout this article, when considering differences between participant groups, we focus primarily on statistical analyses that included all the bilinguals and monolinguals tested in each experiment. When considering TOT rate, we reported additional analyses of subsets of the bilingual group including only those who reported strongest proficiency in spoken English (i.e., strong English) or those who demonstrated equal familiarity with the English targets relative to monolinguals (i.e., low post-DK). Such comparisons are important when considering TOT rates because it is more compelling to find an increased TOT rate in bilinguals who
are unaware of their relatively reduced proficiency level in comparison with monolinguals. We do not report such analyses when considering cognate status and translatability effects because small differences in proficiency are not critical for testing whether phonology and cross-language lexical activation affect TOT rates.

The number (and percentage) of responses that fell into each of the scoring categories for monolinguals and bilinguals is listed in Tables 2 and 3, respectively. Unless otherwise indicated, throughout this article an alpha level of .05 was adopted for all statistical tests, and when t tests are reported, they are two-tailed tests. Statistical analyses were carried out over raw numbers of TOTs and over the proportion of TOTs, that is, number of TOTs/(number of ITEMS - number of post-DKs). This proportion controls for the number of opportunities to have a TOT, an important consideration because it is not possible to retrieve an unknown word, and the bilingual participants were familiar with fewer target words (i.e., they had higher post-DK rates; see below). Negative TOTs and target unclears were left in the denominator because these responses could reflect, at least in part, an inability to retrieve the target word.

**TOT Incidence**

On average, monolinguals had 8.67 (4.03%) TOTs, and bilinguals had nearly twice as many, 16.23 (7.72%). These differences were significant in analyses of raw numbers of TOTs, $F(1, 58) = 21.96, MSE = 39.10, p < .01$; $F(1, 432) = 16.86, MSE = 7.04$.

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2 An alternative method for calculating TOT rate (Brown, 1991; Brown & Nix, 1996; James & Burke, 2000) is to calculate TOTs as a proportion of unrecalled items; that is, number of TOTs/(number of ITEMS - number of GOTs), henceforth called the GOT-less proportion. This method is less relevant for constraining models of intact language production because it excludes successful retrievals from the calculation and as such assumes that TOTs are completely unrelated to successful retrievals. In contrast, the proportion used in the current study, that is, number of TOTs/(number of ITEMS - number of post-DKs) is based on the assumption that each GOT had the potential to have been a TOT, and that, other than a GOT, TOTs represent the most active state a lexical representation can reach. The GOT-less proportion also artificially increases TOT rates in participants.
Future studies on TOT rates are needed to clarify how to interpret TOT predicted if the GOT-less TOT rates in fact reflected retrieval difficulty). A positive correlation between TOT rates using the GOT was reported (Gollan & Silverberg, 2001). Experiment 2, in which these proportions were very close to ceiling (i.e., 79% vs. 70%, respectively; $F_{2}(1, 432) = 18.79$, $MSE = 0.01$, $p < .01$). The relatively low proportion of TOT responses in monolinguals likely resulted from the inclusion of some relatively higher frequency targets compared with what is typically used in TOT studies (A. S. Brown, 1991; see also Gollan & Silverberg, 2001). Bilingual status also significantly increased the number of post-DKs. That is, if being presented with the experimentally intended target word, monolinguals reported not recognizing only 0.93 words on average, whereas bilinguals reported 5.33 post-DKs on average. $F_{2}(1, 432) = 15.13$, $MSE = 2.65$, $p < .01$. Bilinguals and monolinguals reported equivalent numbers of target unclears (both $F_{2} < 1$), suggesting that the pictures were equally effective at eliciting a known target word in both participant types.

**Strong-English and low-post-DK bilinguals.** Although all the bilinguals reported being proficient in both Spanish and English, even very proficient bilinguals often have a somewhat more dominant language. Moreover, at least some bilinguals (see above) did not rate themselves as a 7 (like a native speaker) in English, and (as just reported) bilinguals reported a significantly higher post-DK rate, suggesting that they were familiar with fewer of the picture names. Thus, it is possible that the increased TOT rate in the bilingual group as a whole could be attributed to language proficiency or vocabulary knowledge rather than bilingual status per se. To investigate this possibility, we carried out two additional analyses. First we compared a strong English subset of the bilinguals ($n = 18$) who rated their abilities in English as high as possible on the scale provided (i.e., a rating of 7 or like a native speaker) to an age-matched subset of the monolinguals ($n = 18$). Second, we selected a low-post-DK subset of the bilinguals who reported 0–2 post-DKs, and we compared them to an age-matched subset of the monolinguals. The post-DK cutoff of two or less was chosen to be within the normal range of post-DKs for monolinguals (i.e., not more than two standard deviations greater than average). In both of these comparisons, bilinguals and monolinguals did not differ on age or education (all is $< 1$), and in the low-post-DK rate analysis, bilinguals and monolinguals also did not differ on post-DK rate ($t < 1$). Despite the substantial reduction in power (12 of 30 participants removed from each participant group for the analysis of strong-English bilinguals, and 19 of 30 participants removed from each group for the low-post-DK analysis), bilinguals still had significantly more TOTs in both the strong-English comparison (bilingual $M = 16.78$, $SD = 8.74$; monolingual $M = 8.67$, $SD = 5.24$), $t(34) = 3.27$, $p < .01$, and in the low-post-DK comparison (bilingual $M = 16.91$, $SD = 9.02$; monolingual $M = 10.45$, $SD = 4.50$), $t(20) = 2.04$, $p < .05$. These results indicate that perceived language ability and lack of familiarity with the targets do not account for the increased TOT rate in bilinguals.

**Other differences.** A number of other significant differences between bilinguals and monolinguals also emerged and is discussed only briefly because they are not relevant to the primary questions addressed in this article. First, bilinguals had fewer GOTs on average (182.83) relative to monolinguals (202.77), and this difference was significant, $F_{2}(1, 58) = 43.00$, $MSE = 138.61$, $p < .01$; $F_{2}(1, 432) = 28.97$, $MSE = 28.44$, $p < .01$. This finding is no doubt related to those reported above (e.g., increased TOTs imply fewer GOTs). Second, bilinguals reported more pre-DKs.

### Table 2

**Percentage and Total Number of Responses in Each Scoring Category by Monolinguals in Experiment 1**

<table>
<thead>
<tr>
<th>Postresolution response type</th>
<th>Preresolution response type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GOT</td>
</tr>
<tr>
<td>Total</td>
<td>93 (6,083)</td>
</tr>
<tr>
<td>Self-resolved</td>
<td>25 (64)</td>
</tr>
<tr>
<td>Cued resolve</td>
<td>18 (46)</td>
</tr>
<tr>
<td>Recognize</td>
<td>58 (150)</td>
</tr>
<tr>
<td>Don’t know</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Missing data</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

*Note. n values are in parentheses. The first row sums to 100% (±1% because of rounding values to the nearest whole number). The +TOT, −TOT, Don’t know, Target unclear, and Missing data columns sum to 100% only when the Total row is left out (±1% because of rounding values to the nearest whole number). Preresolution = response given prior to retrieving or being told the target word; postresolution = response given after retrieving or being told the target word; GOT = target correctly retrieved; TOT = tip-of-the-tongue; Don’t know = participant predicts that she or he will not recognize the picture name when it is provided, or the participant says that the name is unfamiliar after being told the target; Target unclear = participant reports not being sure of what the picture represents; Missing data = experimenter error; Self-resolved = participant retrieved the target word without a cue; Cued resolve = participant retrieved the target word after hearing the forced-choice phonemes; Recognize = participant reports recognizing the word after being provided with the target.*

with greater vocabulary knowledge, and as such could in fact (rather counterintuitively) lead to the prediction that monolinguals should have a higher TOT rate. Consistent with this view, using the GOT-less proportion, monolinguals had significantly more TOTs than did bilinguals in Experiment 1 (i.e., 79% vs. 70%, respectively; $t(58) = 2.04$, $p = .05$), but not in Experiment 2, in which these proportions were very close to ceiling (i.e., 96% vs. 95%; $t < 1$). Also, consistent with this view, Brown and Nix (1996) reported a positive correlation between TOT rates using the GOT less proportion and successful retrievals (a negative correlation would be predicted if the GOT-less TOT rates in fact reflected retrieval difficulty). Future studies on TOT rates are needed to clarify how to interpret TOT proportions.
SD bilinguals, into Spanish (included targets that most of the bilinguals were able to translate post-DKs). There was a Word Frequency (LF) words (the means for LF and high frequency [HF] words, respectively, were 7.00 and 1.67 in monolinguals and 13.50 and 2.73 in bilinguals), indicating that the difference in TOT rate between bilinguals and monolinguals is sensitive to the same factor that causes TOTs in general (i.e., word frequency). Finally, bilinguals reported more −TOTs, $F_{1}(1, 58) = 19.71, MSE = 8.00, p < .01$; $F_{2}(1, 432) = 20.51, MSE = 1.06, p < .01$. This result suggests that bilinguals are more likely to produce alternative picture names and, assuming that bilinguals are less proficient than monolinguals, seems consistent with the fact that picture name agreement (Snodgrass & Vanderwart, 1980) is correlated with language proficiency (Goggin, Estrada, & Villarreal, 1994).

Cognate Effects

Because cognate effects can only be observed if bilinguals actually know the word in both languages, we divided the cognates into two halves (using a median split) based on the bilinguals’ performance on the translation test (see Procedure). One half included targets that most of the bilinguals were able to translate into Spanish (“most-translated” items; i.e., on average 27 of 30 bilinguals, $SD = 2.5$, translated these correctly), and the other half included those that the fewest number of bilinguals were able to translate correctly (“least-translated” items; i.e., on average 12 of 30 bilinguals, $SD = 7.0$). We then compared TOT rates (in both bilinguals and monolinguals) for most-translated cognate items with TOT rates for their frequency-matched noncognates in a $2 \times 2$ analysis of variance (ANOVA) with participant type as a nonrepeated factor, and word type (i.e., cognate and noncognate) as a repeated factor in the subjects analysis and a nonrepeated factor in the items analysis. The results are shown in Figure 2. In the analyses on raw numbers of TOTs there were significant main effects of participant type, $F_{1}(1, 58) = 5.24, MSE = 0.57, p < .05$; $F_{2}(1, 124) = 4.23, MSE = 0.67, p < .05$, and cognate status, $F_{1}(1, 58) = 16.80, MSE = 0.26, p < .01$; $F_{2}(1, 124) = 6.20, MSE = 0.67, p < .05$. Most important, there was a Participant Type × Cognate Status interaction that was significant in the subjects

That is, when unable to retrieve the target picture name, bilinguals were significantly more likely to say that they would not know the word even when presented with it, $F_{1}(1, 58) = 22.62, MSE = 58.54, p < .01$; $F_{2}(1, 432) = 34.02, MSE = 5.39, p < .01$. This prediction participants made about themselves was accurate; as noted above, bilinguals were also more likely to report not recognizing target words (i.e., post-DKs). There was a Word Frequency (LF) words (the means for LF and high frequency [HF] words, respectively, were 7.00 and 1.67 in monolinguals and 13.50 and 2.73 in bilinguals), indicating that the difference in TOT rate between bilinguals and monolinguals is sensitive to the same factor that causes TOTs in general (i.e., word frequency). Finally, bilinguals reported more −TOTs, $F_{1}(1, 58) = 19.71, MSE = 8.00, p < .01$; $F_{2}(1, 432) = 20.51, MSE = 1.06, p < .01$. This result suggests that bilinguals are more likely to produce alternative picture names and, assuming that bilinguals are less proficient than monolinguals, seems consistent with the fact that picture name agreement (Snodgrass & Vanderwart, 1980) is correlated with language proficiency (Goggin, Estrada, & Villarreal, 1994).

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analysis, $F_1(1, 58) = 7.15$, $MSE = 0.26$, $p = .01$, with a trend in the same direction in the items analysis. $F_2(1, 124) = 2.64$, $MSE = 0.67$, $p = .12$. The analyses of percentage of TOTs produced the same results; significant main effects of participant type, $F_1(1, 58) = 5.28$, $MSE = 0.00$, $p < .05$; $F_2(1, 124) = 4.18$, $MSE = 0.00$, $p < .05$, and cognate status $F_1(1, 58) = 16.77$, $MSE = 0.00$, $p < .01$; $F_2(1, 124) = 6.21$, $MSE = 0.00$, $p < .05$, and the Participant Type $\times$ Cognate Status interaction was significant in the subjects analysis $F(1, 58) = 7.13$, $MSE = 0.00$, $p < .01$, with a trend in the same direction in the items analysis. $F_2(1, 124) = 2.64$, $MSE = 0.67$, $p = .12$.

This interaction was confirmed in planned comparisons. Bilinguals showed robust cognate facilitation effects with fewer TOTs for cognate targets in both subjects, $t(58) = 3.29$, $p < .01$, and items, $t(62) = 2.46$, $p < .05$, analyses. In contrast, bilinguals showed no cognate effects for least translatable items (all $t < 1$), suggesting that cognate status is only relevant if bilinguals actually know the words in both languages. Crucially, monolinguals showed no significant cognate effects (all $t < 1$), suggesting that the cognate facilitation effects observed in bilinguals were in fact caused by bilingualism. In addition, for the first time in any condition, when the targets were translatable cognates, bilinguals no longer had more TOTs than monolinguals (all $t < 1$). Thus, bilinguals consistently show more TOTs than monolinguals except when they are asked to retrieve a cognate target that they can produce in both languages.

Translatability Effects

The cross-language interference hypothesis predicts that bilinguals should have more TOTs for words that they can translate relative to words they cannot translate and more TOTs than monolinguals only when they can produce the translation equivalent of a TOT target. An adequate test of this hypothesis requires a control for target word difficulty (because, on average, words that bilinguals can translate should also be easier words). The most conservative way to achieve such a control is to assess translatability effects in bilinguals relative to monolingual TOT rates for the same target words. This control is more effective than merely matching translatable and nontranslatable words for frequency (which we also did; see below), or other variables known to affect difficulty, because matching procedures could easily leave out unidentified variables that also affect difficulty.

To make it possible to assess translatability effects in both bilinguals and monolinguals, we used bilingual translation scores to divide the items into most and least translatable targets and then word frequency to further divide the targets into very low, low, higher, and highest frequency groups. Not surprisingly, more of the highest frequency items fell into the most translatable group and vice versa. Specifically, there were 43, 37, 20, and 8 least translatable items that were very low, low, higher, and highest frequency, respectively. In contrast, there were 11, 17, 34, and 47 most translatable items that were very low, low, higher, and highest frequency, respectively. To select frequency-matched most and least translatable items, we randomly selected stimuli from each frequency group, including as many items as possible while also maintaining equal numbers in each translatability group. For example, in the very low frequency group, there were 43 least translatable items and 11 most translatable items; thus 11 was the limiting factor. We randomly selected 11 out of the 43 least translatable items and only included these in the analysis. We did not include word frequency category (i.e., very low, low, high, and highest) in the ANOVA because it was not essential for the question of interest and because we still had uneven numbers of items in each group (i.e., 11, 17, 20, and 8 very low, low, higher, and highest frequency items in each of the translatability groups). After this matching procedure, items in most translatable ($M = 22.58$, $SD = 41.24$) and least translatable groups ($M = 16.59$, $SD = 20.11$) were frequency matched ($t < 1$).

To analyze the effect of translatability, we conducted a $2 \times 2$ ANOVA with participant type (bilingual vs. monolingual) as a nonrepeated factor and translatability (most vs. least) as a repeated factor in the subjects analysis and as a nonrepeated factor in the items analysis. The average numbers of TOTs in each group and condition are shown in Figure 3. In the analyses of raw numbers of TOTs there were main effects of participant type and translatability; monolinguals had fewer TOTs than did bilinguals, $F_1(1, 58) = 15.70$, $MSE = 6.66$, $p < .01$; $F_2(1, 220) = 13.28$, $MSE = 6.03$, $p < .01$, and translatable items produced fewer TOTs, $F_1(1, 58) = 45.02$, $MSE = 2.85$, $p < .01$; $F_2(1, 220) = 18.00$, $MSE = 6.03$, $p < .01$. There was also a marginally significant Participant Type $\times$ Translatability interaction, $F_1(1, 58) = 3.80$, $MSE = 2.85$, $p = .06$; $F_2(1, 220) = 3.42$, $MSE = 6.02$, $p = .07$, suggesting that bilinguals were more affected by translatability than were monolinguals. The analyses of percentage of TOTs produced virtually the same findings: Monolinguals had fewer TOTs than bilinguals, $F_1(1, 58) = 16.47$, $MSE = 0.00$, $p < .01$; $F_2(1, 220) = 10.55$, $MSE = 0.01$, $p < .01$, translatable items produced fewer TOTs, $F_1(1, 58) = 47.17$, $MSE = 0.00$, $p < .01$; $F_2(1, 220) = 12.83$, $MSE = 0.01$, $p < .01$, and in this case the Participant Type $\times$ Translatability interaction was significant by subjects but not by items, $F_1(1, 58) = 4.62$, $MSE = 0.00$, $p < .05$; $F_2(1, 220) = 1.34$, $MSE = 0.01$, $p = .25$.

![Figure 3.](image-url) The average number of tip-of-the-tongue states (TOTs) for most-translated and least translated targets in Experiment 1. Error bars show 95% confidence interval half-widths of the interaction by subjects (as recommended by Loftus & Masson, 1994).
Three main results emerged in Experiment 1. First, bilinguals had more TOTs than did monolinguals. This result was obtained even when limiting the comparison to bilinguals who rated their English to be as strong as that of native speakers and to bilinguals who recognized the same number of target words (i.e., bilinguals who reported the same number of post-DKs as did monolinguals). These analyses indicate that the increased TOT rate was not caused by differences in perceived language ability or by lack of famil-

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3 We also conducted similar analyses on reports of the number of syllables in the target words forms (in both Experiments 1 and 2), but these analyses produced weak findings in both bilinguals and monolinguals (and after collapsing across participant type). This was unexpected because, in other ways, TOTs in this study were comparable to those observed in other studies. We suggest that the ability to access the number of syllables is simply a less robust finding (see also Brown, 1991; Koriat & Lieblich, 1974) than has previously been assumed. Because weak data are unlikely to provide reliable information regarding differences between bilingual and monolingual processing mechanisms, we did not report these findings in detail.
arity with the intended targets. Similarly, despite their increased TOT rate, bilinguals demonstrated a trend toward better access to partial information (first phoneme) about the target words, and bilinguals were equally likely to resolve TOTs (before being provided with the word). Thus, the between-group difference in TOT rates cannot be simply attributed to a general difficulty for bilinguals with all language tasks. This finding also suggests that once a TOT occurs in either a monolingual or a bilingual, similar mechanisms mediate resolution and access to partial information and that the lexical properties that lead an item to be vulnerable to a TOT state do not necessarily underlie access to partial information during that TOT. Accounting for this discrepancy will require positing different mechanisms for TOT rates and TOT quality (see General Discussion).

There were two other main results in Experiment 1. First, cognate status reduced TOT incidence in bilinguals. When the targets were cognates that bilinguals knew in both languages, the difference between TOT rates in bilinguals and monolinguals was eliminated. Second, knowledge of noncognate translation equivalents, or translatability, also reduced TOT rates, with greater effects of translatability in bilinguals. These findings have important implications for accounts of the TOT phenomenon and the increased TOT rate in bilinguals. First, cognate effects identify an effect of phonology on TOT rates. Thus, the failed-single-selection and selected-lemma accounts must be modified to allow phonological effects to influence lexical selection. It is important to note that cognate effects were found only in bilinguals. This indicates that cognate effects cannot be dismissed as a materials effect and that bilingualism affects TOT rates. That is, when comparing different types of words there is always the possibility of a confounding factor (e.g., similar problems arise when comparing concrete to abstract or high- to low-frequency words). However, in the case of the observed cognate effects, the monolingual controls rule out this possibility.

Because most of the bilinguals reported being English-dominant, the observed cognate facilitation effects also suggest that the less dominant language may influence the dominant language even in a single-language task. Similar effects of the second and third language on the first language were recently reported in lexical decision and word association tasks (Van Hell & Dijkstra, 2002). But in research on language production, such effects have been limited either to production in the less-dominant language (Hermans et al., 1998) or to both languages in bilinguals who are unusually balanced in their knowledge of two languages (Costa et al., 2000). After presenting the results of Experiment 2, we discuss cognate effects on the dominant language in more detail.

It is interesting to note that most translatable items produced fewer TOTs than did least translatable items in bilinguals and also in the subjects analysis of the monolingual data. In addition, there were Participant Type × Translatability interactions indicating that bilinguals experienced more facilitation from translatability. Monolinguals should not show any effect of translatability, and the trends towards translatability effects in monolinguals suggest that, despite the frequency matching, the targets in most and least translatable groups were not perfectly matched for difficulty. Nevertheless, this result is certainly inconsistent with the notion of cross-language interference. If the interference hypothesis is correct, then the Participant Type × Translatability interaction should have gone in precisely the opposite direction. That is, bilinguals should also benefit from the nonperfect difficulty matching that made most translatable items easier for monolinguals. If bilinguals also suffered from cross-language interference, then bilinguals should have benefited less (not more) from translatability facilitation than monolinguals. To confirm our conclusions, in Experiment 2 we retested the effects of cognate status and translatability in a different population of bilinguals.

Experiment 2: Tagalog–English Bilinguals

Method

Participants

Thirty Tagalog–English bilinguals (21 women and 9 men) and 30 age- and education-matched monolingual English speakers (23 women and 7 men) volunteered to participate in the experiment. Tagalog–English bilinguals were either originally from the Philippines or had parents who were from the Philippines, and monolinguals were all from the United States. Testing took place in San Diego, California. Tagalog–English bilingualism is common because although Tagalog is the official language of the Philippines, English is often used in school, on the radio, and on television. Tagalog also includes many words borrowed from Spanish because of 300 years of Spanish colonial rule. Both participant groups averaged 15.5 years of education. Participants completed the same language history questionnaire used in Experiment 1 and completed the entire testing session in 1–2 hr. Table 1 shows the participant characteristics. There were no significant differences in average age or education level across participant types (both t < 1). In general, these bilinguals were similar to those in Experiment 1 in that relative to monolinguals, they reported using another language on a daily basis more often, learned English at an older age, learned to speak two languages at an earlier age, rated themselves as having a higher level of proficiency in a language other than English, and rated themselves as having a lower level of proficiency in English. These differences were tested in two-tailed t tests and were significant at the p < .01 level. Finally, as in Experiment 1, in Experiment 2 there were a number of bilinguals (i.e., 7, or 23%) who did not rate themselves as a 7 in either Tagalog or English, suggesting that they believed their abilities in any language they spoke to be weak relative to the abilities of native speakers.

Relative to bilinguals in Experiment 1, the bilinguals in Experiment 2 spent significantly fewer years living in the United States relative to their matched monolinguals, t(58) = 7.67, p < .01, reflecting the fact that these bilinguals were chosen to have more balanced exposure to both languages. Another difference is that bilinguals and monolinguals in Experiment 2 were not all University of California, San Diego students, and their age range was more varied (19–59 years for bilinguals and 18–60 years for monolinguals). In other respects, the monolinguals were similar to those in Experiment 1; 6 reported some knowledge of Spanish only, 1 of French only, 7 of Spanish and French, 1 of French and Danish, 1 of Latin and Russian, 1 of Maltese, 2 of Spanish and German, 1 of Spanish and Italian, 1 of Spanish and American Sign Language, 1 of Spanish and Portuguese, and 8 reported no knowledge of any other language. On average, monolinguals translated 7% (SD = 14) words into another language correctly, and bilinguals translated 42% (SD = 17) words into Tagalog correctly.

Materials

The second author (a monolingual English speaker with some receptive knowledge of Tagalog) selected the target words and the pictures used to elicit TOTs by using a Tagalog–English dictionary (Santos & Santos, 1995) and by checking each item chosen with a proficient Tagalog–English bilingual who did not participate in the experiment. Pictures were selected in the same way and from the same sources described in Experiment 1. The resulting item set included 225 pictures with 72 cognate and 153 noncog-
nate names. The mean CELEX frequency count for the target picture names was 10.7 (SD = 11.9) per million (Baayen, Piepenbrock, & Gulikers, 1995). The 112 picture names with the lowest frequency counts had an average frequency count of 3.79 (SD = 3.31), and the 113 picture names with the highest frequency counts averaged 61.37 (SD = 71.31), which is (as in Experiment 1) higher than that of a typical TOT study (A. S. Brown, 1991). Name length was distributed as follows: 99 (44%) one-syllable, 87 (39%) two-syllable, 30 (13%) three-syllable, and 9 (4%) four-syllable words.

Each cognate stimulus was paired with the closest available frequency-matched noncognate (taken from the 153 noncognate items) for subsequent comparisons of cognates to noncognates. Cognates (n = 64; 8 cognates were not included in this frequency matching procedure because they were not included in the translation test) and noncognates (n = 64) had average frequency counts of 28.97 (SD = 46.25) and 29.01 (SD = 47.87), respectively. This difference was not significant (t < 1).

Procedure

The procedure was the same as in Experiment 1 with two exceptions. Instead of computer presentation, the pictures were presented on white paper in a three-ring binder. In addition, only 19 of 30 of the bilinguals completed the translation test during the testing session (because of time restrictions), and eight words were accidentally missing from the translation posttest. The remaining bilinguals completed the translation test at home and mailed back their responses, but these translation data were not used in any analyses reported below.

Results

TOT Incidence

The total number (and percentage) of responses in each of the scoring categories for monolinguals and bilinguals are listed in Tables 5 and 6, respectively. On average, monolinguals had 10.12 (4.52%) +TOTs, and bilinguals had over twice as many, 26.63 (12.15%). This difference was statistically significant in the analysis of raw numbers of TOTs, F,1, 58) = 23.22, MSE = 175.87, p < .01; F,1, 448) = 38.90, MSE = 14.00, p < .01, and in the analysis of percentage of TOTs, F,1, 58) = 23.08, MSE = 0.00, p < .01; F,1, 448) = 38.88, MSE = 0.01, p < .01. Bilingual status also significantly increased the number of post-DKs. After being presented with the experimenter-intended target word, monolinguals reported not recognizing an average of 0.05 words (compared with 0.93 in Experiment 1), whereas bilinguals reported an average of 0.46 post-DKs (compared with 5.33 in Experiment 1). As in Experiment 1, bilinguals and monolinguals in Experiment 2 showed an even greater effect of bilingualism on TOT rate (on average, bilinguals had 7.5 more TOTs than monolinguals in Experiment 1 and 16.5 more in Experiment 2). As in Experiment 1, bilinguals and monolinguals reported equivalent numbers of target unclear, F,1, 58) = 1.00, MSE = 0.28, p > .05; F,2 < 1.

Strong-English and low-post-DK bilinguals. As in Experiment 1, we carried out an analysis comparing strong-English (n = 10) and low-post-DK (n = 12) bilinguals to an age-matched subset of the monolinguals (with equal numbers of subjects). The post-DK cutoff was lower in Experiment 2 (i.e., 1 instead of 2 in Experiment 1) because of the lower average (and SD) number of post-DKs for monolinguals in Experiment 2. In both of these comparisons, bilinguals and monolinguals did not differ on age and education (both ts < 1), and in the low-post-DK rate analysis, bilinguals and monolinguals also did not differ on post-DK rate (t < 1). The strong-English subset of bilinguals reported a marginally significant higher number of TOTs (bilingual M = 17.25, SD = 12.48; monolingual M = 9.17, SD = 5.73), t(18) = 1.97, p = .05, and the low-post-DK bilinguals reported significantly more TOTs, t(22) = 2.22, p < .05 (bilingual M = 14.92, SD = 10.97; monolingual M = 6.92, SD = 4.76), confirming that sub-

Table 5

Percentage and Total Number of Responses in Each Scoring Category in Monolinguals in Experiment 2

<table>
<thead>
<tr>
<th>Postresolution response type</th>
<th>GOT</th>
<th>+TOT</th>
<th>−TOT</th>
<th>Don’t know</th>
<th>Target unclear</th>
<th>Missing data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>95</td>
<td>6 (336)</td>
<td>1 (44)</td>
<td>0 (7)</td>
<td>0 (6)</td>
<td>0 (3)</td>
</tr>
<tr>
<td>Self-resolved</td>
<td>12</td>
<td>35</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Cued resolve</td>
<td>21</td>
<td>64</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Recognize</td>
<td>67</td>
<td>205</td>
<td>16 (7)</td>
<td>71 (5)</td>
<td>0 (4)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Don’t know</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>25 (11)</td>
<td>14 (1)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Missing data</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>59 (26)</td>
<td>14 (1)</td>
<td>0 (0)</td>
<td>100 (3)</td>
</tr>
</tbody>
</table>

Note. n values are in parentheses. The first row sums to 100% (±1% because of rounding values to the nearest whole number). The +TOT, −TOT, Don’t know, Target unclear, and Missing data columns sum to 100% only when the Total row is left out (±1% because of rounding values to the nearest whole number). Preresolution = response given prior to retrieving or being told the target word; postresolution = response given after retrieving or being told the target word; GOT = target correctly retrieved; TOT = tip-of-the-tongue; Don’t know = participant predicts that she or he will not recognize the picture name when it is provided, or the participant says that the name is unfamiliar after being told the target; Target unclear = participant reports not being sure of what the picture represents; Missing data = experimenter error; Self-resolved = participant retrieved the target word without a cue; Cued resolve = participant retrieved the target word after hearing the forced-choice phonemes; Recognize = participant reports recognizing the word after being provided with the target.
jective proficiency and knowledge of the targets cannot explain the increased TOT rate in bilinguals.

Other differences. As in Experiment 1, a number of other significant differences between bilinguals and monolinguals emerged but will only be mentioned briefly here. First, bilinguals had fewer GOTs on average (190.03) relative to monolinguals (212.87), and this difference was significant, $F_1(1, 58) = 25.77, MSE = 303.42, p < .01$; $F_2(1, 124) = 42.03, MSE = 24.83, p < .01$. Second, as in Experiment 1, bilinguals were also more likely to report pre-DKs; however, in Experiment 2, this difference was less robust, $F_1(1, 58) = 3.71, MSE = 4.90, p < .07$; $F_2(1, 448) = 13.28, MSE = 0.18, p < .01$. There was a Word Frequency × Participant Type interaction on TOTs, $F_1(1, 58) = 15.16, MSE = 21.77, p < .01$; $F_2(1, 222) = 6.93, MSE = 12.76, p < .01$, with a greater difference between groups on LF words (the means for LF and HF words, respectively, were 8.23 and 1.90 in monolinguals and 19.80 and 6.83 in bilinguals). Finally, bilinguals reported more TOTs, $F_1(1, 58) = 18.63, MSE = 18.29, p < .01$; $F_2(1, 448) = 21.32, MSE = 2.13, p < .01$.

Cognate Effects

As in Experiment 1, we divided the cognate targets into most-translated and least-translated targets on the basis of the bilinguals’ performance on the translation test. In Experiment 2, however, to determine translatability of target names we used only the data provided by the 19 participants who were able to complete the translation test immediately after the TOT experiment (see Procedure). As described in Experiment 1, we then carried out a $2 \times 2$ ANOVA using TOTs for the most-translated cognates and frequency-matched noncognates as the dependent variable, and with participant type (bilingual and monolingual) and word type (cognate and noncognate) as factors. The results of this analysis are shown in Figure 4; the pattern of results is identical to that reported in Experiment 1. In the analyses of raw numbers of TOTs, there were significant main effects of participant type, $F_1(1, 58) = 16.92, MSE = 3.23, p < .01$; $F_2(1, 124) = 8.25, MSE = 6.21, p < .01$, and cognate status, $F_1(1, 58) = 22.89, MSE = 1.10, p < .01$; $F_2(1, 124) = 3.81, MSE = 6.21, p = .05$. Most important, there was a Participant × Word Type interaction that was significant in both the subjects, $F_1(1, 58) = 44.86, MSE = 1.10, p < .01$, and items analyses, $F_2(1, 124) = 7.46, MSE = 6.21, p = .01$. The analyses of percentage of TOTs produced the same results. There were significant main effects of participant type, $F_1(1, 58) = 16.47, MSE = 0.00, p < .01$; $F_2(1, 124) = 8.20, MSE = 0.06, p < .01$. The interaction by subjects (as recommended by Loftus & Masson, 1994).
.01, cognate status, \( F_{1, 58} = 23.44, MSE = 0.02, p < .01; F_{2, 124} = 3.99, MSE = 0.00, p < .05 \), and robust Cognate Status \( \times \) Participant Type interactions, \( F_{1, 58} = 44.58, MSE = 0.00, p < .01; F_{2, 124} = 7.55, MSE = 0.01, p < .01 \).

As in Experiment 1, planned comparisons showed that bilinguals did not report more TOTs than monolinguals (both \( n = 1 \)) in the most-translated cognate condition; they also showed robust cognate facilitation effects in bilinguals with fewer TOTs for most-translatable cognates in both subjects, \( t(58) = 4.33, p < .01 \), and items, \( t(62) = 2.93, p < .01 \). Analyses is important to note that for the same stimuli, monolinguals showed no cognate facilitation effects. In fact, monolinguals demonstrated a trend in the opposite direction with slightly more TOTs for most translatable cognates; this inhibition effect was significant by subjects, \( t(58) = 2.08, p < .05 \), but not by items, \( t(62) = 1.36, p = .18 \). This suggests that the cognate facilitation effects observed in bilinguals were strong enough to reverse a trend toward cognate items being slightly more difficult targets (using monolinguals’ TOT rates as a baseline test of target difficulty). Monolinguals did show a trend toward cognate facilitation effects for least translatable items that was significant by subjects, \( t(58) = 2.28, p < .05 \), but not by the items, \( t(62) = 1.06, p = .29 \). However, despite this trend in monolinguals, bilinguals showed no cognate effects for least translatable items (both \( n = 1 \)), again suggesting that cognate status only reduces TOTs if bilinguals know the word in both languages.

**Translatability Effects**

To assess whether the ability to produce a translation equivalent had any effect on TOT rates, we followed the same procedure described in Experiment 1; we first divided items into most and least translatable groups, and then into four frequency groups. As in Experiment 1, more of the highest frequency items fell into the most translatable group and vice versa. Specifically, there were 45, 33, 24, and 11 least translatable items in the very low, low, higher, and highest frequencies, respectively. In contrast, there were 12, 23, 32, and 45 most translatable items in the very low, low, higher, and highest frequencies, respectively. We then randomly selected items to obtain frequency-matched translatability groups. After this matching procedure, items in most translatable \( (M = 23.72, SD = 37.35) \) and least translatable \( (M = 17.94, SD = 22.79) \) were frequency matched, \( t(138) = 1.10, p = .27 \).

Figure 5 shows the average numbers of TOTs in each participant group and frequency category. We conducted a 2 \( \times \) 2 ANOVA with participant type as a nonrepeated factor and translatability as a repeated factor by subjects and a nonrepeated factor by items. As in Experiment 1, there were main effects of participant type and translatability; monolinguals had fewer TOTs than bilinguals, \( F_{1, 58} = 22.62, MSE = 39.16, p < .01; F_{2, 126} = 25.86, MSE = 12.35, p < .01 \), and translatable items produced fewer TOTs, \( F_{1, 58} = 40.07, MSE = 8.32, p < .01; F_{2, 126} = 11.45, MSE = 12.45, p < .01 \). This time, however, the Participant Type \( \times \) Translatability interaction was statistically robust, \( F_{1, 58} = 36.93, MSE = 8.32, p < .01; F_{2, 126} = 10.55, MSE = 12.35, p < .01 \). The analysis of percentage of TOTs produced the same findings. There were main effects of participant type, \( F_{1, 58} = 21.52, MSE = 0.01, p < .01; F_{2, 126} = 26.95, MSE = 0.01, p < .01 \), and translatability, \( F_{1, 58} = 41.32, MSE = 0.08, p < .01; F_{2, 126} = 9.35, MSE = 0.01, p < .01 \), and a robust Participant Type \( \times \) Translatability interaction, \( F_{1, 58} = 38.56, MSE = 0.00, p < .01; F_{2, 126} = 10.32, MSE = 0.01, p < .01 \).

Planned comparisons confirmed the interaction; monolinguals showed no significant effects of translatability whatsoever (both \( F < 1 \)), indicating that the targets in most and least translatable groups were well matched for difficulty. In contrast, bilinguals showed significant translation facilitation effects with items that were easy to translate producing significantly fewer TOTs, \( F_{1, 29} = 48.39, MSE = 13.23, p < .01; F_{2, 138} = 17.63, MSE = 15.41, p < .01 \).

Finally, as in Experiment 1, we carried out an additional 2 \( \times \) 2 ANOVA including participant type and only the most and least translatable items that were not included in the analyses of cognate effects reported above. After excluding all cognates and noncognates included in the analysis reported above, there were 30 most translatable and 67 least translatable items available for this analysis. Because of the uneven number of items in most and least translatable groups, we limited this analysis to TOT rates (not raw numbers of TOTs). This analysis produced the same results as reported above. There was a main effect of participant type with bilinguals producing a higher TOT rate than monolinguals, \( F_{1, 58} = 21.76, MSE = 0.00, p < .01; F_{2, 190} = 11.50, MSE = 0.02, p < .01 \), and a main effect of translatability with least translatable items producing a higher TOT rate, \( F_{1, 58} = 97.82, MSE = 0.00, p < .01; F_{2, 190} = 35.18, MSE = 0.02, p < .01 \). In addition, the Participant \( \times \) Item Type interaction was significant, \( F_{1, 58} = 19.36, MSE = 0.00, p < .01; F_{2, 174} = 8.62, MSE = 0.02, p < .01 \). These analyses confirmed that translatability exerts an effect on TOT rates that is independent of cognate status, and suggest that being able to produce the translation (even a noncognate translation) actually facilitates retrieval of the target in the other language. This finding creates serious problems for the cross-language interference account.
TOT Quality

In this section, we compared bilinguals and monolinguals on TOT resolution and access to first phoneme of the target word forms. These analyses were done in the same way as in Experiment 1 and are presented in Table 7.

TOT resolution. Unlike in Experiment 1, bilinguals were significantly less likely to (spontaneously or with the forced-choice phonemes) resolve a TOT relative to monolinguals, $F_1(1, 58) = 9.48, MSE = 0.04, p < .01; F_2(1, 227) = 8.28, MSE = 0.12, p < .05$. Moreover, the difference in results across experiments was not attributable to self-rated proficiency in English. Resolution rates in strong English bilinguals did not produce substantially different results, $F_1(1, 22) = 3.45, MSE = 0.04, p = .08; F_2(1, 141) = 8.46, MSE = 0.15, p < .01$. The reason for the lower rate of spontaneous resolutions in Experiment 2 is unclear and, also, unexpected given that Gollan and Silverberg (2001) observed the same result reported in Experiment 1.

First phoneme. Bilinguals and monolinguals (collapsed together) were better able to select the correct first phoneme of TOT relative to control state targets, $F(1, 38) = 10.52, MSE = 0.07, p < .01; F_2(1, 74) = 2.04, MSE = 0.09, p = .16$. This effect was only marginally significant in the items analysis because many items had to be eliminated because of the conservative procedure of eliminating items that did not produce at least one control and one TOT (i.e., the analysis including all items did produce a significant $F_2$ analysis). More important, there was no interaction between participant type and the ability to report the first phoneme, indicating no difference between bilinguals and monolinguals in the ability to correctly report the first phoneme of a target, $F_1 < 1; F_2(1, 74) = 1.08, MSE = 0.09, p > .05$.

Discussion

The results of Experiment 2 confirmed that cognates and translatability reduced TOT rates and these effects were observed in bilinguals only, indicating that bilingualism affects TOT rates. The results of Experiment 2 also demonstrated again that bilinguals have more TOTs relative to monolinguals even in the dominant language, when matched for self-rated language proficiency or post-DK rates (or familiarity with the targets), and even though TOTs in monolinguals and bilinguals were similar in quality (i.e., resolution rates in Experiment 1 and access to first phoneme in both Experiments 1 and 2). Further, the between-group difference in TOT rate was eliminated entirely by cognates that bilinguals were able to produce in both languages. Impressively, this lack of difference was obtained even though this analysis (and the comparable analysis in Experiment 1) included several bilinguals who did not report English as their strongest language.

Translatability Effects in Individual Participants

In both Experiments 1 and 2 we controlled for target word difficulty by assigning words to most and least translatable groups using the translation data provided by the bilingual group and using monolingual TOT rates for the same stimuli as a baseline. This control allowed us to rule out the possibility that translatable items were simply easier (because of some unidentified variable that could be correlated with translatability). Another way to evaluate the predictions of the interference account is to ask whether, for each individual, the ability to translate a word predicted whether or not the same individual was able to retrieve that word’s translation. This type of analysis does not provide the same type of control over target difficulty (because each participant translated different words correctly, and because monolinguals translated very few words correctly on average). Nevertheless, it does provide a better estimate of translatability effects in individuals, a potentially important factor given that less proficient bilinguals may be more subject to cross-language interference (Kroll, Michael, Tokowicz, & Dufour, 2002; Tzelgov, Henik, & Leiser, 1990).

To address this possibility we conducted a contingency analysis (see also Gollan & Silverberg, 2001) to test for an association between translation (correct or incorrect) and picture naming (correct or failed naming responses). This analysis assessed the probability of association between these two variables by calculating the frequency of yes—yes or YY cases (i.e., translated correctly and picture named correctly) and no—no or NN pairs (i.e., translated incorrectly and failed naming response) and determining whether they are greater than would be expected under the independence hypothesis. Log odds ratios were calculated separately for each participant and item (in separate analyses) as follows: log$((\text{number of YY cases} + 0.5)(\text{number of NN cases} + 0.5))/((\text{number of YN cases} + 0.5)(\text{number of NY cases} + 0.5)))$, and significance was evaluated using unweighted $t$ tests on the log odds ratio as recommended by Wickens (1993) for the analysis of contingency tables with dichotomous classifications and between-subjects variability. The log odds measure extends from negative to positive infinity, with zero indicating independence. In this case, positive values indicate cross-language facilitation and negative values indicate cross-language interference effects.

Table 7

| Qualitative Aspects of Tip-of-the-Tongue States (TOTs) and Control States in Experiment 2 |
|---------------------------------------------|--------------|-----------------|-----------------|
| Participants                          | % +TOTs spontaneously resolved | % Correct phoneme choices in +TOTs | % Correct phoneme choices in control states |
| All monolinguals                        | 37            | 74              | 53              |
| All bilinguals                          | 20            | 71              | 51              |
| Monolinguals age-matched to strong-English bilinguals | 35            |                  |                  |
| Strong-English bilinguals               | 18            |                  |                  |

Note. Chance accuracy for percentage of correct phoneme choices in +TOTs and control states is 50%.
Cognate Effects on the Dominant Language

We noted above that the cognate effects in Experiment 1 indicated that activation of the less dominant language can influence (and facilitate) production in the dominant language. Because many of the participants in Experiments 1 and 2 rated themselves as being equally proficient in both languages, we sought to confirm that participants who actually reported English dominance (for spoken language production) also showed cognate facilitation effects. We were able to do this by combining 15 participants from Experiment 1 and 4 from Experiment 2. These participants reported an average speaking rating of 6.63 (SD = 0.60) in English and 4.95 (SD = 1.13) in Spanish or Tagalog, and still demonstrated significant cognate facilitation effects, t(28) = 2.82, p = .01. A further subset of these participants (10 from Experiment 1 and 1 from Experiment 2) who also reported that their knowledge of English was as good as that of a native speaker also demonstrated significant cognate facilitation effects, t(20) = 3.15, p < .01. These findings confirm that cognate effects can be observed in the dominant language even when the task does not require the less dominant language to be active, and in participants who believe themselves to be as proficient as native speakers. More generally, the findings support the notion that bilingualism affects processing in both the dominant and the less dominant languages.

Are Cognate Effects Merely Translatability Effects?

We reported above that cognate effects were observed only in bilinguals and only when restricting the comparison to translatable cognates and noncognates that were frequency matched to these cognates. Separate analyses also confirmed the presence of translatability facilitation effects in noncognates that were independent of cognate status. A question that remains is whether the reported cognate effects demonstrated an effect of cross-language phonological similarity that is independent of translatability effects. In fact, because translatability facilitation effects were reported for the first time in the current experiments, the same question applies to all studies that previously reported cognate effects (e.g., Costa et al., 2000) without controlling translatability. To increase power, the analyses in this section included all 120 participants tested in Experiments 1 and 2.

One way to test whether cognate effects are independent of translatability effects is to match cognates and noncognates for translatability (in addition to other variables that affect production, e.g., word frequency). However, it is important to consider that such matching introduces another confound. Cognates are easier to translate than noncognates. To illustrate, *octopus* and *escorpion* both have an English frequency per million of 2; *octopus* and *escorpion* are translated into Spanish as *pulpo* and *escorpión*, respectively. Relative to the noncognate (*pulpo*), presumably it would not take many exposures to the cognate translation (*escorpión*) to be able to produce it in a translation task. Consistent with this (collapsed across Experiments 1 and 2), only 38% of the cognate items fell into the least translatable group. In contrast, 64% of noncognates were in the least translatable group. In addition, although there was no difference in average word frequency across the cognate and noncognate item groups as a whole (*t* < 1), noncognates that fell into the most translatable group were significantly more frequent relative to most translatable cognates, *t*(191) = 2.64, *p* < .01. As such, a nontranslatable cognate would be an unusually difficult word, and translatable noncognates (the type of items needed to test whether cognate effects on TOTs are independent of translatability effects) would be unusually easy.

Consistent with this argument, after selecting a group of noncognates that were matched in translatability (and frequency) to the translatable cognates (included in the analyses above), we found that monolinguals had significantly more TOTs for cognates (*M* = 0.47, *SD* = 0.68) than they had for noncognates (*M* = 0.22, *SD* = 0.49; *t*(118) = 2.34, *p* < .05), but bilinguals showed no significant difference between cognates (*M* = 0.53, *SD* = 0.93) and noncognates (*M* = 0.48, *SD* = 0.83; *t* < 1). This suggests that matching cognates and noncognates for translatability introduced a confounding variable that made cognates more difficult and caused monolinguals to show more TOTs for cognates (i.e., an apparent cognate inhibition effect). In contrast, bilinguals presumably suffered from the difficulty confound but also benefited from cross-language cognate facilitation effects, thereby canceling out the difference between cognates and noncognates seen in the monolinguals’ data.

Although we have argued that looking for cognate facilitation effects after matching cognates and noncognates for translatability introduces a confound, a comparison that does remain valid after such matching is the between-subjects comparison. Recall that in both Experiments 1 and 2 the bilingual disadvantage (i.e., the increased TOT rate) was completely eliminated in the translatable cognates condition. Similarly, the current analysis (with data from both experiments collapsed) demonstrated no difference in TOT rate between bilinguals and monolinguals for translatable cognates (*t* < 1). But most important, bilinguals still had more TOTs than did monolinguals for the translatability matched set of noncognate targets, *t*(118) = 2.14, *p* < .05 (see means and standard deviations in the previous paragraph). In other words, most
translatable cognates, but not most translatable noncognates, were sufficient to eliminate the between-group difference in TOT rate. That bilinguals had significantly more TOTs than did monolinguals even when restricting the analysis to highly translatable noncognates indicates that the cognitive effects observed in the current study cannot simply be reduced to translatability effects. In other words, cross-language phonological overlap produced an independent effect that reduced TOTs.

In future studies it will be important to consider controlling for translatability and to determine whether cognate effects in previously reported studies were also independent of translatability effects. Ideally, this would first entail identifying what factors would cause cognates and noncognates to be matched for both translatability in bilinguals and difficulty in monolinguals. Until then, it is reasonable to assume that previously reported cognate effects were in fact independent of translatability effects. Most studies that reported cognate effects did not investigate TOTs and thus were not limited to very difficult, and hence less translatable, words. For example, the highly proficient bilinguals in Costa et al. (2000) likely would have been able to translate both the cognates and the noncognates used in that study at close to ceiling levels of accuracy. Supporting this assumption, 2 Spanish–English bilinguals drawn from the same population tested in Experiment 1 were able to (rapidly and without consulting any outside source) correctly translate 96% and 91% of the stimuli used in Costa et al.’s (2000) study. Translation accuracy would likely have been even higher for the Catalan–Spanish bilinguals because the stimuli in that study were 50% Catalan–Spanish cognates but only 19% Spanish–English cognates. We now consider the theoretical implications of cognate and translation facilitation effects for accounts of the TOT state and for models of bilingualism.

General Discussion

In this study we compared TOTs for cognate and noncognate picture names in Spanish–English bilinguals, Tagalog–English bilinguals, and age- and education-matched monolingual controls. In both experiments participants named pictures of objects with (primarily) low-frequency names in English only, and after the naming task they attempted to translate all of the target words into another language. The results of both experiments were remarkably similar and produced two main findings: (a) cognate facilitation effects and (b) translatability facilitation effects. First, relative to frequency-matched noncognates, bilinguals had fewer TOTs for cognates (that they could translate), and monolinguals did not show any cognate effects. That is, TOTs are reduced when a participant knows that *rhinoceros* is translated as *rinoceronte*; otherwise, *rhinoceros* is as likely to cause a TOT as is its noncognate counterpart *tweezers*. In addition, for the first time in any condition (or study), bilinguals did not report more TOTs than did monolinguals when the pictures had translatable cognate names. With that exception, bilinguals consistently reported more TOTs than did monolinguals. As outlined in the introduction (and discussed below), the only existing TOT account that predicted cognate facilitation effects a priori was the transmission deficits account (Burke et al., 1991), in which TOTs entail a difficulty in activating sublexical phonological representations. Other accounts of the TOT phenomenon must be modified to accommodate this finding.

Second, bilinguals had fewer TOTs for noncognates that most bilinguals could translate. In contrast, monolinguals did not show any effects of translatability in Experiment 2 (we used the bilingual group’s translation scores to determine translatability). Although there was a small translatability effect in monolinguals in Experiment 1 (suggesting that translatable materials were easier), in both Experiments 1 and 2 there was an interaction such that translatability reduced TOTs in bilinguals more than in monolinguals. This result creates serious problems for the cross-language interference account of the increased TOT rate in bilinguals that predicted that bilinguals should be adversely affected by target translatability. As an alternative, relatively weaker links in the bilingual lexical system may cause the increased TOT rate in bilinguals. Two possible mechanisms (discussed below) may explain translatability facilitation effects: (a) that lexical representations in the nontarget language increase activation in the target lexical node via feedback to the semantic system, or (b) translation equivalents are directly connected via facilitatory lexical links.

In addition to demonstrating that TOTs are sensitive to cross-language phonological overlap and translatability, the current results constitute a replication as well as an elaboration of the original finding that bilinguals are more likely to fall into a TOT state. Although the task required production in English only, and although the bilinguals were either English dominant or highly proficient in both languages, bilinguals had more TOTs relative to monolinguals. The difference between groups was robust. It was significant, even though bilinguals demonstrated equal ability to correctly choose the first phoneme of a TOT target, when only including bilinguals who rated themselves as having native-like proficiency in English, after matching bilinguals and monolinguals for their ratings of the targets as known or unknown (i.e., post-DKs),4 and even when limiting the analysis to a subset of noncognates that were translatability- and frequency-matched to the most translatable cognates. Moreover, the single-language nature of the naming task used in this study indicates that the increased TOT rate is obtained whether the testing procedure forces both languages to be active or not (a question left open by the original Gollan & Silverberg, 2001, study) and that activation of the less dominant language can affect processing in the dominant language even when the task is carried out in the dominant language only. The observed cognate and translatability facilitation effects also demonstrate that the differences in TOT rate cannot be attributed to a general difficulty with all language tasks. Rather, it appears to

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4 Because many of our bilinguals were dominant in their second languages (i.e., learned Spanish or Tagalog first but reported that English is their strongest language), we also carried out analyses to determine whether age of exposure could explain our findings. In Experiments 1 and 2, there were 7 and 9 bilinguals, respectively, who reported regular exposure to English before the age of 1 year. When compared with their age-matched monolinguals, these bilinguals still demonstrated a trend toward reporting more TOTs (an average of 16.57 and 18.78 vs. 7.14 and 7.11 in Experiments 1 and 2, respectively), and these differences were significant using one-tailed t tests, t(12) = 2.02, p < .05, in Experiment 1, and t(16) = 1.96, p < .05, in Experiment 2. This analysis suggests that bilinguals who are exposed to both languages at an early age also have an increased TOT rate. It remains to be seen whether fluent bilinguals who learn a second language at a late age but who remain strongly dominant in their native language also have an increased TOT rate.
be attributable to bilinguals’ knowledge of words in two languages (Mâgiste, 1980; Randsdell & Fischler, 1987); the bilingual disadvantage is reduced or eliminated when bilinguals can make use of their experience in both languages. In addition, cognate and translatability effects on TOTs indicate that bilingualism interacts with the mechanism that causes TOTs and provides further constraint on accounts of the TOT phenomenon. In the next two sections we consider the implications of our results for each of the TOT accounts described in the introduction.

### Cognate Facilitation Effects and Accounts of the TOT Phenomenon

In the introduction we argued that only the transmission deficits account (Burke et al., 1991; James & Burke, 2000; Rastle & Burke, 1996) predicted cognate facilitation effects on TOTs a priori. It is important to note that lexical access has already been completed when TOTs arise in this account, and TOTs arise during failed activation of phonological representations. Cognate facilitation effects are predicted to arise in this account when phonological representations receive additional activation (via cascading) from translation-equivalent lexical representations in the nontarget language. Thus, cognate facilitation effects provide additional support both for the proposal that TOTs arise postlexical selection and for Costa et al.’s (2000) proposed mechanism of cognate facilitation effects in language production.

The observed cognate facilitation effects pose a challenge to the failed-single-selection account. This account is part of the Independent Representation Model that incorporates cascading activation and also stipulates that cross-language translation equivalents do not compete for lexical selection. As such, this model predicts cognate facilitation effects on picture naming (Costa et al., 2000). However, the model does not include feedback (Caramazza et al., 2001), and without feedback it is not clear how cognate effects, which constitute a phonological manipulation, could affect lexical selection (a processing step that precedes phonological activation during language production, and the level at which TOTs occur in the failed-single-selection account).

Feedback effects are controversial (Levelt et al., 1999; Rapp & Goldrick, 2000), and though clearly influential, their nature is sufficiently complex (Dell, 1986; Dell & O’Seaghdha, 1991) as to make simple predictions difficult. The cognate effects are no exception to this problem. It is important to note that although feedback clearly provides a mechanism for cognate status to affect lexical selection, it is not clear that all models that already incorporate feedback would predict cognate facilitation per se. It is possible that the added activation provided by feedback to cognates at the lexical level could instead lead to cognate inhibition effects (i.e., more TOTs for cognates) if the added activation also increased cross-language competition for selection. This problem does not affect the transmission deficits account, even though it is couched within the Node Structure Theory model that incorporates feedback (MacKay, 1987), because in this account TOTs arise after lexical selection. However, without knowing the exact activation flow parameters in the model, it is difficult to predict whether any model with feedback (e.g., Dell et al., 1997) should predict cognate facilitation or inhibition effects. One way for all models that include feedback to account for the observed cognate facilitation effects while also maintaining a lexical locus of TOT retrieval failure is to propose that translation equivalents do not compete for selection (Costa et al., 1999). This solution would obviously require rejecting the cross-language interference account; however, this move may turn out to be a desirable one (see Accounts of the Increased TOT Rate in Bilinguals section). Moreover, this proposal resembles Dell et al.’s (1997, p. 806) suggestion that competition for selection will be limited to words in the “proper syntactic category” (e.g., nouns) and as such seems feasible in that it does not constitute a major departure from monolingual mechanisms of language production.

The observed cognate facilitation effects pose an even greater challenge for the selected-lemma account and the discrete WEAVER++ (Levelt et al., 1999). This model lacks both feedback and cascading activation (i.e., it is discrete). Without cascading activation it is not clear how nontarget language lexical representations could affect production in the target language (as already argued by Costa et al., 2000). Further, without interactivity between the phoneme representations and the lexeme level it is not clear how cognate status could influence lexeme selection where TOTs occur in this model.

### Alternative Accounts of Cognate Effects

The above discussion assumes that cognate effects reflect simultaneous (and converging) activation of lexical representations in both languages. A number of alternative accounts seem possible. First, it could be argued that cognate facilitation effects should be attributed to sublexical frequency effects. By this view, cognates contain segments that are simply more frequent (for bilinguals but not for monolinguals). A problem with this proposal is that the evidence for phoneme, syllable, or other sublexical segment frequency effects in production is weak. This may be in part because of the difficulty of isolating them from other correlated factors (e.g., lexical frequency and neighborhood density, and cross-linguistic markedness) and because of the difficulty of localizing such effects to production rather than comprehension or articulation (for a review, see Goldrick, 2002). However, even if segment frequency effects are found, it is not at all clear that cognate status would be sufficient to increase the frequency of sublexical segments in the bilingual phonological system (Costa et al., 2000). Most important, this proposal is tantamount to admitting that TOTs primarily reflect a difficulty in selecting sublexical segments, thereby requiring revision of all TOT accounts that propose TOTs to be a failure to select a whole-word lexical representation.

It could be argued that cognate facilitation effects simply reflect a cuing strategy that bilinguals use to escape from the TOT state. For example, if a Spanish–English bilingual fell into a TOT state for the Spanish target rinoceronte, this bilingual could attempt to retrieve the word in English, and the overlap in phonology could then cue retrieval of the Spanish target in much the same way in which phonological cues improve naming performance. However, two aspects of the present methodology suggest that this cuing strategy cannot explain the observed pattern. First, we observed cognate facilitation effects on the dominant language (see Discussion section of Experiment 2) and consider it somewhat unlikely that bilinguals would often have TOTs for targets in the dominant language and subsequently be able to produce these words in the less dominant language (although this may happen occasionally, it
can also be explained using direct lexical links across lexicons.

Another possibility is that the similarity across languages is salient and leads cognates to be better learned relative to noncognates, and even in proficient bilinguals the striking cross-language similarity may operate as a powerful retrieval cue. A puzzling aspect of this proposal is that it assumes coactivation of lexical representations in both languages during learning, but it must also assume that such coactivation fails to occur after some point (presumably whenever the learning phase ends). Without this additional, and ad hoc, assumption, this proposal would hardly differ from that already proposed by Costa et al. (2000). Another problem for this account is that for many language pairs cognates are extremely common. For example, although they certainly were not designed with Spanish–English bilinguals in mind, 25 of 60 of the pictures in The Boston Naming Test (Goodglass & Kaplan, 1987) and 54 of 260 of the pictures in the Snodgrass and Vanderwart (1980) study have cognate names. Thus, when the first few cognates are learned, the cross-language similarity may be notable; however, this novelty would likely become less salient over time. In addition, this account does not provide a clear mechanism for the observed effects. At what level of processing would the ease-of-learning effect arise in accounts of TOT? Until a specific proposal is developed that explains exactly how learnability or salience affects language production (and TOT rates), it is not possible to adequately evaluate this idea.

A final possibility is that all translation equivalents are connected by direct links between lexical representations, and that these links are stronger for cognate representations. This possibility is different from the three discussed in this section in that it does assume coactivation of lexical representations in both languages during production in a single language. We return to this possibility after discussing translatability facilitation effects, which can also be explained using direct lexical links across lexicons.

### Accounts of the Increased TOT Rate in Bilinguals

In the introduction we discussed two accounts of the increased TOT rate in bilinguals: the weaker links and the cross-language interference accounts. Although neither account predicted translation facilitation effects on TOT rates, the weaker links account clearly has an easier time accommodating this finding. This account attributes the increased TOT rate to a relative weakness in the connections in the bilingual lexical system. This relative weakness occurs because bilinguals speak each language only some of the time and therefore spend less time strengthening the connections particular to each language relative to monolinguals. The weaker links account assumes that bilinguals and monolinguals spend roughly the same amount of time speaking overall and that bilinguals and monolinguals require roughly the same absolute number of exposures to word forms to be able to produce them efficiently. This account does not assume any direct effect of cross-language coactivation. For this reason, weaker links may arise even if the bilingual does not know the word in both languages. For example, in attempting to say beehive a bilingual who has had less exposure to this particular word in English may say something like Watch out for all the bees in that thingamajiggy they live in!! Therefore, over time, this bilingual would accrue a relative weakness when compared with a monolingual.

The alternative cross-language interference account assumes that the increased TOT rate in bilinguals arises from direct cross-language competition for selection (as in Hermans et al., 1998; Lee & Williams, 2001) at a stage of retrieval that affects TOT rates. For several reasons, the reported pattern of results cannot be explained using this account. Most important, after matching most translatable and least translatable targets for difficulty, bilinguals consistently had fewer TOTs for words that they could translate. Furthermore, across experiments, monolinguals did not show a consistent relationship between translatability and TOT rates; this ruled out the possibility that translatable targets were simply easier for some other reason. Thus, the ability to produce a translation equivalent (cognate or noncognate) actually facilitated target word retrieval, a finding that confirms Askitari’s (1999) anecdotal report that bilinguals sometimes retrieve translation equivalents in a strategic attempt to resolve TOTs.

A further strength of the weaker links account is that it provides an explanation for the increased post-DK rate observed in bilinguals in both Experiments 1 and 2. Specifically, a word must be heard a certain number of times before one can have the sense that it is an appropriate label for a given picture. Because bilinguals spend a substantial portion of time speaking another language, they should be less likely, relative to monolinguals, to have heard (or read) very low frequency word forms (even in their dominant language). To explain both results, the cross-language interference account would have to incorporate additional assumptions (that would probably be very similar to the weaker links proposal).

It is worth noting at this point that the notion of weaker links is flexible with respect to the locus of TOT failure and thus is not necessarily incompatible with the selected-lemma and failed-single-selection accounts. Weaker links could occur anywhere where language specific representations are proposed. In fact, Burke et al. (1991; James & Burke, 2000; Rastle & Burke, 1996) proposed that the transmission deficits associated with aging are present throughout the lexical system. TOTs were localized specifically in the phonological system because it contains one-to-one connections that were proposed to be most vulnerable to deficits. However, if the effect of bilingualism on connection strength is greater than the aging effect, then bilingualism may produce an effect even in less vulnerable processing locations, and thus several loci of TOT retrieval failure could be possible using the weaker links mechanism.

### Translatability Facilitation Effects

A question that remains is how the different TOT accounts can accommodate translatability facilitation effects. As noted in the introduction, Costa et al. (1999) found that translation equivalent distracters facilitated picture naming responses. Our findings are similar and extend this result. Because the translations were never explicitly presented (the division of targets into most and least translatable items took place after the TOT elicitation task), the current results suggest that translation facilitation effects can arise implicitly and can occur even during a single language task. In contrast, the picture–word interference paradigm overtly activates
Direct Lexical Links Between Translation Equivalents

Both languages (e.g., in Costa et al., 1999, participants named in one language while trying to ignore translation distractors in the other language). As a way of dismissing Costa et al.’s (1999) findings as evidence against cross-language interference, Kroll and Dijkstra (2002) suggested that cross-language interference effects (as in Hermans et al., 1998, and also in the semantic interference obtained by Costa et al., 1999) may only arise when there is no cue to the language of production and proposed that translation equivalent distractors may have functioned as a cue (to say the word in the other language). However, this proposal cannot account for the implicit translatability facilitation effects obtained here (in the absence of any distractors).

Feedback to the Semantic System From Nontarget Language Lexical Representations

In picture-word interference, translation facilitation effects can be explained either as an advantage arising from the absence of an unrelated competitor (the condition compared to the translation condition) or because of added activation that the translation distractor produces in the semantic system (Costa et al., 1999), or both. The fact that we obtained similar findings without presenting distracter items supports the latter proposal. By this view, a picture stimulus activates lexical nodes in both the target and the nontarget languages, and this added lexical node increases activation to the target through feedback to the semantic system. Although the translations were never actually presented in this study, it is reasonable to assume that their corresponding lexical nodes would nevertheless become active in the course of language-selective production.

Of the three TOT accounts discussed in the introduction, the failed-single-selection account most easily accommodates the semantic mechanism of translation facilitation effects because in this account the locus of TOT failure is only one processing step removed from semantic representations, the locus at which translation equivalents overlap. The transmission deficits account could also use feedback to the semantic system to explain translation facilitation effects; however, in this case, an additional step is necessary because the locus of TOT failure is one processing step later. Thus, the transmission deficits account would have to also assume that the added activation (provided by the lexical representation in the nontarget language) is sufficiently strong to survive the journey down to the phonological system. Finally, although the selected-lemma account does have interactivity between the semantic system and lexical nodes, it could not rely on this mechanism to explain translation facilitation effects because once a lemma has been selected, semantic processing has already been completed and, hence, semantic processing cannot affect TOTs.

Direct Lexical Links Between Translation Equivalents

Thus far we have proposed that both cognate and translatability effects reflect simultaneous (and converging) activation of lexical representations in both languages. These accounts are consistent with other recent findings in monolingual and bilingual language production demonstrating that phonological representations become more available when they are activated from more than one lexical source (Colomé, 2001; Cutting & Ferreira, 1999; Harley & Brown, 1998; Jescheniak & Schriefers, 1998; Peterson & Savoy, 1998; Vitevitch, 2002). A more radical proposal for explaining both of these effects is to assume that all translation-equivalent lexical representations are connected by bidirectional facilitatory links. Direct links between translations have also been used to explain reaction times in translation production (Kroll & Stewart, 1994) and masked cross-language translation priming effects (Golan et al., 1997). Such links would increase the degree of activation in the target lexical nodes, thereby reducing the number of TOTs in the failed-single selection account and also, through cascading activation, in the target phonological representations, where TOTs occur in the transmission deficits account. This proposal, in combination with an additional assumption, namely that such links are stronger for cognate translations, would also provide a way for the failed-single selection and selected-lemma accounts to explain cognate facilitation effects (on both TOTs and picture naming). Although it is post hoc, such a proposal does provide some added flexibility. For example, cognates vary in their degree of cross-language similarity; some differ very little (e.g., animal and the Spanish equivalent animal), and others differ quite a lot (e.g., artichoke and the Spanish equivalent alcachofa). The account of cognate effects proposed by Costa et al., 2000, leads to the prediction that cognate effects should be stronger when there is increased phonological overlap across languages. In contrast, the lexical links mechanism could account for all-or-none cognate effects such that translation pairs with a certain amount of (or more) phonological overlap would produce the same degree of facilitation.

Although in principle the selected-lemma account could use lexical links to explain the translation facilitation effects on TOTs, we note that this possibility does not work as well in this account. A central assumption of the selected-lemma account is that semantic processing has already been completed during the TOT state. Thus, what is lacking is an explanation of why lexical links should arise specifically at the lexeme level (where they could influence TOT states in the selected-lemma account). Noncognate translation equivalents are semantically related. Therefore, it is odd that lexical links should arise at the lexeme level, where word forms are represented. Strictly speaking, the selected-lemma account was not

5 In the current study, the authors (and assistants) determined cognate status using subjective judgments. A recent study on German–English cognates (Friel & Kennison, 2001) confirms that such subjective ratings are strongly positively correlated with more objective measures of cognate status (e.g., whether monolinguals can guess the translation). The large number of reported cognate facilitation effects in the absence of any consistent definition of what qualifies as a cognate across studies also confirms this approach. Nevertheless, to provide a more objective measure of the materials that produced the above reported cognate facilitation effects, we calculated the average Phonological Overlap Index (POL; Rapp & Goldrick, 2000) for the translatable cognates and their frequency matched noncognates. The POL index ranges from 0 to 1 (with 1 representing complete phonological overlap), and it estimates form overlap using the proportion of shared phonemes in each translation pair (for a detailed explanation, see Rapp & Goldrick, 2000). The average POIs for cognates and matched noncognates were 0.60 (SD = 0.18) and 0.22 (SD = 0.19), respectively, in Experiment 1, and 0.63 (SD = 0.15) and 0.17 (SD = 0.15) in Experiment 2. In addition, 91% of the most translatable cognate pairs (in both Experiments 1 and 2) shared phonological onset across languages.
designed to explain language production in bilinguals. Nevertheless, proponents of this account often use the TOT state as a justification for the need for two levels of lexical representation (Bock & Levelt, 1994; Levelt et al., 1999). The reported translation facilitation effects diminish the extent to which this argument is convincing. It would be much more convincing if they could show that TOTs are affected only by features naturally associated with lexeme retrieval such as word frequency and phonology.

Explaining Cognate and Translatability Effects in One Account

Given that both phonological cross-language overlap and translatability affected TOT rates, it is worth considering which locus of TOT failure would most easily accommodate both findings. With or without using direct lexical links between translation equivalents, the most parsimonious way to explain both findings is to localize the TOT failure one-processing step removed from both phonological and semantic representations where cognate status and translation equivalence are likely to be represented. This requires a model with a single layer of lexical representations. In addition, unless translations are connected directly via facilitatory links, interactivity between semantics and phonology is also needed to allow both semantic (i.e., prior TOT-locus) and phonological (i.e., post TOT-locus) processing to affect TOT rates. Finally, cross-language competition for selection must be prohibited to allow translatability and cognate status to produce facilitation (rather than inhibition). This account is shown in Figure 6.

TOT Quality

Although bilinguals and monolinguals consistently differed in TOT quantity, of interest was the lack of consistent differences between bilinguals and monolinguals in TOT quality; bilinguals demonstrated a trend toward improved access to first phoneme information in Experiment 1 but not in Experiment 2, and monolinguals had higher spontaneous resolution rates in Experiment 2 but not in Experiment 1. Increased TOT rates (e.g., as observed in

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**Figure 6.** A hybrid tip-of-the-tongue (TOT) account that explains both the cognate and translatability facilitation effects most easily. The locus of retrieval failure during TOTs is shown at the lexical level, which in this account is just one processing step removed from both semantic and phonological representations. The proximity to both semantic and phonological representations allows TOT rates to be affected by both cognate status and translatability. On the right are the least translatable English targets (*anvil* and *bunker*), and the Spanish equivalents (*yunque* and *bunker*) are shown in lighter print to indicate that these could not be produced in a translation task. The least translatable targets are shown in dotted lines to indicate that they are less active relative to the most translatable targets (*pot* and *filter*) and their Spanish equivalents (*olla* and *filtro*). The most translatable targets are more active because of interactivity between lexical representations and the semantic system (for both cognates and noncognates) and between lexical representations and the phonological system (for cognates only). Semantic and phonological representations that receive additional activation from nontarget (in this case Spanish) lexical representations are in bold to indicate increased activation. The jagged lines between Spanish and English lexical representations indicate that translation equivalents do not compete for selection. A discrete (noninteractive) version of this account is possible if direct facilitatory connections between lexical representations are added, with strongest connections between translatable cognates and weakest connections between least translatable lexical representations.
older adults) have been associated with slower rates of spontaneous target resolution and less access to partial information about the target form. This relationship was assumed to reflect a common mechanism underlying TOT rate and quality (Burke et al., 1991) and led us to expect similar findings in bilinguals. It is interesting to note that A. S. Brown and Nix (1996) reported equal ability to correctly report partial information in older and young adults, and Burke et al. (1991) also did not observe consistent differences in this regard. They obtained significant differences in a diary study but not in an experimental study more similar to those reported here. Burke et al. suggested that access to partial information is simply a “less reliable” difference (p. 569). An alternative possibility is that different mechanisms may explain TOT quantity and quality.

One such account provides yet another possible reason for the increased TOT rate in bilinguals. Schwartz (1999) proposed that retrieval monitoring, not retrieval itself, produces the TOT experience. According to this hypothesis, bilinguals may have more TOTs simply because they sometimes retrieve the word in the other language, and this serves as a powerful cue that the word is also known in the target language (Gollan & Silverberg, 2001). However, this proposal leads to precisely the wrong prediction regarding partial information. That is, if at least some of the time bilingual TOTs are caused not by true partial activation of a target word (i.e., “no representation of the target is present”; Schwartz, 1999, p. 388) but, rather, because knowledge of the translation foils bilinguals into thinking they are in a TOT, then bilinguals should be less able to access correct partial information about TOT targets relative to monolinguals, and this clearly was not the case.

Perhaps a better way to explain why bilinguals differ in TOT rate but not in TOT quality is to assume that TOTs will tend to occur in both bilinguals and monolinguals when there is a particular degree of partial activation of the target word form but that once a TOT occurs, the likelihood of target resolution and access to partial information should be the same. By this view, bilinguals experience more TOTs because a greater number of lexical representations are in this critical TOT-vulnerable range. Consistent with this hypothesis, of all the stimulus materials, there were 83 and 79 words that caused a TOT in at least one monolingual compared with 123 and 150 that caused a TOT in at least one bilingual, in Experiments 1 and 2, respectively. Thus, apparently bilinguals should be less able to access correct partial information about TOT targets relative to monolinguals, and this clearly was not the case.

References


Caramazza, A., & Miozzo, M. (1998). More is not always better. A final topic of interest for future research is individual variability in TOT rates. Why some individual bilinguals do not have increased TOT rates. More generally, bilinguals may continue to provide a useful tool for investigating individual variation in TOT rate and the mechanisms of TOT quality.

6 Consistent with this proposal, Gollan and Silverberg (2001) reported that bilinguals were able to use the same number of low frequency words as were monolinguals when the bilinguals were given one point for producing the word in one language and one point for producing it in both languages. Thus, although bilinguals could not produce twice as many names as did monolinguals (i.e., one in each language), they named the same number of targets provided that credit was given for naming in either language. One interpretation of this result is, that relative to monolinguals, bilinguals required fewer exposures to word forms to be able to produce them. Variation in this factor may explain individual variability in TOT rates in both bilinguals and monolinguals.
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