Research Report

"Tip of the Fingers" Experiences by Deaf Signers

Insights Into the Organization of a Sign-Based Lexicon

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ABSTRACT—*The "tip of the fingers" phenomenon (TOF) for sign language parallels the "tip of the tongue" phenomenon (TOT) for spoken language. During a TOF, signers are sure they know a sign but cannot retrieve it. Although some theories collapse semantics and phonology in sign language and thus predict that TOFs should not occur, TOFs were elicited in the current study. Like TOTs, TOFs often resolve spontaneously, commonly involve targets that are proper names, and frequently include partial access to phonology. Specifically, signers were more likely to retrieve a target sign's handshape, location, and orientation than to retrieve its movement. Signers also frequently recalled the first letter of a finger-spelled word. The existence of TOFs supports two-stage retrieval and a division between semantics and phonology in American Sign Language. The partial phonological information available during TOFs suggests that phonological features are accessed more simultaneously during lexical access for signed language than during lexical access for spoken language.*

A common misconception about sign language is that intended meaning and sign form are always related. According to this view, signers should never experience a retrieval failure analogous to one of the most compelling types of retrieval failure in spoken language production: a tip of the tongue state, or TOT. During TOTs, speakers temporarily cannot remember a word or name they are sure they know (A.S. Brown, 1991; R. Brown & McNeill, 1966). TOTs occur in most, if not all, spoken languages (Schwartz, 1999), but the possibility of a parallel state in signed languages has never been formally examined. We investigated whether American Sign Language (ASL) signers experience what we term a "tip of the fingers" state (TOF).

The existence and nature of TOTs in spoken languages suggest that independent processing stages provide access to word meanings and word forms (e.g., Dell, Schwartz, Martin, Saffran, & Gagnon, 1997; Garrett, 1975; Levelt, Roelofs, & Meyer, 1999; Miozzo & Caramazza, 1997). However, for signed languages, the division between semantic and phonological form has been questioned because these languages exhibit a high degree of iconicity. For example, the common view that signs are complex pantomimes necessarily entails that sign language does not have componential form-based structure (phonology). In addition, Stokoe (1991) proposed a theory of *semantic phonology* in which representations of a sign's form can be derived from aspects of its semantics. Semantic phonology eliminates form-meaning distinctions and rejects duality of patterning for signed languages (Armstrong, Stokoe, & Wilcox, 1995). Under such a model, TOFs should not occur because there is no clear division between semantics and phonology.

In contrast, most sign-language models assume a solid separation between phonological and semantic representations (e.g., Brentari, 1998; Liddell & Johnson, 1989; Sandler, 1989; Van der Hulst, 1993). Linguists refer to sign language "phonology" to underscore that sublexical, nonmeaningful units, although not based on sound, are nonetheless constrained by the same universal linguistic principles as phonological units in spoken languages. Signs are composed of four basic phonological categories, called parameters: handshape, location, movement, and orientation of the hand (or hands). Given the meaning-independent nature of phonological representations within these models, signers are predicted to experience TOFs in which they retrieve semantic information about target signs, but cannot retrieve the form of the signs. Such experiences would support the idea of separate semantic and phonological representations in ASL.

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If TOFs occur, the next question is whether any aspect of phonological structure is more easily retrieved than the others. The answer to this question would provide insight into how phonological forms are accessed during sign retrieval. During TOTs, speakers accurately report the first phoneme of TOT targets at above-chance levels, suggesting a special role for word onsets in lexical retrieval. Interestingly, sign-language dictionaries are typically organized by handshape, which suggests that handshape is cognitively more salient than other parameters. In addition, handshape is the phonological parameter most likely to participate in a sign production error (Hohenberger, Happ, & Leuninger, 2002; Newkirk, Klima, Pedersen, & Bellugi, 1980). Therefore, handshape may have special status and be retrieved during TOFs more often than other phonological parameters.

Alternatively, the degree to which phonological units are realized simultaneously is much greater in signed than spoken language. For example, handshape, orientation, and location are often expressed at the same time, and the number of sequential units (segments) is severely limited compared with spoken languages (see Brentari, 1998). Gating studies with ASL signs indicate that handshape, location, and orientation are accessed nearly simultaneously during sign perception (Emmorey & Corina, 1990; Grosjean, 1981). Movement is the last parameter to be identified, and its identification coincides with sign identification. If sign perception parallels sign production, then all phonological parameters except movement are accessed simultaneously.

For spoken languages, most naturally occurring TOTs involve proper names (Cohen & Burke, 1993). ASL represents proper names in two ways—through name signs and through finger spelling (a set of handshapes representing the English alphabet). Name signs are lexical signs generally used for friends, relatives, places, and a few famous people. Otherwise, finger-spelled letters are used to represent or "spell out" proper names. Because finger spelling requires sequential letter (i.e., handshape) production, TOFs for finger-spelled words may mirror the pattern observed for TOTs, with initial letters more accessible than middle or later letters.

In the current study, we asked three questions: (a) Do ASL signers experience TOFs? (b) Are TOFs similar to TOTs? (c) What dimensions of target signs or finger-spelled words are retrieved during TOFs? The existence of TOFs for lexical signs would support models of the sign lexicon with a clear division between semantic and phonological representations, and would be evidence against semantic phonology (Stokoe, 1991), demonstrating that intended meaning and manual form are dissociable, unlike pantomime. A preliminary diary study indicated that deaf signers do experience TOFs for both finger-spelled words and lexical signs. This led us to conduct a controlled study of laboratory-elicited TOFs.

Qualitatively, TOFs for lexical signs would offer clues about how the ASL lexicon is organized. If handshape is more accessible than other parameters, then it may be recalled more often than other parameters during a TOF. However, if lexical access during sign production parallels access during sign perception, then handshape, location, and orientation should be retrieved equally often in a TOF, and movement should be recalled less often. Finally, we predicted that TOFs for finger-spelled names, compared with TOFs for lexical signs, more closely parallel TOTs for spoken words, with better recall of initial letters (handshapes) than middle or final letters.

METHOD

Thirty-three deaf signers (14 males, 19 females) participated in the study (mean age = 24.9 years; range: 19–44 years). Eighteen were native signers (born into signing families), 8 acquired ASL at an early age (mean = 4.7), and 7 acquired ASL later (mean = 10.5). All subjects used ASL as their preferred and primary means of communication and had 12 or more years of education.

First, to elicit finger-spelled TOFs, we asked subjects to name 20 pictures of famous faces (e.g., Audrey Hepburn, Mikhail Gorbachev). Second, to elicit lexical-sign TOFs, we asked signers to translate a list of written English words into their corresponding ASL signs. The word list consisted of proper names for cities and countries (e.g., *Korea*, *Minneapolis*) and low-frequency words (e.g., *orbit*), to increase the number of TOFs elicited.

Participants were told that a TOF is "when you temporarily cannot retrieve a word you are sure that you know." All participants reported being familiar with the phenomenon and experiencing TOFs in the past. Participants were asked to produce a finger-spelled name for each famous person and an ASL sign for each English word that they knew, or to indicate when they did not know a person or could not remember a sign. When participants reported experiencing a TOF, they were asked if they could recall any properties of the target name or sign. Finally, participants' incorrect responses (e.g., "Joan Crawford" in response to a picture of Audrey Hepburn) were coded as "don't know" responses.

RESULTS

Participants reported a total of 79 TOFs, 55 for finger-spelled names and 24 for lexical signs. Twenty-one participants reported TOFs for finger-spelled names (from 1 to 6 per person), and 13 participants reported TOFs for lexical signs (from 1 to 4 per person). As commonly reported for TOTs (e.g., Burke, MacKay, Worthley, & Wade, 1991), the majority of lexical TOFs ($n = 22$) were for proper names.

For 31 of the finger-spelled TOFs (56%), subjects recalled some partial phonological information. They were most likely to report the first letter of the first name, last name, or both (71%). Nineteen of the 24 lexical TOFs reported (79%) were accompanied by an accurate report of one or more phonological

parameters of the target (i.e., handshape, location, orientation, or movement).

To consider whether some phonological parameters play a special role in lexical-sign retrieval, we conducted several analyses of the partial information reported during TOFs for lexical signs. Perhaps the most compelling aspect of these data was that in more than half (10/19, or 53%) of the TOFs, participants reported three of the four phonological parameters. The odds of obtaining this result by chance range from .00004 to .0006, depending on how chance is calculated (see subsequent discussion). Likelihood of resolving a TOF did not correlate with the amount of phonological information to which participants had access; across all cases, TOFs were resolved about 60% of the time.

Frequency of Parameter Reports During TOFs

To determine if participants reported certain parameters more often than others during TOFs, we calculated the rate of report of each parameter for each subject. Across subjects, the percentages of report were 56% for handshape, 53% for location, 42% for orientation, and 28% for movement. We entered these rates into a repeated measures analysis of variance (ANOVA) with four levels (one for each parameter) and found a significant effect of parameter, such that participants were most likely to report handshape and least likely to report movement, $F(1, 12) = 10.51$, $\eta^2 = .47$, $p = .01$. Planned comparisons using paired t tests revealed that participants reported handshape more often than movement, $t(12) = 3.16$, $d = 0.88$, $p = .01$, but equally often as location ($t < 1$) and only marginally more often than orientation, $t(12) = 1.85$, $d = 0.51$, $p = .09$.

Accuracy of Parameter Reports During TOFs

To assess whether participants reported certain parameters more accurately than others, we compared raw accuracy rates in a repeated measures ANOVA with four levels (one for each parameter; for means, see Table 1, column 1). There were no significant differences across the parameters, $F(1, 12) = 2.16$, $\eta^2 = .15$, $p = .17$. However, the accuracy of parameter reports is interesting only when it is above what would be expected by chance. A similar problem arises in TOT research. During TOTs, speakers sometimes accurately report the number of syllables and stress location. However, it is difficult to determine whether, for example, the accuracy of number of syllables reported is above chance accuracy because it is relatively easy to guess the number of syllables accurately (A.S. Brown, 1991; R. Brown & McNeill, 1966; Koriat & Lieblich, 1974).

To consider accuracy relative to chance, we estimated chance levels of accuracy in two ways and then considered how much more accurate participants' reports were relative to these chance levels (see Table 1). First, we derived an experiment-based estimate using the experimental stimuli; second, we derived a language-based estimate using existing analyses (Friedman, 1977; Vogler, Sun, & Metaxas, 2000) to estimate how many different types of each parameter exist in ASL. For example, there were 27 different handshapes (as opposed to 12 places of articulation, 8 orientations, and 18 movements) in the stimulus materials. If participants' handshape reports were based exclusively on their metalinguistic knowledge of different handshape types, then their likelihood of guessing handshape correctly should have been roughly 1 in 27, or only 4%. Participants' reports of parameters were between 3 and 15 times more accurate than levels expected by chance. For example, subjects reported handshape correctly 44% of the time, which was 11 times more accurate than the experiment-based chance estimate of 4% (i.e., 44/4 = 11). This suggests that participants based their parameter reports on partial access to the lexical representation of the targeted signs.

TABLE 1

Mean Accuracy (per Participant) of Parameter Reports During Tip-of-the-Fingers States and Estimates of Chance Accuracy Levels

Parameter	Raw accuracy rate[a]	Chance accuracy: Experiment-based chance	Chance accuracy: Language-based chance
Handshape	.44 (.43)	.04	.03
Location	.53 (.43)	.08	.04
Orientation	.40 (.43)	.13	.09
Movement	.26 (.39)	.06	.04

Note. Standard deviations are in parentheses.

[a]Accuracy rates were calculated conservatively by including unreported parameters in the baseline: accuracy = correct guesses/(correct guesses + incorrect guesses + no parameter guessed).

DISCUSSION

The existence of TOFs in so many of the study participants and the similarity of these TOFs to TOTs confirm that a TOT-type of retrieval failure generalizes to signed languages. In studies of lab-elicited TOTs, semantic cues are not very effective at resolving TOTs (Heine, Ober, & Shenaut, 1999; Meyer & Bock, 1992). Similarly, subjects in our study reported having detailed semantic information during a TOF, but little or no access to the word form. Note that although some TOF sign parameters were iconic (e.g., the movement for *Switzerland* outlines the cross on the Swiss flag), there was no relation between degree of iconicity for a particular parameter and access to it during a TOF (e.g., the iconic cross of *Switzerland* was not more likely to be retrieved than noniconic parameters of this lexical sign). This separation between semantic and phonological retrieval is evidence against semantic phonology (Stokoe, 1991).

TOFs were similar to TOTs in that the majority involved proper names and participants sometimes had partial access to phonological form. Partial access did not lead to immediate TOF resolution. TOFs for finger-spelled words further resembled

TOTs in that participants were more likely to recall the first letter (i.e., finger-spelled handshape) than other letters of TOF targets.

Similarly, for lexical signs, recall of phonological onsets was more frequent than recall of other phonological information. Participants were equally likely to recall handshape, location, and orientation, which are simultaneously present at the beginning of a sign, and least likely to recall movement, which unfolds over time. Thus, the results do not indicate that handshape is easier to access than other parameters. Rather, the results parallel those of gating studies of sign perception, indicating that phonological onsets are privileged for both signed and spoken languages.

Perhaps the most remarkable aspect of the TOFs for lexicalized signs was participants' frequent recall of as many as three of the four parameters. This qualitative aspect of TOFs has further implications for models of signed-language production and distinguishes TOFs from TOTs. Two or more phonological characteristics are not generally analyzed together in TOT studies; instead, each phonological characteristic is considered separately. For example, Caramazza and Miozzo (1997) found that during TOTs, speakers accurately reported grammatical gender 73.8% of the time, number of syllables 37.2% of the time, and initial phoneme 28.3% of the time. Caramazza and Miozzo did not say how often participants accurately reported all three characteristics together, but given the independent accuracy levels, this should have happened only 7.8% of the time. In contrast, participants in our study accurately reported three out of four phonological parameters correctly 53% of the time during a TOF. Thus, TOFs may be qualitatively quite different from TOTs with respect to the amount of phonological information that is retrieved simultaneously. In addition, recall of three parameters did not result in more TOF resolutions than did recall of fewer or no parameters. Thus, signs appear to be stored as a set of phonological attributes, and retrieval of one or more attributes does not result in immediate access to the full phonological representation. TOFs, therefore, can occur when any one parameter is insufficiently activated.

To summarize, the existence of TOFs for sign language supports a two-stage model of lexical access and a division between semantic and phonological representations. Like TOT targets, TOF targets were most frequently proper names. Further, the nature of recall during TOFs was similar to recall during TOTs in that partial phonological information (most frequently from word onsets) was sometimes retrieved. However, lexical TOFs differed from TOTs in the amount of information simultaneously available. Our results suggest that the ASL mental lexicon is not organized by a single phonological parameter that guides retrieval. Rather, sign production appears to parallel sign perception, such that when experiencing a TOF, signers are least likely to retrieve the movement of the target sign. More generally, our results support a language-universal processing pattern in which onsets have a special status, regardless of language modality.

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