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Conceptual Locations and Pronominal Reference in American Sign Language

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We report the results of an experiment investigating the ramifications of using space to express coreference in American Sign Language (ASL). Nominals in ASL can be associated with locations in signing space, and pronouns are directed toward those locations to convey coreference. A probe recognition technique was used to investigate the case of "locus doubling" in which a single referent is associated with two distinct spatial locations. The experiment explored whether an ASL pronoun activates both its antecedent referent and the location associated with that referent. An introductory discourse associated a referent (e.g., MOTHER) with two distinct locations (e.g., $STORE_{left}$, $KITCHEN_{right}$), and a continuation sentence followed that either contained a pronoun referring to the referent in one location or contained no anaphora (the control sentence). Twenty-four deaf participants made lexical decisions to probe signs presented during the continuation sentences. The probe signs were either the referent of the pronoun, the referent-location determined by the pronoun, or the most recently mentioned location (not referenced by the pronoun). The results indicated that response times to referent nouns were faster in the pronoun than in the no-pronoun control condition and that response times to the location signs did not differ across conditions. Thus, the spatial nature of coreference in ASL does not alter the processing mechanism underlying the on-line interpretation of pronouns. Pronouns activate only referent nouns, not spatial location nouns associated with the referent.

KEY WORDS: American Sign Language; pronominal reference; probe recognition; spatial locations.

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INTRODUCTION

American Sign Language (ASL) manipulates space for at least two purposes: to convey referential distinctions and to convey locative information (Emmorey *et al.*, 1995). Pronominal coreference is conveyed by associating nominal signs with specific locations in signing space. Pronominal signs are directed toward those locations to convey a coreference relation between the referent of the nominal and the proform. In addition, space can convey locative information about a referent. For example, the location associated with a referent shifts when a spatial verb like MOVE[4] is used, as illustrated in (1) (adapted from Padden, 1988, p. 262):

(1) $\text{PRONOUN}_{\text{left}}$ $_{\text{left}}\text{PERSON-WALK-TO}_{\text{right}}$. STOP, THINK-ABOUT. $\text{PRONOUN}_{\text{right}}$ DECIDE WAIT.

"She_i walked over there, stopped and thought a bit, then she_i decided to wait there."

The referent specified by the verb PERSON-WALK-TO is understood to have moved from one location (represented on the left of signing space) to a new location (represented on the right of signing space). The spatial locations specified by the two subject pronouns in (1) are different although the pronouns are coreferential. van Hoek (1992) presents further evidence that under certain circumstances, two distinct spatial locations can be associated with a single referent. She provides the following example (the relevant pronominal contrast is highlighted):

(2) NIGHT, $\text{WE-TWO}_{\text{right}}$ TALK $\text{THERE}_{\text{right}}$ $\text{HIS}_{\text{right}}$ ROOM. $\text{PRO}_{\text{right}}$ $_{\text{right}}\text{BAWL-OUT}_{\text{1st}}$. I $_{\text{1st}}\text{TELL}_{\text{right}}$ I SORRY. $\text{PRO}_{\text{right}}$ FORGIVE ME. MORNING, I GO_{left} OUT_{left} Y-A-R-D_{left}. $_{\text{1st}}\text{SEE}_{\text{left}}$ PRO_{left} AGAIN. $_{\text{left}}\text{BAWL-OUT}_{\text{1st}}$ AGAIN. STRANGE. BEFORE, **$\text{PRO}_{\text{right}}$** $_{\text{right}}\text{TELL}_{\text{1st}}$ **$\text{PRO}_{\text{right}}$** FORGIVE ME. MORNING **PRO_{left}** ANGRY AGAIN.

English Translation: "In the evening, we talked, in his room. He bawled me out. I told him I was sorry, and he forgave me. In the morning, I went out to the yard and saw him again. He bawled me out again. It was strange. Before, **he** told me **he** forgave me, but in the morning **he** was angry again."

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[4] Words in capital letters represent English glosses (the nearest equivalent translation) for ASL signs. Multiword glosses connected by hyphens are used when more than one English word is required to translate a single sign. The subscripts "left" and "right" indicate locations in signing space. A subscript at the beginning of a sign indicates the initial location, and a subscript at the end of a sign indicates the final location. A bracketed word following a sign indicates a change in meaning associated with grammatical morphology.

> (from van Hoek, 1992, p. 185; subscripts are substituted for semi-circles representing signing space in the original and bolding is added).

In this example, one pronominal form was used to refer to the referent in one context (in his room) and the other form was used to refer to the referent in a different location (in the yard). The choice of pronominal form reflects the conceptual location of the referent. In general, if the same referent participates in two events that have two distinct spatial settings, the signer may use two locations in signing space for that referent (van Hoek, 1992). We will refer to this phenomenon as *locus doubling*.

In the experiment reported here, we investigated the ramifications of locus doubling for processing pronominal coreference in ASL. Specifically, we hypothesized that pronouns in ASL may activate not only their nominal referent, but also the spatial setting associated with that referent. Previous research using the probe recognition technique found that ASL pronouns activate their referents, as has been found for pronouns in spoken languages (e.g., Emmorey, 1997; Emmorey & Lillo-Martin, 1995; Emmorey *et al*., 1991). In the probe recognition technique, sentences are presented that contain a pronoun, such as "John and Mary went to the grocery store, and he bought a quart of milk" (Chang, 1980). Recognition time for the probe word "John" (the referent of the pronoun in the second clause) is faster than recognition time for "Mary" (the nonreferent). In addition, recognition times for referent probes are also faster than when the same probes are presented after a control sentence without a pronoun (MacDonald & MacWhinney, 1990). These results suggest that comprehension of a pronoun invokes the backward activation of its referent. Referent activation occurs for both spoken and signed languages (see Emmorey, 2002, for a review) and serves to make the referent nouns more accessible during language comprehension (Gernsbacher, 1990).

Given the spatial nature of pronominal reference in ASL, we conjectured that the comprehension of an ASL pronoun may invoke the activation of both its referent and the spatial location associated with that referent, particularly in the case of locus doubling because spatial settings are salient and are distinguished by the form of the pronoun. Therefore, we developed stimuli in which an introductory discourse associated a referent with two distinct spatial locations. The introductory discourse was followed by two possible continuations: a pronoun continuation in which a pronoun referred back to the first location of a referent and a no-pronoun control condition that contained no anaphora. Two examples are given in (3) and (4) (see footnote 4 for transcription conventions). The approximate point at which the probe sign was presented is indicated by the "Δ" (see the section "Methods"):

(3) *Introductory discourse*:
MY WONDERFUL MOTHER B-U-S-Y, WENT-TO$_{left}$ STORE$_{left}$ BUY$_{[iterative]}$ FOOD, FINISH. $_{left}$BRING$_{right}$ KITCHEN$_{right}$ PREPARE.
"My wonderful mother is very busy. She went to the store and shopped for food. Then she brought it to her kitchen where she prepared it."

Pronoun continuation:
HAPPEN PRONOUN$_{left}$ FORGOT BU$_{\Delta}$Y ONION.
"As it happens, she forgot to buy onion (while she was at the store)."

Control (no-pronoun) continuation:
HAPPEN WILL BIG DIN$_{\Delta}$NER GATHERING.
"As it happens, there will be a big get-together for dinner."

PROBES: MOTHER (referent), STORE (referent-location), KITCHEN (recent-location)

(4) *Introductory discourse*:
LAST SATURDAY, MY BEST-FRIEND WENT$_{left}$ THEATER$_{left}$ WATCH$_{left}$, FINISH. $_{left}$ZOOM$_{right}$ LIBRARY$_{right}$, STUDY.
"Last Saturday, my best friend went to the theater where she watched (a play). Then, she zoomed off to the library to study."

Pronoun continuation:
BEFORE PRONOUN$_{left}$ LAUGH-HA$_{\Delta}$RD$_{[iterative]}$ REAL FUNNY!
"Earlier she (at the theater) laughed really hard it was so funny!"

Control (no-pronoun) continuation:
BEFORE SURPRISE OLD SWEETHEA$_{\Delta}$RT APPEAR.
"Earlier an old sweetheart unexpectedly showed up."

PROBES: BEST-FRIEND (referent); THEATER (referent-location), LIBRARY (recent-location)

As indicated in Examples (3) and (4), the probes were either the referent of the pronoun, the location associated with the referent as indicated by the pronoun, or the most recent location (but not the location

referenced by the pronoun). Following previous research, we hypothesize that response time for referent probes (e.g., MOTHER) will be faster in the pronoun condition than in the control condition, reflecting referent activation by the pronoun.

Of critical interest, however, is whether response time to the referent-location probes (the location specified by the pronoun, e.g., STORE) will also be faster in the pronoun condition. If so, this result would indicate that ASL pronouns activate both their referents and the locations associated with their referents. If not, then it would indicate that referent activation is specific to antecedent nouns only, as for spoken language. Response time to the recent-location probes (e.g., KITCHEN) is not expected to differ for the pronoun and control conditions, although it is possible that the pronoun may serve to suppress activation of the nonindexed location (but see Emmorey, 1997, for arguments that nonantecedent suppression may not be observed using a no-pronoun control condition). Finally, it is also possible that the pronoun may invoke activation of both location nouns since its referent is associated with both locations. In that case, response time to all probe types should be faster in the pronoun than in the controls condition.

In summary, the form of an ASL pronoun is influenced by the conceptual location of its referent. The following experiment investigated the ramifications of this fact for the on-line comprehension of pronouns in ASL. When signers encounter an ASL pronoun that specifies a referent at a specific location as in (3) and (4), does the pronoun serve to activate both the location noun and the referent noun? Or does the pronoun only serve to activate the referent noun? Answers to these questions will provide insight into how spatialized pronouns are interpreted during on-line processing of a signed language.

METHOD

Participants

Twenty-four deaf participants who were fluent in ASL participated in the experiment. All participants were prelingually deaf and ranged in age from 19 to 35 years (mean age = 25 years). Nineteen participants came from deaf families and were exposed to ASL from birth. Four participants had hearing families and acquired ASL prior to age 7. All participants used ASL as their primary and preferred language. Participants were paid for their participation and were tested either at Gallaudet University in Washington, DC or at The Salk Institute for Biological Studies in San Diego, CA.

Materials

A total of 42 experimental stimuli and 52 filler stimuli were developed.[5] All stimuli began with an introductory discourse that associated a referent with two locations (see Examples (3) and (4)). For the experimental stimuli, there were two possible continuations: (1) a pronoun continuation containing a pronoun directed toward the original location of the referent (and referring to that referent); (2) a control continuation that contained no anaphoric references. Participants made lexical decisions to probe signs presented during the continuation sentence. Probe signs were presented 1000 ms after the pronoun in the pronoun condition and after the second word in the control continuation (e.g., 1000 ms after WILL in Example (3)). The presentation time of 1000 ms was chosen because our previous research has shown this to be optimal for detecting antecedent activation by a pronoun in ASL (Emmorey & Lillo-Martin, 1995; Emmorey *et al.*, 1991). Test probe signs were either the antecedent of the pronoun (the referent probe; e.g., MOTHER), the location of the referent as indicated by the pronoun (the referent-location probe; e.g., STORE), or the most recent location of the referent (the recent-location probe; e.g., KITCHEN).

Nonsigns for the lexical decision task were developed by altering one or two phonological parameters of an ASL sign to create a possible but nonoccurring ASL form (Emmorey, 1991, 1995). For 38 of the 52 filler sentences, nonsigns were presented 1000 ms after the beginning of the continuation clause (half contained pronouns, half did not). For the remaining 14 filler sentences, signs referring to people (e.g., REPUBLICAN) requiring a "yes" answer were presented. These additional sign stimuli were included in order to balance the number of signs referring to persons (14 in the filler sentences and 14 in the test sentences) with the number of signs referring to locations (14 referent-location signs and 14 recent-location signs, e.g., STORE, KITCHEN). Thus, participants saw an equal number of signs referring to persons and to locations. The combination of experimental and filler stimuli produced 60% "yes" responses to signs and 40% "no" responses to nonsigns.

It was important to ensure that the referent and location probes did not differ significantly in frequency, in recognition time, or in length. Therefore, we first determined that the English glosses for the signs in each of the three probe categories did not differ significantly in frequency,

[5] Videotape copies of the experimental sentence stimuli are available upon request. Please contact the first author.

as measured by Francis and Kucera (1982). A one-way analysis of variance (ANOVA) revealed no significant differences in frequency ($F(2, 123) = 1.3$ ns). Mean frequency of the English gloss per million was 106 (sd = 124) for the referent signs, 123 (sd = 164) for the referent-location signs, and 160 (sd = 200) for the recent-location signs. Second, we presented the probe signs together with nonsigns to six native ASL signers for lexical decision in isolation. Reaction times for signs in the three probe categories did not differ significantly ($F(2, 5) = 1.21$ ns). Mean recognition times were as follows: 922 ms (sd = 222 ms) for referent signs, 942 ms (sd = 257 ms) for referent-location signs, and 910 ms (sd = 231 ms) for recent-location signs. Finally, the probe signs also did not differ significantly in length ($F < 1$). Mean duration was 813 ms (sd = 219 ms) for referent signs, 821 ms (sd = 281 ms) for referent-location signs, and 864 ms (sd = 307 ms) for recent-location signs.

Design and Procedure

We videotaped a native signer who produced all of the probes (signs and nonsigns) and sentential stimuli. This master videotape was used to create six experimental tapes which counterbalanced two levels of sentence type (pronoun, control) and three levels of probe (referent, referent-location, recent-location). Each subject saw only one of the videotapes; thus each subject saw each experimental sentence in some form, but no subject saw any sentence more than once. The filler sentences were the same for all tapes.

When editing the probe signs and nonsigns, we defined the beginning of a stimulus as the moment the hand(s) entered signing space and the end as the moment the hand(s) began to move out of the sign configuration and back down to resting position on the lap. The videotapes were edited using a Panasonic AG-A650 editor controller and Panasonic AG 6500 and 6300 video-cassette recorders.

In order to make clear that the inserted stimulus was the probe, rather than a continuation of the sentence (in the case of true signs), the signer wore a different colored blouse when producing the probe. Participants did not see the remainder of the sentence after probe presentation. A tone was aligned with the first frame of the probe, and this audio signal was fed into the Carnegie Mellon button box, a response-time measuring device with 1 ms resolution. Three seconds of black videotape separated each trial. Yes/no comprehension questions followed 31 of the stimuli to help ensure that participants were processing the sentence stimuli for meaning. All questions referred only to the introductory discourse.

The participants were tested individually using a SONY PVM 1380 trinitron color video-monitor. Reaction times were recorded by a Power Macintosh G-3 using PsyScope software. Participants were instructed in ASL to decide as quickly as possible whether a probe stimulus was a real ASL sign or an invented nonsign, and they responded by pressing the appropriate button marked "yes" (green) or "no" (red) on the button box. Nine practice stimuli were presented with feedback from the experimenter. The participants completed the experiment without a break in one 30 min session.

RESULTS

Only correct responses were analyzed, and response times that were more than two standard deviations above or below each participant's mean response time were deleted from the analysis (this procedure eliminated less than 5% of the data). Two separate ANOVAs were conducted with subjects and items as random factors (Clark, 1973). The experimental design was 2 (sentence type) × 3 (probe type). Error analyses were not significant and are not reported (mean error rate was 7%). Results from the response time analysis are shown in Fig. 1.

There was no significant main effect of sentence type (subjects: $F(1, 23) = 3.61$, $p < .08$; items: $F(1, 41) < 1$). There was a main effect of probe type, but only with the subjects analysis (subjects: $F(2, 46) = 3.57$, $p < .05$; items: $F(2, 82) = 1.47$ ns). Overall, response time to the referent probes was faster than to the referent-location probes ($F(1, 23) = 9.32$, $p < .01$) but not significantly different from the recent-location probes ($F(1, 23) = 1.26$ ns). The predicted interaction between sentence type

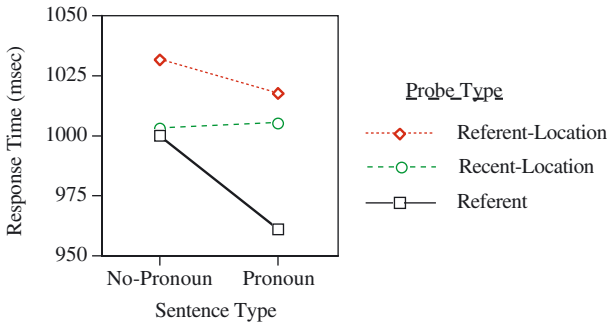

Fig. 1. Mean response time to probes in the pronoun and control (no-pronoun) conditions.

and probe type was significant with the items analysis ($F(2, 82) = 3.17$, $p < .05$), but not with the subjects analysis ($F(2, 46) < 1$).

Planned comparisons revealed that response time to referent probes was faster in the pronoun sentences than in the control sentences (subjects: $F(1, 23) = 4.95$, $p < .05$; items: 6.81, $p = .01$). Response time to the referent-location probes and to the recent-location probes did not differ significantly across sentence types with either analysis ($F < 1.20$ with all analyses). For the pronoun sentences, response time to referent probes was faster than to referent-location probes (subjects: ($F(1, 23) = 10.79$, $p < .01$; items ($F(1, 41) = 5.39$, $p < .05$), and response time to referent probes was also faster than to recent-location probes (subjects: $F(1, 23) = 3.97$, $p = .05$; items: $F(1, 41) = 6.01$, $p = .01$). In contrast, for the control sentences, response time to the various probe types did not differ significantly ($F < 1$ with both analyses).

DISCUSSION

The results do not support the hypothesis that ASL pronouns activate both their referents and the locations associated with those referents. Rather, the results indicate that ASL pronouns only activate their antecedent noun phrases, as has been found for spoken languages (e.g., Gernsbacher, 1989; Nicol & Swinney, 1989). Thus, the processing mechanism that assigns coreferential relationships among sentential elements appears to be identical for spoken and signed languages, despite the tremendous difference in the nature of the pronominal systems. Although the form of an ASL pronoun is influenced by the conceptual location of its referent, the processing mechanism that assigns coreference relations is not affected by the referent's conceptual location. Specifically, when a pronoun is encountered during on-line processing, only the antecedent noun (or noun phrase, see Bever & McElree, 1988) is (re)activated in memory. Such activation reflects the coreference assignment process and serves to maintain the salience of the pronominal referent in memory.

The results should not be interpreted to mean that ASL pronouns are not understood with respect to their referents' conceptual location. For example, in Example (4) from the section "Introduction", native ASL signers understand that the best friend is laughing in the theater, not in the library. Rather, the results suggest that the location noun (e.g., THEATER) is not activated by the pronoun, even though this noun has been associated with the same location in signing space as the referent of the pronoun (on the left in Example (4)). Thus, the coreference processing mechanism appears to be sensitive only to the coreference relation between

the pronoun and its antecedent, not between the pronoun and all nominals associated with the indexed location in signing space.

Given the spatial nature of the ASL pronominal system, an obvious question arises with respect to ambiguity. Since both THEATER and BEST-FRIEND have been associated with the same location in signing space, the ASL pronoun is potentially ambiguous between referring to THEATER and referring to BEST-FRIEND. However, the verb immediately following the pronoun in all of the stimuli used in the current experiment disambiguated the pronoun. It is possible that if the probe signs were presented immediately after the pronoun (or at least prior to the disambiguating information), we would find evidence of activation of both nouns. Previous research has suggested that an ambiguous pronoun activates all potential antecedents (Nicol & Swinney, 1989). Syntactically, either THEATER or BEST-FRIEND could be the antecedent of the subject pronoun in the continuation sentence in (4), but pragmatically only BEST-FRIEND could be the subject of the sentence.

The phenomenon of locus doubling in ASL provides clear evidence that the association between a referent and a location in signing space is not arbitrary, but is influenced by semantic factors, such as the conceptual location of a referent. Engberg-Pedersen (1993) presents further evidence that the choice of a spatial location for a referent conveys information about location, authority status, and point of view. We hypothesized that coreference processing in ASL might be affected by the semantic richness of signing space and that an ASL pronoun might activate a noun associated with the spatial setting indexed by that pronoun, along with its antecedent noun. However, we found no evidence supporting this hypothesis, at least using the probe recognition technique traditionally used to assess on-line coreference processing. These results provide evidence that the processing mechanisms used to resolve and interpret coreference relations do not differ cross-linguistically or cross-modally. Pronouns activate only their antecedent nouns, regardless of other semantic information conveyed by the form of the pronoun.

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