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Relative distance and gaze in the use of entity-referring spatial demonstratives: An event-related potential study

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ABSTRACT

How linguistic expressions are contextually constrained is of vital importance to our understanding of language as a formal representational system and a vehicle of social communication. This study collected behavioral and event-related potential (ERP) data to investigate neural processing of two entity-referring spatial demonstrative expressions, *this one* and *that one*, in different contexts involving the speaker, the hearer and the referred-to object. Stimulus presentation varied distance and gaze conditions with either semantically congruent or incongruent audiovisual pairings. Behavioral responses showed that distance determined the demonstrative form only in joint gaze conditions. The ERP data for the joint gaze conditions further indicated significant congruent vs. incongruent differences in the post-stimulus window of 525–725 ms for the hearer-associated spatial context. Standardized Low Resolution Brain Electromagnetic Tomography (sLORETA) showed left temporal and bilateral parietal activations for the effect. The results provide the first neural evidence that the use of spatial demonstratives in English is obligatorily influenced by two factors: (1) shared gaze of speaker and hearer, and (2) the relative distance of the object to the speaker and hearer. These findings have important implications for cognitive-linguistic theories and studies on language development and social discourse.

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1. Introduction

Spatial demonstratives are a subset of deictic expressions whose selection and interpretation depend on contextual information in reference to person, place, and object in space. For example, English has a two-member demonstrative system (i.e. *this* and *that*), which is considered the most common among the world's languages (Diessel, 1999). Traditional accounts have considered English demonstratives to refer to space that is either near or far from the speaker (Halliday & Hasan, 1979; Lyons, 1977; Quirk, Greenbaum, Leech, & Svartvik, 1979). It is easy to find counterexamples to the simple proximal-distal distinction between *this* and *that* (e.g., "*This* star, you mean?", where the referent was far away from both the speaker and the hearer). Yet the speakers somehow retain an intuition that relative distance does factor into their decision to use one or the other demonstrative.

An alternative view treats demonstratives as devices to establish a joint focus of attention in a conversation. Demonstratives draw the attention of the audience to some specific aspects of the discourse context (Diessel, 2006; Fillmore, 1971; Himmelmann, 1992; Levinson, 1983; Lyons, 1977; Webber, 1991). Theoretical accounts have emphasized different factors in terms of acceptability of demonstrative forms (Fillmore, 1971; Gundel, Hedberg, & Zacharski, 1993; Hanks, 1992; Strauss, 2002). Fillmore (1971) argued for a need of shared knowledge in the choice of *this* versus *that*, a framework that introduces the role of the hearer as a consideration in the choice of demonstrative form. Hanks (1992) emphasized the attentional aspect of demonstrative expressions in terms of their role to shift attention between the *figure* (i.e. the focus) and the *ground* of a speech context. Gundel et al. (1993) offered a framework for selecting various referring forms based on the attentional or memory state that a referent is presumed to occupy in the discourse. Strauss (2002) performed a corpus analysis of American English by considering various factors in the selection of a demonstrative form, which included the relative importance of the referent, its newness, and the degree of attention that the hearer is asked to give to the referent. The conclusion was that the use of *this* demands a stronger attentional state of the hearer than *that*.

Despite all the linguistic research, we still lack an understanding of the mental processes involved in the proper use of demonstratives and the neural mechanisms underlying our intuitive judgments. For instance, psycholinguistic experiments suggest that spatial demonstratives function as means to demarcate objects differently according to their distance to the speaker (Coventry, Valdes, Castillo, & Guijarro-Fuentes, 2008). But there is a lack of explanation at the neuro-psychological level for the relative acceptability of demonstrative forms in relation to the speaker's location. The use of spatial demonstratives in face-to-face interactions is generally accompanied by nonverbal social signals of eye gaze and gesture. All cultures, for instance, use pointing gestures, and all languages have demonstratives associated with pointing (Diessel, 2006; Kita, 2003). However, it remains unclear how distance from the speaker's and hearer's perspectives, the presence or absence of shared gaze, and the use of pointing gesture jointly determine the choice of a demonstrative form in a discourse.

Cognitive brain research offers a different approach to address how the demonstratives such as *this* and *that* in English are used differentially to refer to objects in space. In this study, we were particularly interested in whether gaze sharing between the speaker and hearer is important in acceptability judgment and whether the location of the hearer affects the expectation for a demonstrative form. We chose the event-related potential (ERP) technique in consideration of its capability to precisely track the time course of neural activity for processing semantic information (Kutas & Hillyard, 1980; Osterhout, Allen, Mclaughlin, & Inoue, 2002). We adopted an experimental paradigm of semantic violation that previous ERP studies had employed to investigate the neural basis of gesture use (Holle & Gunter, 2007; Kelly, Kravitz, & Hopkins, 2004; Kelly, Ward, Creigh, & Bartolotti, 2007; Ozyurek, Willems, Kita, & Hagoort, 2007; Wu & Coulson, 2007). The results in those studies consistently showed a parietal N400 effect for the unexpected pairings of speech with visual context involving gestures. The N400 is a negative potential deflection that peaks at approximately at the post-stimulus latency of 400 ms and is known to reflect cognitive processing of semantic anomaly. A later negativity effect was reported for processing semantic incongruity between gesture and metaphorical speech in native speakers (Cornejo et al., 2009) as well as in second-language learners (Ibanez et al., 2010).