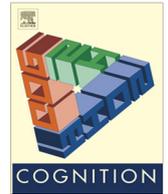




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Syntax and intentionality: An automatic link between language and theory-of-mind



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ABSTRACT

Three studies provided evidence that syntax influences intentionality judgments. In Experiment 1, participants made either speeded or unspeeded intentionality judgments about ambiguously intentional subjects or objects. Participants were more likely to judge grammatical subjects as acting intentionally in the speeded relative to the reflective condition (thus showing an intentionality bias), but grammatical objects revealed the opposite pattern of results (thus showing an unintentionality bias). In Experiment 2, participants made an intentionality judgment about one of the two actors in a partially symmetric sentence (e.g., “John exchanged products with Susan”). The results revealed a tendency to treat the grammatical subject as acting more intentionally than the grammatical object. In Experiment 3 participants were encouraged to think about the events that such sentences typically refer to, and the tendency was significantly reduced. These results suggest a privileged relationship between language and central theory-of-mind concepts. More specifically, there may be two ways of determining intentionality judgments: (1) an automatic verbal bias to treat grammatical subjects (but not objects) as intentional (2) a deeper, more careful consideration of the events typically described by a sentence.

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1. Introduction

Certain aspects of theory-of-mind appear to be automatic. For example, on the basis of visual cues alone, people spontaneously ascribe certain mental states to actors that may conflict with the judgments they make after careful reflection (e.g. Gao, McCarthy, & Scholl, 2010; Heider & Simmel, 1944). Such automatic processes may arise from “core knowledge” structures often studied by infancy researchers (Spelke, 2000; Spelke & Kinzler, 2007) and are seen as continuing to operate automatically into adulthood (Cherries, Mitroff, Wynn, & Scholl, 2009; Flombaum & Scholl, 2006). Due to their illusory nature, these attribu-

tions can be quite different from the judgments people make after taking the time to think more deeply about a situation.

Here we ask whether *linguistic* cues might also trigger the immediate impression of intentionality in a way similar to visual cues. In particular, the current studies suggest a connection between the grammatical subject position and a representation of intentional action. This link creates a bias for stronger intentionality attribution to grammatical subjects than to non-subjects (e.g. indirect objects and direct objects).

1.1. Automaticity in theory-of-mind

Consider the disposition to attribute intentions to creatures and people in the world around us. All available evidence suggests that this is an early emerging and fundamental part of cognition. At 10 months of age, infants

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can represent and evaluate goal states of simple props made to move around like animate objects (Hamlin, Wynn, & Bloom, 2007). Twelve-month-old infants attribute intentions and rational principles to inanimate objects navigating simple spatial environments (Gergely & Csibra, 2003). Similarly, 11-month-old infants link intentionality with order creation but not destruction (Newman, Keil, Kuhlmeier, & Wynn, 2010).

As is the case with many early emerging features of cognition, certain aspects of the representation of others' intentions appear to be automatic, arising in ways that people cannot control and that may even conflict with the judgments they make after careful reflection. One prominent example comes from the Heider and Simmel (1944) displays, in which simple animations create the illusion that basic geometric forms possess intentions even if the viewer is consciously aware that this is not the case. More recently it has been shown that the visual system automatically and irresistibly picks out "chasers" in simple animated displays (Gao et al., 2010). In other words, the perceptual apparatus locks onto a certain type of intention (i.e. chasing), which in turn serves to structure the processes of visual attention.

Just as there is a tight link between theory-of-mind representations and high-level vision, there may analogously be a tight linkage between theory-of-mind representations and grammatical structure. The current studies ask whether links between the representation of intentional action in theory-of-mind and specific syntactic positions may introduce quick and reflexive biases on intentionality judgments.

1.2. Thematic roles

Linguists employ the notion of thematic roles to explain relationships between the syntactic structure of a sentence and its underlying semantics (Carlson & Tanenhaus, 1988; Dowty, 1991; Fillmore, 1968; Gruber 1965; Schein, 2002). To begin with a simple example, it seems that there is some sense in which the objects denoted by the underlined phrases in sentences (1)–(3) all carry out similar roles in the described event.

- (1) John rolled the ball.
- (2) George dropped the coin.
- (3) Mary moved the pencil.

Although the events described by these different sentences are in many ways quite different (the first involves rolling, the second involves dropping), there does seem to be an important respect in which the objects picked out by the underlined phrases are occupying the same role within each event. Linguists have captured this intuition by suggesting that in each of these cases the underlined phrase occupies the role of theme (i.e. the object that undergoes movement). The key idea of this approach is that rules of the lexicon (or mental dictionary) stipulate that when verbs like the above are used and explicitly name two actors, the theme occupies the syntactic position of direct object (Carlson & Tanenhaus, 1988; Gruber, 1965).

Work in this area has examined a number of different potential thematic roles (theme, patient, instrument,

experiencer, etc.), but the one most directly relevant to the present experiments is the role of agent. This is the role occupied by the underlined phrases in sentences (4)–(6).

- (4) John rolled the ball.
- (5) George dropped the coin.
- (6) Mary moved the pencil.

Here, as in the above examples, the events described by these sentences are all different types, but the person picked out by the underlined phrase seems to perform a similar role in each case. The underlined phrase designates an actor who intentionally or volitionally brought about some state of affairs.

In the examples provided thus far, the theme has appeared as the direct object, while the agent has appeared as the grammatical subject. But there is no simple relationship between the thematic role of an argument and the syntactic position in which it is expressed. For example, consider (7)–(9):

- (7) The ball rolled.
- (8) The coin dropped.
- (9) The pencil moved.

The underlined phrases in these latter sentences appear as grammatical subjects (instead of as objects), but they nonetheless seem to occupy the same semantic role as the underlined phrases in (1)–(3), namely, theme.

Nevertheless, languages do not just work in such a way that one can arbitrarily assign any syntactic position to any thematic role. For example, suppose we try to imagine a verb *shmite* that has the converse meaning of the English verb *bite* (for similar examples see Marantz, 1984). If such a word could exist, one could use the sentence (10) to express the idea that the man bit the dog.

- (10) The dog *shmit* the man.

In such a hypothetical sentence, the subject would occupy the role theme, while the direct object would occupy the role agent. While it would be logically possible for a verb like *shmite* to exist in English, we find no such examples. Indeed, within every language, the mappings between thematic roles and syntactic positions are highly predictable and do not vary arbitrarily from verb to verb. Such regular mappings are the reason why just looking at the syntax of this sentence alone, one can make inferences about the likely assignment of thematic roles.

Indeed, the literature on syntactic bootstrapping has shown that young children are able exploit such regular mappings from a very early age in order to make educated guesses at the meaning of verbs. For example, when 26 month-old children hear a sentence like "The duck is gorging the bunny" they are more likely to look at a picture representing a causal action (i.e. the duck doing something to the bunny) than to a synchronous action (i.e. the duck and bunny each performing an action with no causal interaction between the two). However, when children hear "The duck and bunny are gorging," the children no longer preferentially direct their attention to the causal event

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