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THEMATIC ROLES

Verbs describe a situation involving one or more entities, or arguments. Running, for example, necessarily involves one argument (*Mary ran*), kicking involves two (*Mary kicked the chair*), and giving three (*Mary gave Sue a book*). A thematic role is a general characterization of an argument's role in the situation described by the verb. For example, an *agent* is an argument that initiates and executes the action of the verb. A *theme* is an argument that moves or changes state during the verbal action. A *patient* is an argument undergoing the verbal action, a *goal* is the destination of another verbal argument, and an *experiencer* is an argument whose mental state is affected or described by the verb. Less familiar roles include *measure* (the object in such sentences as *Mary weighs 150 lbs*), *source* (*the box* in *Mary removed the gift from the box*), and *incremental theme* (the created or consumed object in *Mary ate the apple* or *Sue wrote a letter*).

Thematic roles are implicated in many kinds of phenomena besides LEXICAL SEMANTICS. They are important in derivational MORPHOLOGY; for example, in English the verbal suffix *-er* forms agent or instrument nouns, like *writer* or *snipper*. They also play a role in acquisition: Syntactic frames in which agents are subjects and patients are objects tend to be mastered early by children. And they are clearly relevant to SYNTAX: Grammatical relations

like subject, object, and indirect object correlate strongly with particular thematic roles – agent, theme, and goal, respectively. In many Austronesian languages, such as Tagalog, verbs are inflected differently depending on which theta role is assigned to a certain syntactic position (see, e.g., Kroeger 1992).

Many theories, in consequence, have treated thematic roles as primitives. Within GOVERNMENT AND BINDING theory (Chomsky 1981), for example, *θ-roles* were central to many analyses. Every verb was associated in the lexicon with a *θ-grid*, a characterization of its semantic and selectional properties: e.g., *run* [agent] or *love* [experiencer, patient]. Verbs with similar *θ-grids* thus belonged to similar semantic classes and underwent similar (morpho)lexical operations. The *θ-grid* also affected the well-formedness of a sentence, via the *θ-criterion*: Every *θ-role* must be assigned to one and only one argument, and every argument must be assigned one and only one theta-role. The theory thus predicted that clauses with too many arguments, or too few, are ungrammatical.

Arguably the most important application of thematic roles, however, is the characterization of the robust connection between syntax and semantics, also known as the *linking problem* (Carter 1976). Indeed, this was the original motivation for the postulation of thematic roles, in the work of Jeffrey Gruber (1965) and Charles Fillmore (1968); in the latter work, the assignment of thematic roles was intimately connected with the assignment of morphosyntactic case.

One influential idea is that there is a universal mapping from thematic roles to grammatical functions or syntactic positions, expressed as the *Universal Alignment Hypothesis* by David Perlmutter and Paul Postal 1984 and as the *Uniformity of Theta Assignment Hypothesis* by Mark Baker 1988. If INNATE, such a universal mapping, besides accounting for the linking problem and acquisition facts, could also account for the mixed behavior of the single argument of intransitive verbs, such as *collapse*, *appear*, or intransitive *explode*. The single subject arguments of these verbs, which assign only a single theme theta-role, behave in some ways like objects – presumably because the theme role is typically assigned to objects, not subjects.

Given such a rigid view of the syntax-lexical semantics mapping, the precise description and diagnosis of thematic roles came to be of paramount importance. However, despite intensive study, a definitive list is elusive. Theorists disagree on the definition of roles and their relationship to syntactic structure. Particularly difficult cases for the rigid mapping hypothesis are posed by alternating verbs (Levin 1993) – verbs whose arguments can appear in more than one position, despite apparently bearing the same role, for example, ditransitive verbs like *give* (*Mary gave the book to Sue/gave Sue the book*), and spray/load verbs (*Mary sprayed the wall with paint/paint on the wall*). Similar problems are posed by pairs like *buy/sell*, *chase/flee* and *like/please*, where apparently identical roles appear in different positions with each verb.

There have been two types of response to these issues. On one approach, the notion of thematic role is recast as more probabilistic. Each argument is characterized as more or less like one of two *macroroles*, *proto-agent* and *proto-patient* (Dowty 1991) or ROLE AND REFERENCE GRAMMAR's *actor* and *undergoer* (Van Valin 1993). Strongly identified arguments will map to the canonical position associated with each role, while arguments exhibiting characteristics of both roles map

more flexibly. For example, *The tank filled with water* and *The water filled the tank* are both possible with *fill*, because one of the arguments is moving (*the water*) and the other is changing state (*the tank*).

The other approach has eliminated thematic roles as primitives and introduced a more fine-grained representation of verb meaning. The decomposition of verbs into predicates such as CAUSE, BECOME, GO, HAVE, and MANNER, and the recognition of the importance of event semantics and notions like *initiation*, *process*, and (*end*)*state*, has played an important role in accounting for argument structure alternations, for example, in the work of Ray Jackendoff (1990), James Pustejovsky (1995), and Hagit Borer (2004), among many others. Although thematic relations are not primitives in recent approaches, they retain their usefulness as descriptors.

– Heidi Harley

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THEORY OF MIND AND LANGUAGE ACQUISITION

Having a theory of mind (ToM) enables us to reason about the mental states of others – their beliefs, desires, and intentions – and to understand and anticipate how these differ from our own. A lack of ToM would be a formidable obstacle to all sophisticated forms of human social interaction. Without the recognition that beliefs can be true or false, there would exist a constant state of misunderstanding, mistrust, and conflict.

The majority of investigations of ToM reasoning have been concerned with children's understanding of false beliefs. These have often used a form of the "Sally-Anne" task involving changed

locations for hidden objects (Baron-Cohen, Leslie, and Frith 1985). In the standard verbal task, children are given a story. They are told about Sally, a story character with a false belief about the location of a marble. The character is described as having placed the marble in a box, but when she is away, another story character called Anne moves it into a different location. The test question concerns where Sally – who has not witnessed the deception and therefore has a false belief – will look for the marble. On such measures, despite variations in culture and family background, most typically developing three-year-olds respond incorrectly that Sally will look where the marble really is, whereas at four years of age, most children respond correctly in indicating that Sally will look for the marble in the believed location, rather than the real one (Wellman, Cross, and Watson 2001).

Two main proposals have advanced to characterize the origin and development of ToM reasoning in children. One is that ToM reasoning undergoes a fundamental conceptual change between the age of three and four years (Perner, Leekam, and Wimmer 1987; Wellman, Cross, and Watson 2001) – a change that has been hypothesized by Karen Milligan, Janet W. Astington and Lisa A. Dack (2007) to come about through the child's language development. This view is compatible with research indicating that the expression of ToM reasoning between three and four years is linked to the child's LEXICAL ACQUISITION and acquisition of semantics (Slade and Ruffman 2005; see SEMANTICS, ACQUISITION OF). In keeping with the conceptual change account, it has also been maintained that acquisition of grammatical rules for mentalistic discourse is required for constructing propositions about mental states and so is a necessary precursor for ToM (de Villiers and Pyers 2002). According to this theory, mastery of the grammatical rules for embedding tensed complement clauses under verbs of speech or cognition (e.g., "Sally thinks that the marble is in the basket") enables ToM reasoning. In embedded complements of this kind, the truth value of the embedded clause (prefaced by that ...) is independent of that of the main argument (*Sally thinks ...*).

It may be that acquisition of a certain level of syntax and semantics (see SYNTAX, ACQUISITION OF) is necessary for success on standard ToM reasoning tasks but, nevertheless, on current evidence, a link between the understanding of sentence complements and ToM reasoning has not been established (Harris, de Rosnay, and Pons 2005; Tardif, So, and Kaciroti 2007). Young children are often adept at syntax and semantics but still do poorly on ToM. Many three-year-olds who fail such tasks are nevertheless able to produce and comprehend sentence complements that take the structure [person]-[pretends]-[that *x*] (e.g., "He pretends that his puppy is outside").

The other main proposal is that ToM is present very early in development as a key marker of the MODULARITY of the human mind. Alan M. Leslie, Ori Friedman, and Tim P. German (2004) argue that the expression of ToM is a manifestation of a dedicated module for mental state reasoning that is based on the development of a mechanism of attention called a *selection processor*. This mechanism involves *executive functioning* that enables children to inhibit the usual state of affairs in which a person's beliefs do correspond to reality and to recognize instead that beliefs may be false. Development of this mechanism underpins children's selection of the correct alternative on the Sally-Anne type of ToM