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18. Thematic roles

Abstract

Thematic roles provide one way of relating situations to their participants. Thematic roles have been widely invoked both within lexical semantics and in the syntax-semantics interface, in accounts of a wide range of phenomena, most notably the mapping between semantic and syntactic arguments (argument realization). This article addresses two sets of issues. The first concerns the nature of thematic roles in semantic theories: what are thematic roles, are they specific to individual predicates or more general, how do they

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figure in semantic representations, and what interactions do they have with event and object individuation and with the semantics of plurality and aspect? The second concerns properties of systems of thematic roles: what is the inventory of thematic roles, and what relationships, such as an ordering of roles in a thematic hierarchy, or the consistency of roles across semantic domains posited by the thematic relations hypothesis, exist among roles? Various applications of thematic roles will be noted throughout these two sections, in some cases briefly mentioning alternative accounts that do not rely on them. The conclusion notes some skepticism about the necessity for thematic roles in linguistic theory.

1. Introduction

Thematic roles provide one way of relating situations to their participants. Somewhat informally, we can paraphrase this by saying that participant *x* plays role *R* in situation *e.* Still more informally, the linguistic expression denoting the participant is said to play that role.

Thematic roles have been widely invoked both within lexical semantics and in the syntax-semantics interface, in accounts of a wide range of phenomena, including the mapping between semantic and syntactic arguments (*argument realization*), controller choice of infinitival complements and anaphors, constraints on relativization, constraints on morphological or syntactic phenomena such as passivization, determinants of telicity and distributivity, patterns of idiom frequencies, and generalizations about the lexicon and lexical acquisition. Automatic role labeling is now an active area of investigation in computational linguistics as well (Marquez et al. 2008).

After a brief terminological discussion, this article addresses two sets of issues. The first concerns the nature of thematic roles in semantic theories: what are thematic roles, are they specific to individual predicates or more general, how do they figure in semantic representations, and what interactions do they have with event and object individuation and with the semantics of plurality and aspect? The second concerns properties of systems of thematic roles: what is the inventory of thematic roles, and what relationships, such as an ordering of roles in a *thematic hierarchy*, or the consistency of roles across semantic domains posited by the *thematic relations hypothesis*, exist among roles? Various applications of thematic roles will be noted throughout these two sections, in some cases briefly mentioning alternative accounts that do not rely on them. The conclusion notes some skepticism about the necessity for thematic roles in linguistic theory.

2. Historical and terminological remarks

Pāṇini's *kārakas* are frequently noted as forerunners of thematic roles in modern linguistics. Gruber (1965) and Fillmore (1968) are widely credited with initiating the discourse on thematic roles within generative grammar and research relating to thematic roles has blossomed since the 1980s in conjunction with growing interest in the lexicon and in semantics. A variety of terms appear in the literature to refer to essentially the same notion of thematic role: *thematic relation*, *theta-role*, *(deep) case role*, and *participant role*. A distinction between "broad", general roles and "narrow", predicate-specific roles is worth noting as well. General roles (also termed *absolute roles* (Schein 2002) or *thematic role types* (Dowty 1989)) apply to a wide range of predicates or events; they include the well-known *Agent*, *Patient*, *Theme*, *Goal,* and so on. Predicate-specific roles (also

termed *relativized* (Schein 2002), *individual thematic roles* (Dowty 1989), or "relation-specific roles") apply only to a specific event, situation, or predicate type; such roles as *Devourer* or *Explainer* are examples. There need not be a sharp distinction between broad and narrow roles; indeed, roles of various degrees of specificity, situated in a subsumption hierarchy, can be posited. In this article the term *thematic role* will cover both broad and narrow roles, though some authors restrict its use to broad roles.

3. The nature of thematic roles

Thematic roles have been formally defined as relations, functions, and sets of entailments or properties. As Rappaport & Levin (1988: 17) state: "Theta-roles are inherently relational notions; they label relations of arguments to predicators and therefore have no existence independent of predicators." Within model-theoretic semantics, an informal definition like the one that begins this article needs to be made explicit in several respects. First, what are the entities to be related? Are thematic roles present in the semantic representations of verbs and other predicators (i.e., lexical items that take arguments), or added compositionally? Are they best viewed as relations or as more complex constructs such as sets of entailments, bundles of features, or merely epiphenomena defined in terms of other linguistic representations that need not be reified at all?

3.1. Defining thematic roles in model-theoretic semantics

Attempts to characterize thematic roles explicitly within model-theoretic semantics begin with works such as Chierchia (1984) and Carlson (1984). Both Chierchia and Carlson treat thematic roles as relations between an event and a participant in it. Dowty (1989: 80) provides the following version of Chierchia's formulation. Events are regarded as tuples of individuals, and thematic roles are therefore defined thus:

(1) A θ-role θ is a partial function from the set of events into the set of individuals such that for any event k, if $\theta(k)$ is defined, then $\theta(k) \in k$.

For example, given (2a), an event tuple in which ^kill' is the intension of the verb *kill* and x is the killer of y, the functions *Agent* and *Patient* yield the values in (2b) and (2c:)

(2) a. $\langle$^kill', x, $y\rangle$
b. Agent($\langle$^kill', x, $y\rangle$) = x
c. Patient ($\langle$^kill', x, $y\rangle$) = y

This shows how thematic roles can be defined within an *ordered argument* system for representing event types. The roles are distinguished by the order of arguments of the predicate, though there is no expectation that the same roles appear in the same order for all predicates (some predicates may not have an *Agent* role at all, for example). Another representation, extending Davidson's (1967) insights on the representation of events, is the *neo-Davidsonian* one, in which thematic roles appear explicitly as relations between events and participants; see article 34 (Maienborn) *Event semantics*. The roles are labeled, but not ordered with respect to one another. In one form of such a representation, the equivalent of (2) would be (3):

(3) ∃e [killing(e) & Agent(e, x) & Patient(e, y)]

Here, thematic roles are binary predicates, taking an eventuality (event or state) as first argument and a participant in that eventuality as second argument. For a discussion of other possibilities for the type of the first argument; see Bayer (1997: 24–28). Furthermore, as Bayer (1997: 5) notes, there are two options for indexing arguments in a neo-Davidsonian representation: lexical and compositional. In the former, used, e.g., in Landman (2000), the lexical entry for a verb includes the thematic roles that connect the verb and its arguments. This is also effectively the analysis implicit in structured lexical semantic representations outside model-theoretic semantics, such as Jackendoff (1987, 1990), Rappaport & Levin (1988), Foley & van Valin (1984), and van Valin (2004). But it is also possible to pursue a compositional approach, in which the lexical entry contains only the event type, with thematic roles linking the arguments through some other process, as does Krifka (1992, 1998), who integrates the thematic role assignments of the verb's arguments through its subcategorization. Bayer (1997: 127–132) points out some difficulties with Krifka's system, including coordination of VPs that assign different roles to a shared NP.

A position intermediate between the lexical and compositional views is advocated by Kratzer (1996), who claims that what has been regarded as a verb's external argument is in fact not an argument at all, although its remaining arguments are present in its lexical entry. Thus the representation of *kill* in (3) would lack the clause Agent(e, x), this role being assigned by a VoiceP (or "little v") above VP. This, Kratzer argues, accounts for subject/object asymmetries in idiom frequencies and the lack of a true overt agent argument in gerunds. Svenonius (2007) extends Kratzer's analysis to adpositions. However, Wechsler (2005) casts doubt on Kratzer's prediction of idiom asymmetries and notes that some mechanism must still select which role is external to the verb's lexical entry, particularly in cases where there is more than one agentive participant, such as a commercial transaction involving both a buyer and a seller.

Characterizing a thematic role as a partial function leaves open the question of how to determine the function's domain and range; that is, what events is a role defined for, and which participant does the role pick out? In practice, this problem of determining which roles are appropriate for a predicate plagues every system of broad thematic roles, but it is less serious for roles defined on individual predicates. Dowty (1989: 76) defines the latter in terms of a set of entailments, as in (4):

(4) Given an n-place predicate δ and a particular argument x_i, the *individual thematic role* ⟨δ, i⟩ is the set of all properties α such that the entailment $\Box[\delta(x_1, \ldots x_i, \ldots x_n) \rightarrow \alpha(x_i)]$ holds.

What counts as a "property" must be specified, of course. And as Bayer (1997: 119–120) points out, nothing in this kind of definition tells us which of these properties are important for, say, argument realization. Formulating such cross-lexicon generalizations demands properties or relations that are shared across predicates. Dowty defines cross-predicate roles, or *thematic role types*, as he terms them, as "the intersection of all the individual thematic roles" (Dowty 1989: 77). Therefore, as stated by Dowty (1991: 552): "From the semantic point of view, the most general notion of thematic role (type) is A SET OF ENTAILMENTS OF A GROUP OF PREDICATES WITH RESPECT TO ONE OF THE ARGUMENTS OF EACH. (Thus a thematic role type is a kind of second-order

property, a property of multiplace predicates indexed by their argument positions.)." Thematic role types are numerous; however, he argues, linguists will generally be interested in identifying a fairly small set of these that play some vital role in linguistic theory.

This definition of thematic role types imposes no restrictions on whether an argument can bear multiple roles to a predicate, whether roles can share entailments in their defining sets and thus overlap or subsume one another, whether two arguments of a predicate can bear the same role (though this is ruled out by the functional requirement in (1)), and whether every argument must be assigned a role. These constraints, if desired, must be independently specified (Dowty 1989: 78–79) As the discussion of thematic role systems below indicates, various models answer these questions differently. Whether suitable entailments for linguistically significant broad thematic roles can be found at all is a further issue that leads Rappaport & Levin (1988, 2005), Dowty (1991), Wechsler (1995), Croft (1991, 1998), and many others to doubt the utility of positing such roles at all.

Finally, note that definitions such as (1) and (4) above, or Dowty's thematic role types, make no reference to morphological, lexical, or syntactic notions. Thus they are agnostic as to which morphemes, words, or constituents have thematic roles associated with them; that depends on the semantics assigned to these linguistic entities and whether roles are defined only for event types or over a broader range of situation types. Verbs are the prototypical bearers of thematic roles, but nominalizations are typically viewed as role-bearing, and other nouns, adjectives, and adpositions (Gawron 1983, Wechsler 1995, Sevenonius 2007), as predicators denoting event or situation types, will have roles associated with them, too.

3.2. Thematic role uniqueness

Many researchers invoking thematic roles have explicitly or implicitly adopted a criterion of *thematic role uniqueness*. Informally, this means that only one participant in a situation bears a given role. Carlson (1984: 271) states this constraint at a lexical level: "one of the more fundamental constraints is that of 'thematic uniqueness' – that no verb seems to be able to assign the same thematic role to two or more of its arguments." This echoes the θ-criterion of Chomsky (1981), discussed below. Parsons (1990: 74) defines thematic uniqueness with respect to events and their participants: "No event stands in one of these relations to more than one thing." Note that successfully connecting the lexical-level constraint and the event-level constraints requires the Davidsonian assumption that there is a single event variable in the semantic representation of a predicator, as Carlson (1998: 40) points out. In some models of lexical representation (e.g., Jackendoff's lexical decomposition analyses and related work), this is not the case, as various subevents are represented, each of which can have a set of roles associated with it.

The motivations for role uniqueness are varied. One is that it simplifies accounts of mapping from thematic roles to syntactic arguments of predicators (which are also typically regarded as unique). It is implicit in hypotheses such as the Universal Alignment Hypothesis (Rosen 1984) and the Uniformity of Theta Assignment Hypothesis (Baker 1988, 1997), described in greater detail in the section on argument realization below. Role uniqueness also provides a tool to distinguish situations – if two different individuals appear to bear the same role, then there must be two distinct situations involved (Landman 2000: 39). A further motivation, emphasized in the work of Krifka (1992, 1998),

is that role uniqueness and related conditions are crucial in accounting for the semantics of events in which a participant is incrementally consumed, created, or traversed.

Role uniqueness does not apply straightforwardly to all types of situations. Krifka (1998: 209) points out that a simple definition of uniqueness – "it should not be the case that one and the same event has different participants" – is "problematic for *see* and *touch*." If one sees or touches an orange, for example, then one also typically sees or touches the peel of the orange. But the orange and its peel are distinct; thus the seeing or touching event appears to have multiple entities bearing the same role.

A corollary of role uniqueness is *exhaustivity*, the requirement that whatever bears a given thematic role to a situation is the only thing bearing that role. Thus if some group is designated as the Agent of an event, then there can be no larger group that is also the Agent of that same event. Exhaustivity is equivalent to role uniqueness under the condition that only one role may be assigned to an individual; as Schein (2002: 272) notes, however, if thematic roles are allowed to be "complex" – that is, multiple roles can be assigned conjunctively to individuals, then exhaustivity is a weaker constraint than uniqueness.

3.3. How fine-grained should thematic roles be?

As noted in the introduction, thematic roles in the broad sense are frequently postulated as crucial mechanisms in accounts of phenomena at the syntax-semantics interface, such as argument realization, anaphoric binding, and controller choice. For thematic roles to serve many of these uses, they must be sufficiently broad, in the sense noted above, that they can be used in stating generalizations covering classes of lexical items or constructions. To be useful in this sense, therefore, a thematic role should be definable over a broad class of situation types. Bach (1989: 111) articulates this view: "Thematic roles seem to represent generalizations that we make across different kinds of happenings in the world about the participation of individuals in the eventualities that the various sentences are about." Schein (2002: 265) notes that if "syntactic positions [of arguments given their thematic roles] are predictable, we can explain the course of acquisition and our understanding of novel verbs and of familiar verbs in novel contexts."

Within model-theoretic semantics, two types of critiques have been directed at the plausibility of broad thematic roles. One is based on the difficulty of formulating definitional criteria for such roles, arguing that after years of effort, no rigorous definitions have emerged. The other critique examines the logical implications of positing such roles, bringing out difficulties for semantic representations relying on broad thematic roles given basic assumptions, such as role uniqueness.

It is clear that the *Runner* role of *run* and the *Jogger* role of *jog* share significant entailments (legs in motion, body capable of moving along a path, and so on). Indeed, to maintain that these two roles are distinct merely because there are two distinct verbs *run* and *jog* in English seemingly determines a semantic issue on the basis of a language-particular lexical accident. But no attempt to provide necessary, sufficient, and comprehensive criteria for classifying most or all of the roles of individual predicates into a few broad roles has yet to meet with consensus. This problem has been noted by numerous researchers; see, for example, Dowty (1991: 553–555), Croft (1991: 155–158), Wechsler (1995: 9–11), and Levin & Rappaport Hovav (2005: 38–41) for discussion. *Theme* in particular is notoriously defined in vague and differing ways, but it is not an isolated case; many partially overlapping criteria for *Agenthood* have been proposed, including volitionality, causal

involvement, and control or initiation of an event; see Kiparsky (1997: 476) for a remark on cross-linguistic variation in this regard and Wechsler (2005: 187–193) for a proposal on how to represent various kinds of agentive involvement.

Moreover, there are arguments against the possibility of broad roles even for situations that seemingly semantically quite close, in cases where two predicators would appear to denote the same situation type. The classic case of this, examined from various perspectives by numerous authors, involves the verbs *buy* and *sell*. As Parsons (1990: 84) argues, given the two descriptions of a commercial transaction in (5):

(5) a. Kim bought a tricycle from Sheehan.
b. Sheehan sold a tricycle to Kim.

and the assumptions that "Kim is the *Agent* of the buying, and Sheehan is the *Agent* of the selling", then to "insist that the buying and the selling are one and the same event, differently described" entails that "Kim sold a tricycle to Kim, and Sheehan bought a tricycle from Sheehan." Parsons concludes that the two sentences must therefore describe different, though "intimately related", events; see article 29 (Gawron) *Frame Semantics*. Landman (2000: 31–33) and Schein (2002) make similar arguments; the import of which is that one must either individuate fine-grained event types or distinguish thematic roles in a fine-grained fashion.

Schein (2002) suggests, as a possible alternative to fine-grained event distinctions, a ternary view of thematic roles, in which the third argument is essentially an index to the predicate, as in (6), rather than the dyadic thematic roles in, e.g., (3):

(6) Agent(e, x, *kill'*)

The *Agent* role of *kill* is thereby distinguished from the *Agent* of murder, throw, explain, and so on. This strategy, applied to *buy* and *sell*, blocks the invalid inference above. However, this would allow the valid inference from one sentence in (5) to the other only if we separately ensure that the *Agent* of *buy* corresponds to the *Recipient* of *sell*, and vice versa. Moreover, other problems remain even under this relativized view of thematic roles, in particular concerning symmetric predicates, the involvement of parts of individuals or of groups of individuals in events, whether they are to be assigned thematic roles, and whether faulty inferences would result if they are.

Assuming role uniqueness (or exhaustivity), and drawing a distinction between an individual car and the group of individuals constituting its parts, one is seemingly forced to conclude that (7a) and (7b) describe different events (Carlson 1984, Schein 2002). The issue is even plainer in (8), as the skin of an apple is not the same as the entire apple.

(7) a. I weighed the Volvo.
b. I weighed (all) the parts of the Volvo.

(8) a. Kim washed the apple.
b. Kim washed the skin of the apple.

Similar problems arise with symmetric predicators such as *face* or *border*, as illustrated in (9) (based on Schein 2002) and (10).

(9) a. The Carnegie Deli faces Carnegie Hall.
b. Carnegie Hall faces the Carnegie Deli.

(10) a. Rwanda borders Burundi.
b. Burundi borders Rwanda.

If two distinct roles are ascribed to the arguments in these sentences, and the mapping of roles to syntactic positions is consistent, then the two sentences in each pair must describe distinct situations.

Schein remarks that the strategy of employing fine-grained roles indexed to a predicator fails for cases like (7) through (10), since the verb in each pair is the same. Noting that fine-grained events seem to be required regardless of the availability of fine-grained roles, Schein (2002) addresses these issues by introducing additional machinery into semantic representations, including fine-grained scenes as perspectives on events, to preserve absolute (broad) thematic roles. Each sentence in (9) or (10) involves a different scene, even though the situation described by the two sentences is the same. "In short, scenes are fine-grained, events are coarser, and sentences rely on (thematic) relations to scenes to convey what they have to say about events." (Schein 2002: 279). Similarly, the difficulties posed by (7) and (8) are dealt with through "a notion of resolution to distinguish a scene fine-grained enough to resolve the Volvo's parts from one which only resolves the whole Volvo." (Schein 2002: 279).

3.4. Thematic roles and plurality

Researchers with an interest in the semantics of plurals have studied the interaction of plurality and thematic roles. Although Carlson (1984: 275) claims that "it appears to be necessary to countenance groups or sets as being able to play thematic roles", he does not explore the issues in depth. Landman (2000: 167), contrasting collective and distributive uses of plural subjects, argues that "distributive predication is not an instance of thematic predication." Thus, in the distributive reading of a sentence like *The boys sing.*, the semantic properties of Agents hold only of the individual boys, so "no thematic implication concerning the sum of the boys itself follows." For "on the distributive interpretation, not a single property that you might want to single out as part of agenthood is predicated of the denotation of *the boys*" (Landman 2000: 169). Therefore, Landman argues, "the subject *the boys* does not fill a thematic role" of *sing*, but rather a "non-thematic role" that is derived from the role that *sing* assigns to an individual subject. He then develops a theory of plural roles, derived from singular roles (which are defined only on atomic events), as follows (Landman 2000: 184), where E is the domain of events (both singular and plural):

(11) If e is an event in E, and for every atomic part a of e, thematic role R is defined for a, then plural role $*R$ is defined for e, and maps e onto the sum of the R-values of the atomic parts of e.

Thus $*R$ subsumes R (if e is itself atomic then R is defined for e). Although Landman does not directly address the issue, his treatment of distributive readings and plural roles seems to imply that a role-based theory of argument realization – indeed, any theory of

argument realization based on entailments of singular arguments – must be modified to extend to distributive plural readings.

3.5. Thematic roles and aspectual phenomena

Krifka (1992, 1998) explores the ways in which entailments associated with participants can account for aspectual phenomena. In particular, he aims to make precise the notions of incremental theme and of the relationships of incremental participants to events and subevents, formalizing properties similar to some of the proto-role properties of Dowty (1991). Krifka (1998: 211–212) defines some of these properties as follows, where ⊕ denotes a mereological sum of objects or events, ≤ denotes a part or subevent relation, and ∃x means that there exists a unique entity x of which the property following x holds:

(12) a. A role θ shows *uniqueness of participants*, UP(θ), iff:
$\theta(x, e)$ & $\theta(y, e) \rightarrow x = y$

b. A role θ is *cumulative*, CUM(θ), iff:
$\theta(x, e)$ & $\theta(y, e') \rightarrow \theta(x \oplus_P y, e \oplus_E e')$

c. A role θ shows *uniqueness of events*, UE(θ), iff:
$\theta(x, e)$ & $y \leq_P x \rightarrow \exists! e'[e' \leq_E e$ & $\theta(y, e')]$

d. A role θ shows *uniqueness of objects*, UO(θ), iff:
$\theta(x, e)$ & $e' \leq_E e \rightarrow \exists! y[y \leq_P x$ & $\theta(y, e')]$

The first of these is a statement of role uniqueness, and the second is a weak property that holds of a broad range of participant roles, which somewhat resembles Landman's definition of plural roles in (11). The remaining two are ingredients of *incremental* participant roles, including those borne by entities gradually consumed or created in an event. Krifka's analysis treats thematic roles as the interface between aspectual characteristics of events, such as telicity, and the mereological structure of entities (parts and plurals). In the case of event types with incremental roles, the role's properties establish a homomorphism between parts of the participant and subevents of the event. Slightly different properties are required for a parallel analysis of objects in motion and the paths they traverse.

4. Thematic role systems

This section examines some proposed systems of thematic roles; that is, inventories of roles and relationships among them, if any. One simple version of such a system is an unorganized set of broad roles, such as *Agent*, *Instrument*, *Experiencer*, *Theme*, *Patient*, etc., each assumed to be atomic, primitive, and independent of one another. In other systems, roles may be treated as non-atomic, being defined either in terms of more basic features, as derived from positional criteria within structured semantic representations, or situated within a hierarchy of roles and subroles (for example, the *Location* role might have *Source* and *Goal* subroles). Dependencies among roles are also posited; it is reasonable to claim that predicates allowing an *Instrument* role should also then require an *Agent* role, or that *Source* or *Goal* are meaningless without a *Theme* in motion from one to the other. Another type of dependency among roles is a *thematic hierarchy*, a global

ordering of roles in terms of their prominence, as reflected in, for instance, argument realization or anaphoric binding phenomena. These applications of thematic roles at the syntax-semantic interface are examined at the end of this section.

4.1. Lists of primitive thematic roles

Fillmore (1968) was one of the earliest in the generative tradition to present a system of thematic roles (which he terms "deep cases"). This foreshadows the hypotheses of later researchers about argument realization, such as the Universal Alignment Hypothesis (Perlmutter & Postal 1984, Rosen 1984), and the Uniformity of Theta Assignment Hypothesis (Baker 1988, 1997), discussed in the section on argument realization below. Fillmore's cases are intended as an account of argument realization at deep structure, and are, at least implicitly, ranked. A version of role uniqueness is also assumed, and roles are treated as atomic and independent of one another.

A simple use of thematic roles that employs a similar conception of them is to ensure a one-to-one mapping from semantic roles of a predicate to its syntactic arguments. This is exemplified by the θ-criterion, a statement of thematic unique-ness formulated by Chomsky (1981: 36), some version of which is assumed in most syntactic research in Government and Binding, Principles and Parameters, early Lexical-Functional Grammar, and related frameworks.

(13) Each argument bears one and only one θ-role, and each θ-role is assigned to one and only one argument.

This use of thematic roles as "OK marks", in Carlson's (1984) words, makes no commitments as to the semantic content of θ-roles, nor to the ultimate syntactic effects. As Ladusaw & Dowty (1988: 62) remark, "the θ-criterion and θ-roles are a principally diacritic theory: what is crucial in their use in the core of GB is whether an argument is assigned a θ-role or not, which limits possible structures and thereby constrains the applications of rules." The θ-criterion as stated above is typically understood to apply to coreference chains; thus "each chain is assigned a θ-role." and "the θ-criterion must be reformulated in the obvious way in terms of chains and their members.." (Chomsky 1982: 5–6).

Other researchers have continued along the lines suggested by Fillmore (1968), furnishing each lexical item with a list of labeled thematic roles. These representations are typically abstracted away from the issue of whether roles should be represented in a Davidsonian fashion; an example would look like (14), where the verb *cut* is represented as requiring the two roles *Agent* and *Patient* and allowing an optional *Instrument*:

(14) *cut* (Agent, Patient, (Instrument))

This is one version of the "θ-grid" in the GB/P&P framework. Although the representation in (14) uses broad roles, the granularity of roles is a independent issue. For an extensive discussion of such models, see chapter 2 of Levin & Rappaport Hovav (2005). They note several problems with thematic list approaches: difficulties in determining which role to assign "symmetric" predicates like *face* and *border* with two arguments seemingly bearing the same role, "the assumption that semantic roles are taken to be discrete

and unanalyzable" Levin & Rappaport Hovav (2005: 42) rather than exhibiting relations and dependencies amongst themselves, and the failure to account for restrictions on the range of possible case frames (Davis & Koenig 2000: 59–60).

An additional feature of some thematic list representations is the designation of one argument as the external argument. Belletti & Rizzi (1988: 344), for example, annotate this external argument, if present, by italicizing it, as in (15a), as opposed to (15b) (where lexically specified case determines argument realization, and there is no external argument).

(15) a. *temere* ('fear') (*Experiencer*, Theme)
b. *preocupare* ('worry') (Experiencer, Theme)

This leaves open the question of how the external argument is to be selected; Belletti & Rizzi address this issue only in passing, suggesting the possibility that a thematic hierarchy is involved.

4.2. Thematic hierarchies

It is not an accident that thematic list representations, though ostensibly consisting of unordered roles, typically list the *Agent* role first if it is present. Apart from the intuitive sense of *Agents* being the most "prominent", the widespread use of thematic role lists in argument realization leads naturally to a ranking of thematic roles in a *thematic hierarchy*, in which prominence on the hierarchy corresponds to syntactic prominence, whether configurationally or in terms of grammatical functions.

As Levin & Rappaport Hovav (2005: chapters 5 and 6) make clear, there are several distinct bases on which a thematic hierarchy might be motivated, independently of its usefulness in argument realization: prominence in lexical semantic representations (Jackendoff 1987, 1990), event structure, especially causal structure (Croft 1991, Wunderlich 1997), and topicality or salience (Fillmore 1977). However, many authors motivate a hierarchy primarily by argument realization, adopting some version of a correspondence principle to ensure that the thematic roles defined for a predicate are mapped to syntactic positions (or grammatical functions) in prominence order.

The canonical thematic hierarchy is a total ordering of all the thematic roles in a theory's inventory (many hierarchies do not distinguish an ordering among *Source*, *Goal*, and *Location*, however). While numerous variants have been proposed – Levin & Rappaport Hovav (2005: 162–163) list over a dozen – they agree on ranking *Agent/Actor* topmost, *Theme* and/or *Patient* near the bottom, and *Instrument* between them. As with any model invoking broad thematic roles, thematic hierarchy approaches face the difficulty of defining the roles they use, and addressing the classification of roles of individual verbs that do not fit well. A thematic hierarchy of fine-grained roles would face the twin drawbacks of a large number of possible orderings and a lack of evidence for establishing a relative ranking of many roles.

Some researchers emphasize that the sole function of the thematic hierarchy is to order the roles; the role labels themselves are invisible to syntax and morphology, which have access only to the ordered list of arguments. Thus Grimshaw (1990: 10) states that though she will "use thematic role labels to identify arguments ... the theory gives no status to this information." Williams (1994) advocates a similar view of the visibility of

roles at the syntactic level. Wunderlich (1997) develops an approach that is similar in this regard, where depth of embedding in a lexical semantic structure determines the prominence of semantic arguments.

It is worth noting that these kinds of rankings can be achieved by means other than a thematic hierarchy, or even thematic roles altogether. Rappaport & Levin's (1988) predicate argument structures consist of an ordered list of argument variables derived from lexical conceptual structures like those in (17) below, but again no role information is present. Fillmore (1977) provides a saliency hierarchy of criteria for ascertaining the relative rank of two arguments; these include active elements outranking inactive ones, causal arguments outranking noncausal ones, and changed arguments outranking unchanged ones. Gawron (1983) also makes use of this system in his model of argument realization. Wechsler (1995) similarly relies on entailments between pairs of participants, such as one having a notion of the other, to determine a partial ordering amongst arguments. Dowty's (1991) widely-cited system of comparing numbers of proto-agent and proto-patient entailments is a related though distinct approach, discussed in greater detail below. Finally, Grimshaw (1990) posits an aspectual hierarchy in addition to a thematic hierarchy, on which causers outrank other elements. Li (1995) likewise argues for a causation-based hierarchy independent of a thematic hierarchy, based on argument realization in Mandarin Chinese resultative compounds. Primus (1999, 2006) presents a system of two role hierarchies, corresponding to involvement and causal dependency. "Morphosyntactic linking , i.e., case in the broader sense, corresponds primarily to the degree and kind of involvement ... while structural linking responds to semantic dependency" (Primus 2006: 54). These multiple-hierarchy systems bear an affinity to systems that assign multiple roles to participants and to the structured semantic representations of Jackendoff, discussed in the following section.

4.3. Multiple role assignment

Thematic role lists and hierarchies generally assume some principle of thematic uniqueness. However, there are various arguments for assigning multiple roles to a single argument of a predicator, as well as cases where it is hard to distinguish the roles of two arguments. Symmetric predicates such as those in (9) and (10) exemplify the latter situation. As for the former, Jackendoff (1987: 381–382) suggests *buy*, *sell*, and *chase* as verbs with arguments bearing more than one role, and any language with morphologically productive causative verbs furnishes examples such as 'cause to laugh', in which the laugher exhibits both *Agent* and *Patient* characteristics. Williams (1994) argues that the subject of a small clause construction like *John arrived sad.* is best analyzed as bearing two roles, one from each predicate. Broadwell (1988: 123) offers another type of evidence for multiple role assignment in Choctaw (a Muskogean language of the southeastern U.S.). Some verbs have suppletive forms for certain persons and numbers, and "1 [= subject] agreement is tied to the θ-roles Agent, Effector, Experiencer, and Source/Goal. Since the Choctaw verb 'arrive' triggers 1 agreement, its subject must bear one of these θ-roles. But I have also argued that suppletion is tied to the Theme, and so the subject must bear the role Theme." Similarly, one auxiliary is selected if the subject is a *Theme*, another otherwise, and *arrive* in Choctaw selects the *Theme*-subject auxiliary.

Cases like these have led many researchers to pursue representations in which roles are derived, not primitive. Defining roles in terms of features, or positions in lexical

representations based on semantic decomposition, can more readily accommodate those predicators that appear to violate role uniqueness within a system of broad thematic roles.

4.4. Structural and featural analyses of thematic roles

Many researchers, perhaps dissatisfied with the seemingly arbitrary set of descriptions of the meanings of thematic roles such as *Agent*, *Patient*, *Goal*, and, notoriously, *Theme*, have sought organizing principles that would characterize the range of broad thematic roles. These efforts can be loosely divided into two, somewhat overlapping types. The first might be called *structural* or *relational*, situating roles within structures typically representing lexical entries, including properties of the event type they denote. The second approach is *featural*, analyzing roles in terms of another set of more fundamental features that provides some structure for the set of possible roles. Both approaches are compatible with viewing thematic roles as sets of entailments. Under the structural approach, the entailments are associated with positions in a lexical or event structure, while under the featural approach, the entailments can be regarded as features. Both approaches are also compatible with thematic hierarchies or other prominence schemes. However, a notion of prominence within event structures can do the work of a thematic hierarchy in argument selection within a structural approach, and prominence relations between features can do the same within a featural approach.

While Fillmore's cases are presented as an unstructured list, Gruber (1965) and Jackendoff (1983) develop a model in which the relationships between entities in motion and location situations provide an inventory of roles: *Theme*, *Source*, *Goal*, and *Location*. Through analogy, these extend to a wide range of semantic domains, as phrased by Jackendoff (1983: 188):

(16) Thematic Relations Hypothesis
In any semantic field of [EVENTS] and [STATES], the principal event-, state-, path-, and place-functions are a subset of those used for the analysis of spatial location and motion. Fields differ in only three possible ways:
a. what sorts of entities may appear as theme;
b. what sorts of entities may appear as reference objects;
c. what kind of relation assumes the role played by location in the field of spatial expressions.

This illustrates one form of lexical decomposition (see article 17 (Engelberg) *Frameworks of decomposition*) allowing thematic roles to be defined in terms of their positions within the structures representing the semantics of lexical items. Such an approach is compatible with the entailment-based treatments of thematic roles discussed above, but developing a model-theoretic interpretation of these structures that would facilitate this has not been a priority for those advocating this kind of analysis. However, lexical decomposition does reflect the internal complexity of natural language predicators. For example, causative verbs are plausibly analyzed as denoting two situation types standing in a causal relationship to one another, and transactional verbs such as *buy*, *sell*, and *rent* as denoting two oppositely-directed transfers. The Lexical Conceptual Structures of Rappaport & Levin (1988) (see article 19 (Levin & Rappaport Hovav)

Lexical Conceptual Structure) illustrate decomposition into multiple subevents of the two alternants of "spray/load" verbs; the LCS for the *Theme*-object alternant is shown in (17a) and that of the *Location*-object alternant in (17b), in which the LCS of the former is embedded as a substructure:

(17) a. [*x* cause [*y* to come to be at *z*]]
b. [*x* cause [*z* to come to be in STATE]
BY MEANS OF [*x* cause [*y* to come to be at *z*]]]

As noted above, in such representations, thematic roles are not primitive, but derived notions. And because LCSs – or their counterparts in other models – can be embedded as in (17b), there may be multiple occurrences of the same role type within the representation of a single predicate. A causative or transactional verb can then be regarded as having two *Agents*, one in each subevent. Furthermore, participants in more than one subevent can accordingly be assigned more than one role; thus the buyer and seller in a transaction are at once *Agents* and *Recipients* (or *Goals*). This leads to a view of thematic roles that departs from the formulations of role uniqueness developed within an analysis of predicators as denoting a unitary, undecomposed event, though uniqueness can still be postulated for each subevent in a decompositional representation. It also can capture some of the dependencies among roles; for example Jackendoff (1987: 398–402) analyzes the *Instrument* role in terms of conceptual structures representing intermediate causation, and this role exists only in relation to others in the chain of causation.

Croft (1991, 1998) has taken causation as the fundamental framework for defining relationships between participants in events, with the roles more closely matching the *Agent*, *Patient*, and *Instrument* of Fillmore (1968). The causal ordering is plainly correlated with the ordering of roles found in thematic hierarchies and with the Actor-Undergoer cline of Role and Reference Grammar (Foley & van Valin 1984, van Valin 2004), which orders thematic roles according to positions in a structure intended to represent causal and aspectual characteristics of situations. In Jackendoff (1987, 1990) the causal and the motion/location models are combined in representations of event structures, some quite detailed and elaborate. Thematic roles within these systems are also derived notions, defined in terms of positions within these event representations. As the systems become more elaborate, one crucial issue is: how can we tell what the correct representation should be? Both types of systems exploit metaphorical extensions of space, motion, and causation to other, more abstract domains, and it is often unclear what the "correct" application of the metaphors should be. The implication for thematic roles defined within such systems is that their semantic foundations are not always sound.

Notable featural analyses of thematic roles include Ostler (1979), whose system uses eight binary features that characterize 48 roles. His features are further specifications of the four generalized roles: *Theme*, *Source*, *Goal*, and *Path* from the Thematic Role Hypothesis, and include some that resemble entailments (*volitional*) and some that specify a semantic domain (*positional*, *cognitive*). Somers (1987) puts forward similar systems, again based on four broad roles that appear in various semantic domains, and Sowa (2000), takes this as a point of departure for a hierarchy of role types within a knowledge representation system. Sowa decomposes the four types of Somers into two pairs of roles characterized by features or entailments: *Source* ("present at the beginning of the process") and *Goal* ("present at the end of the process"), and *Determinant*

("determines the direction of the process") and *Immanent* ("present throughout the process", but "does not actively control what happens"). Sowa argues that this system allows for useful underspecification; in *the dog broke the window*, the dog might might be involved volitionally or nonvolitionally as initiator, or used as an instrument by some other initiator, but *Source* covers all of these possibilities. This illustrates another characteristic of Sowa's system; he envisions an indefinitely large number of roles, of varying degrees of specificity, but all are subtypes of one of these four. In this kind of system, the set of features will also grow indefinitely, so that it is more naturally viewed as a hierarchy of roles induced from the hierarchy of event types, at least below the most general roles. Similar ideas have been pursued in Lehmann (1996) and the Framenet project (http://framenet.icsi.berkeley.edu); see article 29 (Gawron) *Frame Semantics*.

Rozwadowska (1988) pursues a somewhat different analysis, with three binary features: ±*sentient*, ±*cause*, and ±*change*, intended to characterize broad thematic roles. This system permits natural classes of roles to be defined, which Rozwadowska argues are useful in describing restrictions on the interpretation of English and Polish specifiers of nominalizations. For example, the distinction between **the movie's shock of the audience*, vs. *the audience's shock at the movie* is accounted for by a requirement that the specifier's role not be *Neutral*; that is, not have negative values of all three features. Thus either an *Agent* or an *Experiencer* NP (both marked as +*change*) can appear in specifier position, but not a *Neutral* one.

Featural analyses of thematic roles are close in spirit to entailment-based frameworks that dispense with reified roles altogether. If the features can be defined with sufficient clarity and consistency, then a natural question to ask is whether the work assigned to thematic roles can be accomplished simply by direct reference to these definitions of participant properties. The most notable exponent of this approach is Dowty (1991), with the two sets of proto-Agent and proto-Patient entailments. Wechsler (1995) is similar in spirit but employs entailments as a means of partially ordering a predicator's arguments. Davis & Koenig (2000) and Davis (2001) combine elements of these with a limited amount of lexical decomposition. While these authors eschew the term "thematic role" for their characterizations of a predicate's arguments, such definitions do conform to Dowty's (1989) definition of thematic role types noted above, though they do not impose any thematic uniqueness requirements.

4.5. Thematic roles and argument realization

Argument realization, the means by which semantic roles of predicates are realized as syntactic arguments of verbs, nominalizations, or other predicators, has been a consistent focus of linguists seeking to demonstrate the utility of thematic roles. This section examines some approaches to argument realization, and the following one briefly notes other syntactic and morphological phenomena that thematic roles have been claimed to play a role in.

Levin & Rappaport Hovav (2005) provide an extensive discussion of diverse approaches to argument realization, including those in which thematic roles play a crucial part. Such accounts can involve a fixed, "absolute" rule, such as "map the *Agent* to the subject (or external argument)" or relative rules, which establish a correspondence between an ordering (possibly partial) among a predicate's semantic roles and an ordering among

grammatical relations or configurationally-defined syntactic positions. The role ordering may correspond to a global ordering of roles, such as a thematic hierarchy, or be derived from relative depth of semantic roles or from relationships, such as entailments, holding among sets of roles. One example is the Universal Alignment Hypothesis developed within Relational Grammar; the version here is from Rosen (1984: 40):

(18) There exists some set of universal principles on the basis of which, given the semantic representation of a clause, one can predict which initial grammatical relation each nominal bears.

Another widely employed principle of this type is the Uniformity of Theta Assignment Hypothesis (UTAH), in Baker (1988: 46), which assumes a structural conception of thematic roles:

(19) Identical thematic relationships between items are represented by identical structural relationships between those items at the level of D-structure.

Baker (1997) examines a relativized version of this principle, under which the ordering of a predicator's roles, according to the thematic hierarchy, must correspond to their relative depth in D-structure.

In Lexical Mapping Theory (Bresnan & Kanerva 1989, Bresnan & Moshi 1990, Alsina 1992), the correspondence is more complex, because grammatical relations are decomposed into features, which in turn interface with the thematic hierarchy. A role's realization is thus underspecified in some cases until default assignments fill in the remaining feature. For example, an *Agent* receives an intrinsic classification of –O(bjective), and the highest of a predicate's roles is assigned the feature –R(estricted) by default, with the result that *Agents* are by default realized as subjects.

These general principles typically run afoul of the complexities of argument realization, including cross-linguistic and within-language variation among predicators and diathesis alternations. A very brief mention of some of the difficulties follows. First, to avoid an account that is essentially stipulative, the inventory of roles cannot be too large or too specific; once again this leads to the problem of assigning roles to the large range of verbs whose arguments appear to fit poorly in any of the roles. Second, cross-linguistic variation in realization patterns poses problems for principles like (18) and (19) that claim universally consistent mapping; some languages permit a wide range of ditransitive constructions, for example, while others entirely lack them (Gerdts 1992). Third, there are some cases where argument realization appears to involve information outside what would normally be ascribed to lexical semantic representations; some semantically similar verbs require different subcategorizations (*wish for* vs. *desire*, *look at* vs. *watch*, *appeal to* vs. *please*) or display differing diathesis alternations (*hide* and *dress* permit an intransitive alternant with reflexive meaning, while *conceal* and *clothe* are only transitive) (Jackendoff 1987: 405–406, Davis 2001: 171–173). Fourth, there are apparent cases of the same roles being mapped differently, as in the Italian verbs *temere* and *preocupare* in (15) above; these cases prove problematic particularly for a model with a thematic hierarchy and a role list for each predicate.

These difficulties have been addressed in large degree through entailment-based models described in the following section, and through models that employ more

elaborate semantic decomposition that what is assumed by principles such as (18) and (19) (Jackendoff 1987, 1990, Alsina 1992, Croft 1991, 1998).

4.6. Lexical entailments as alternatives to thematic roles

Dowty (1991) is an influential proposal for argument realization avoiding reified thematic roles in semantic representations. The central idea is that subject and object selection relies on a set of *proto-role entailments*, grouped into two sets, proto-agent properties and proto-patient properties, as follows (Dowty 1991: 572):

(20) Contributing properties for the Agent Proto-Role
  a. volitional involvement in the event or state
  b. sentience (and/or perception)
  c. causing an event or change of state in another participant
  d. movement (relative to the position of another participant)
  e. exists independently of the event named by the verb)

(21) Contributing properties for the Patient Proto-Role
  a. undergoes change of state
  b. incremental theme
  c. causally affected by another participant
  d. stationary relative to the movement of another participant
  e. does not exist independently of the event, or not at all)

Each of these properties may or may not be entailed of a participant in a given type of event or state. Dowty's Argument Selection Principle, in (22), characterizes how transitive verbs may realize their semantic arguments (Dowty 1991: 576):

(22) In predicates with grammatical subject and object, the argument for which the predicate entails the greatest number of Proto-Agent properties will be lexicalized as the subject of the predicate; the argument having the greatest number of Proto-Patient properties will be lexicalized as the direct object.

This numerical comparison across semantic roles accounts well for the range of attested transitive verbs in English, but fares less well with other kinds of data (Primus 1999, Davis & Koenig 2000, Davis 2001, Levin & Rappaport Hovav 2005). In the Finnish causative example in (23), for example (Davis 2001: 69), the subject argument bears fewer proto-agent entailments than the direct object.

(23) Uutinen puhu-tt-i nais-i-a pitkään.
news-item talk-CAUS-PAST woman-pl-PART long-ILL
'The news made the women talk for a long time.'

Causation appears to override the other entailments in (23) and similar cases. In addition, (22) makes no prediction regarding predicators other than transitive verbs, but their argument realization is not unconstrained; as with transitive verbs, a causally affecting argument or an argument bearing a larger number of proto-agent entailments is realized

as the subject of verbs such as English *prevail (on)*, *rely (on)*, *hope (for)*, *apply (to)*, and many more.

Wechsler (1995) presents a model of argument realization that resembles Dowty's in eschewing thematic roles and hierarchies in favor of a few relational entailments amongst participants in a situation, such as whether one participant necessarily has a notion of another, or is part of another. Davis & Koenig (2000) and Davis (2001) borrow elements of Dowty's and Wechsler's work but posit reified "proto-role attributes" in semantic representations reflecting the flow of causation in response to the difficulties noted above.

4.7. Other applications of thematic roles in syntax and morphology

Thematic roles and thematic hierarchies have been invoked in accounts of various other syntactic phenomena, and the following provides only a sample.

Some accounts of anaphoric binding make explicit reference to thematic roles, as opposed to structural prominence in lexical semantic representations. Typically, such accounts involve a condition that the antecedent of an anaphor must outrank it on the thematic hierarchy. Wilkins (1988) is one example of this approach. Williams (1994) advocates recasting the principles of binding theory in terms of role lists defined on predicators (including many nouns and adjectives). This allows for "implicit", syntactically unrealized arguments to participate in binding conditions. For example, the contrast between *admiration of him* (admirer and admiree must be distinct) and *admiration of himself* (admirer and admiree must be identical) suggests that even arguments that are not necessarily syntactically realized play a crucial role in binding. Thematic role labels, however, play no part in this system; rather, the arguments of a predicator are simply in an ordered list, as in the argument structures of Rappaport & Levin (1988) and Grimshaw (1990), though ordering on the list might be determined by a thematic hierarchy. And Jackendoff (1987) suggests that indexing argument positions within semantically decomposed lexical representations can address these binding facts, without reference to thematic hierarchies.

Everaert & Anagnostopoulou (1997) argue that local anaphors in Modern Greek display a dependence on the thematic hierarchy; as a *Goal* or *Experiencer* antecedent can bind a *Theme*, for example, but not the reverse. This holds even when the lower thematic role is realized as the subject, resulting in a subject anaphor.

Nishigauchi (1984) argues for thematic role-based effect in controller selection for infinitival complements and purpose clauses, a view defended by Jones (1988). For example, the controller of a purpose clause is said to be a *Goal*. Ladusaw & Dowty (1988) counter that the data is better handled by verbal entailments and by general principles of world knowledge about human action and responsibility.

Donohue (1996) presents data on relativization in Tukang Besi (an Austronesian language of Indonesia) that suggest a distinct relativization strategy for *Instruments*, regardless of their grammatical relation.

Mithun (1984) proposes an account of noun incorporation in which *Patient* is preferred over other roles for incorporation, though in some languages arguments bearing other roles (*Instrument* or *Location*) may incorporate as well. But alternatives based on underlying syntactic structure (Baker 1988) and depth of embedding in lexical semantic representations (Kiparsky 1997) have also been advanced. Evans (1997) examines

noun-incorporation in Mayali (a non-Pama-Nyungan language of northern Australia) and finds a thematic-role based account inadequate to deal with the range of incorporated nominals. He instead suggests that constraints based on animacy and prototypicality in the denoted event are crucial in selecting the incorporating argument.

5. Concluding remarks

Dowty (1989: 108–109) contrasts two positions on the utility of (broad) thematic roles. Those advocating that thematic roles are crucially involved in lexical, morphological, and syntactic phenomena have consequently tried to define thematic roles and develop thematic role systems. But, even 20 years later, the position Dowty states in (24) can also be defended:

(24) Thematic roles per se have no priviledged [*sic*] status in the conditioning of syntactic processes by lexical meaning, except insofar as certain semantic distinctions happen to occur more frequently than others among natural languages.

Given the range of alternative accounts of argument realization, lexical acquisition, and other phenomena for which the "traditional", broad thematic roles have sometimes been considered necessary, and the additional devices required even in those approaches that do employ them, it is unclear how much is gained by introducing them as reified elements of linguistic theory. There do appear to be some niche cases of phenomena that depend on such notions, some of which are noted above, and there are stronger motivations for entailment-based approaches to argument realization, diathesis alternations, aspect, and complement control. Such entailments can certainly be viewed as thematic roles, some even as roles in a broad sense that apply to a large class of predicates. But the overall picture is not one that lends support to the "traditional" notion of a small inventory of broad roles, with each of a predicate's arguments uniquely assigned one of them.

Fine-grained roles serve a somewhat different function in model-theoretic semantics, one not dependent on the properties of a thematic role system but on the use of roles in individuating events and how they are related to their participants. But in this realm, too, they do not come without costs; as Landman and Schein have argued, dyadic thematic roles, coupled with principles of role uniqueness, lead both to unwelcome inferences that can be blocked only with additional mechanisms and to requiring events that are intuitively too fine-grained. These difficulties arise in connection with symmetric predicators, transactional verbs, and other complex event types that may warrant a more elaborated treatment than thematic roles defined on a unitary predicate can offer.

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19. Lexical Conceptual Structure

Abstract

The term "Lexical Conceptual Structure" was introduced in the 1980s to refer to a structured lexical representation of verb meaning designed to capture those meaning components which determine grammatical behavior, particularly with respect to argument realization. Although the term is no longer much used, representations of verb meaning which share many of the properties of LCSs are still proposed in theories which maintain many of the aims and assumptions associated with the original work on LCSs. As LCSs and the representations that are their descendants take the form of predicate decompositions, the article reviews criteria for positing the primitive predicates that make up LCSs. Following an overview of the original work on LCS, the article traces the developments in the representation of verb meaning that characterize the descendants of the early LCSs. The more recent work exploits the distinction between root and event structure implicit in even the earliest LCS in the determination of grammatical behavior. This work

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