

Qualia Roles

follow speech. In the case of human and non-human perception of speech and non-speech contexts, speech perception appears to be relative to and contrastive with the acoustics of context sounds, whether speech or non-speech.

This portfolio of research findings is indicative of a psychophysical approach to speech perception in that it pays careful attention to the spectrotemporal information available to listeners, it makes use of nonhuman animals as a means of examining the generality of the mechanisms available to speech processing, and it examines the extent to which complex non-speech signals may give rise to some of the same patterns of perception as speech. Research relating the context-dependent coding of acoustic signals to neural response (see PHONETICS AND PHONOLOGY, NEUROBIOLOGY OF) adds to the understanding of how phonetic context effects may arise from general characteristics of the perceptual system. The constellation of available results suggests that general perceptual mechanisms play a role in phonetic context effects.

In other domains, the psychophysical approach has contributed to the understanding of auditory representation, auditory learning, and cross-modal processing as they relate to speech processing. There remains much potential for understanding the perceptual, cognitive, and neural underpinnings of speech communication from a general perceptual/cognitive perspective.

– Lori L. Holt

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QUALIA ROLES

Qualia structure is a system of relations that characterizes the semantics of a lexical item or phrase. The notion of qualia structure is derived in part from the Aristotelian theory of explanation (Moravcsik 1975). An important semantic concept within *generative lexicon theory* (GL), qualia roles are the major building blocks for constructing word and phrasal meaning in a language compositionally.

GL (Pustejovsky 1995) is a theory of linguistic semantics, which focuses on the distributed nature of compositionality in

natural language. On this view, there are four computational resources available to a lexical item as part of its linguistic encoding: *lexical typing structure*, *argument structure*, *event structure*, and *qualia structure*. There are four possible qualia roles associated with a word:

- (a) *Formal*: the basic category distinguishing the meaning of word within a larger domain;
- (b) *Constitutive*: the relation between an object and its constituent parts;
- (c) *Agentive*: the factors involved in the object's origins or coming into being;
- (d) *Telic*: the purpose or function of the object, if there is one.

There are two general points that should be made concerning qualia roles: 1) Every category expresses a qualia structure, and 2) not all lexical items carry a value for each qualia role. The first point is important for the way a generative lexicon provides a uniform semantic representation compositionally from all elements of a phrase. The second point allows us to view qualia as applicable or specifiable relative to particular semantic classes.

In effect, the qualia structure of a noun determines its meaning in much the same way as the typing of arguments to a verb determines its meaning. The elements that make up a qualia structure include such familiar notions as container, space, surface, figure, or artifact. One way to model the qualia structure is as a set of constraints on types (cf. Copestake and Briscoe 1992; Pustejovsky and Boguraev 1993). The operations in the compositional semantics make reference to the types within this system. The qualia structure, along with the other representational devices (event structure and argument structure), can be seen as providing the building blocks for possible object types.

Consider, for example, the qualia structure for the nouns *beer* and *sandwich*, with formal (F), agentive (A), telic (T), and constitutive (C):

- a. **beer**. x:[F = liquid A = brew T = drink]
- b. **sandwich**. x:[F = physical A = make T = eat C = bread,...]

From qualia structures such as these, it now becomes clear how a sentence such as "Mary enjoyed her sandwich" receives the default interpretation it does, namely, that of Mary enjoying eating the sandwich. Similarly, for "Mary finished her beer," the composition of the event-selecting aspectual verb *finish* and its object involves a rule that retrieves a possible event interpretation of "drinking the beer." These are examples of type coercion, where the compositional rules in the grammar make reference to values such as qualia structure, if such interpretations are to be constructed on-line and dynamically.

The qualia structure of verbs characterizes the general role of the subpredicates of a verb's event structure (as in Dowty 1979). It also interacts with the aspectual category of the predicate. For example, *run* and *bake* are process verbs, where the process predicate is assigned to the agentive role, as in "John ran" and "Mary baked the potato."

- a. **run(x)** P:[A = run_act(x)]
- b. **bake(x)** P:[A = bake_act(x)]

Quantification

They can both, however, be coerced to accomplishments (transitions) by specifying a termination predicate, assigned to the formal role (cf. Pustejovsky 1995), for example, “John ran to the store,” “Mary baked a cake.”

Recently, researchers in computational linguistics and lexicography have adopted the notion of qualia roles as one organizing principle in the process of building resources for lexical knowledge bases.

– James Pustejovsky

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QUANTIFICATION

Quantification has been a central concern in **LOGIC AND LANGUAGE** at least since Aristotle, who systematized all valid and invalid syllogisms involving the forms *All/ some/ no/ not all A’s are B’s* (see Kneale and Kneale 1962). In linguistics, quantificational phenomena played a role in upsetting the architecture of “standard” **TRANSFORMATIONAL GRAMMAR** (Chomsky 1965) in which deep structure determines semantic interpretation. Many transformations that were meaning-preserving on sentences involving referential terms were not so when applied to quantifiers:

- (1) John wanted [John win] \Rightarrow John wanted to win
- (2) Everyone wanted [everyone win] \Rightarrow (?) Everyone wanted to win

The semantic inappropriateness of derivations such as (2) helped to ignite the so-called linguistic wars (Newmeyer 1980).

Quantification and the Syntax-Semantics Interface

Quantification raises issues for the syntax-semantics interface concerning scope **AMBIGUITY**, **BINDING**, and **ANAPHORA**. Theories differ sharply in the treatment of scope-ambiguous sentences like (3), which challenge the otherwise plausible assumption that every ambiguity involves a lexical ambiguity or an ambiguity of syntactic structure; (3) on the face of it has neither.

- (3) At least two students read every book.
 - i. Wider scope for *at least two*: There are at least two who read the whole lot.
 - ii. Wider scope for *every*: Every book got at least two readings.

The problem illustrated in “transformation” (2) is a problem of binding and anaphora. It was soon recognized that pronouns and “null” anaphors whose antecedent is a quantifier behave like logical variables, as in (4), and not like “repetitions” of the antecedent noun phrase (NP).

- (4) Everyone wanted (\emptyset) to win: For every person x , x wanted [x win]

The same phenomenon appears in (5a) and (5b).

- (5) a. John rescued himself = John rescued John
b. Someone rescued himself = For some x , x rescued $x \neq$ Someone rescued someone

Thus, whereas anaphora with referential antecedents may involve *coreference*, anaphora with quantificational antecedents involves *binding*; anaphora and binding remain a major topic in syntax and semantics.

The Semantics of Quantification

The rise of **FORMAL SEMANTICS** brought investigations into the model-theoretic semantics of NPs and determiners. In **MONTAGUE GRAMMAR**, all English NPs, even proper names, are *generalized quantifiers* (Montague 1973), denoting sets of properties of individuals. This uniform treatment launched the study of the semantic properties of NPs and determiners (Barwise and Cooper 1981; Keenan and Stavi 1986), leading to progress on semantic universals of determiner meanings (see **SEMANTICS, UNIVERSALS OF**), the semantics of existential sentences and “weak” NPs (those that can occur in existential sentences: *a, some, three, no, many*, but not *the, every, both, most*), the semantics of determiners like *any* that can occur in negative and certain other contexts but not in simple affirmative sentences (the *negative polarity* phenomenon), and other topics in quantification.

In the early 1980s, Irene Heim ([1982] 1989) and Hans Kamp (1981) independently argued against Richard Montague’s uniform treatment of NPs, distinguishing *definite* and *indefinite NPs* (with determiners such as *a, the, three, the three, some, several*) from *essentially quantificational NPs* (*every, all, most*). On their approaches, an indefinite introduces a *discourse referent* into the context, bringing context into semantics proper (see **SEMANTICS-PRAGMATICS INTERACTION**); only the essentially quantificational NPs are treated as generalized quantifiers. Barbara H. Partee (1986) reconciled Montague’s uniform semantics with the Kamp-Heim theory through type-shifting mechanisms such that all NPs *can* have generalized quantifier-type meanings, but many NPs have referential and/or predicative meanings as well. *The king*, for instance, may have a quantificational meaning (roughly, “whoever is the one and only king,” with no presuppositions), a referential meaning (referring to the unique king if there is one, failing to refer if existence and uniqueness presuppositions are not satisfied), or a predicative meaning in *is the king*, asserting of its subject that he is the one and only king.

Other topics in the semantics of quantification include the semantics of distributive, collective, and cumulative quantification; the semantics of the mass-count distinction; event quantification and tense logic; generic sentences; implicit quantification; and the binding of implicit variables. There is also active research on children’s acquisition and adult processing of the syntax and semantics of quantification.

Logicians have continued to make progress on the logic of quantification, including work in game-theoretical semantics (Hintikka and Sandu 1997; Clark 2007), where the foundations of