Event Perception and Verb Learning

Verbs and prepositions are the cornerstones of language, allowing us to talk about relations between objects in events. However, a wealth of research shows that learning verbs and other relational terms is difficult when compared to nouns. Imagine trying to teach the verb *sliding* to your child while watching children play at a park. You locate a boy about to go down a slide and point to him saying, "Look! He's sliding!" To you, these actions may appear to provide a defined referent for *sliding*; however, the story is much more complex from the perspective of the child. For one, while objects have discrete perceptual boundaries, events are continuous. The child learning *sliding* must figure out that the action begins after the child climbs the ladder and ends prior to him landing on the ground and running to the jungle gym. Even with the event appropriately segmented, there are numerous components of this event to which the verb *sliding* could refer. While you intend to refer to the manner in which he descends the slide, you could be referring to the downward path of his motion, or the fact that he is perched *on* the slide rather than *underneath* it. To make matters more complicated, languages differ in the components of events they represent in various parts of speech: verbs typically depict manner information (e.g., how an action is performed – that is, *sliding* vs. *running*) and prepositions path information (e.g., trajectory of motion – that is, *through* vs. *around*) in English, but verbs in Spanish focus more on the path of motion (e.g., *salir; go*) and manner is expressed as an optional gerund (e.g., *corriendo*; running). How do children resolve such complicated issues of verb learning?

Over the last decade, research has sought to illuminate this intersection between event processing and language development to understand how children maneuver this complex problem space. This entry reviews the existing literature on how infants process and package events in a way that supports language learning. We begin by examining infants' ability to attend to a wide range of components of events that underlie relational terms across languages. We then turn our attention to how children progress from this broad base to more language- specific representations, wrapping up with a discussion of what these processes tell us about the relation between language and thought.

Linguistic Origins

The study of verb learning began in cognitive linguistics, where researchers considered the conceptual underpinnings of relational language. According to Talmy, relational terms label a subset of many simultaneous occurring components of events, including *path* (trajectory of motion), *manner* (the way in which a figure moves), *source* (beginning point of an action), *goal* (endpoint of an action), *figure* (the primary agent in the event), *ground* (the reference point for that event's path), *containment* (when something is fully or partially surrounded by a container), *suppor*t (the contact of an object on top of a surface), and *force dynamics* (how entities interact with respect to force). While not intended to be an exhaustive list, these concepts provide a springboard for studying how children process the semantic categories in events that support relational terms across languages.

Bringing linguistics into psychology, researchers began to study semantic components in early childhood that have three features. First, these components of events that will be encoded in language are perceptually available in infancy. Second, these components are codified across the world's languages. Third, languages differ in *how* they encode these components, as in the path and manner example above. In the following sections, we review what has been discovered about children's ability to discriminate and categorize these semantic components in preparation for mapping word to world.

Path-Manner

Manner of motion, expresses *how* an action is performed. *Path of motion* describes the trajectory of an action. In the example, "The dog is running up the stairs" the verb (i.e., *running*) encodes the manner of the dog's motion while the preposition (i.e., *up*) expresses the dog's path with respect to the ground (i.e., stairs). While both are present across languages, languages differ in how they encode such information. English is a *manner-biased* language, with manner expressed in the main verb (as in *running*) and path in a prepositional phrase (*up* the stairs). On the other hand, languages such as Turkish primarily encode path in the verb and manner outside the verb (e.g., "sinifa *kosarak girdi - go into* the class *runningly*").

Studies show that 7-month-old English-reared infants attend to path and manner changes in non-linguistic dynamic events. Infants were shown an animated starfish performing both a path and manner (e.g., a starfish *spinning under* the ball) until their looking time dropped to or below 65%. At test, infants increased their attention to both a path (e.g., starfish spinning *over* the ball) and manner change (e.g., starfish *jumping jacks* under the ball), suggesting that they discriminated changes in these two semantic components. However, discrimination is insufficient for acquiring motion verbs. Children must form categories of path and manner onto which motion verbs can be mapped. Research shows that after being familiarized to the same path (e.g., *over*) with varying manners (e.g., *spinning*, *bending*, *twisting*, and *jumping jacks*), 10- to 12-month-old infants can form categories of a figure's *path*. In addition, studies suggest that 13-to 15-month-old infants abstract manner of motion (e.g., *spinning*) across changes in path (e.g., *past*, *in front of*, *under*, and *over*). Thus, even in the first year of life, children seem to be sensitive to manner and path changes in these non-linguistic tasks.

Containment-Support

Containment refers to a relation in which an object is fully or partially surrounded by a container (e.g., apple *in* a bowl), whereas a *support* relation consists of an object resting upon a surface (e.g., apple *on* a table). Though encoded across languages, these categories vary. English utilizes the categories of *in* and *on,* while Korean labels containment and support based on the *degree of fit* between objects. These categories of *tight fit* (e.g., apple in cup, ring on finger) and *loose fit* (e.g., book on table, orange in bowl) collapse across the English categories of *in* and *on*.

English-reared infants notice Korean degree-of-fit relations by 5 months of age and differentiate between *in* and *on* by 6 months. The English categories of containment relations also appear around 6 months of age across a variety of exemplars, but support relations are not categorized until 14 months. Both English- and Korean-reared infants form categories of tight-

fitting and loose-fitting relations by 9 months of age, showing that infants attend to conceptual divisions within events that are not encoded in their native language.

Figure-Ground

The *figure* of an event is a movable entity that can follow any path in reference to the *ground,* or stationary setting. Terms across languages encode ground information, such as the English words *cross* or *through*. Yet figure and ground are encoded differently in languages such as English and Japanese. Japanese ground-path (GP) verbs encode the nature of the ground along the trajectory of the motion. A verb like *wataru* implies that someone crosses a flat barrier diving two points such as bridge or a road. *Wataru* cannot be used to describe a ground that is not flat (e.g., a hill) or when the ground does not contain a barrier between two sides (e.g., a field). Other relations include *koeru* (i.e., go over) and *nukeru* (i.e., pass through). These ground distinctions in Japanese GP verbs are not marked in English.

English-reared infants distinguish figures in dynamic events by 10 months. Both English- and Japanese-reared infants differentiate between and form categories of Japanese ground distinctions (e.g., crossing a railroad vs. a grassy field) by 14 months.

Source-Goal

The *source* of motion is a reference point from which a figure moves, while the *goal* of motion is a location or reference point towards which the figure moves. Source and goal are encoded in both source paths (e.g., *from*, *flee*) and goal paths (e.g., *to*, *approach*). Source and goal are exceptions to the pattern observed with previous constructs. While they are encoded in all languages studied to date, these components appear to be packaged in similar ways: languages encode goals more often than sources for both movements of intentional and inanimate figures. However, some languages such as Japanese differentiate source and goal with specific morphemes (e.g., 'ni' and 'kara') attached to the noun.

Research shows that infants discriminate between goals in motion events by 12 months of age. Twelve-month-olds also identify source changes in events, but only when sources are made extremely salient (e.g., decorated with sparkles). Fourteen-month-olds form categories of goals across different objects, spatial relations, and agents. Infants of the same age cannot form categories of sources across such variation.

Spatiotemporal Causality-Force Dynamics

Spatiotemporal causality refers to the action of one figure bringing about the action of a second. Such relations have traditionally been defined by the presence of spatial and temporal contiguity between the motions of the two figures. Spatiotemporal causality is encoded via transitive frames (e.g., "The boy pushed the girl") and across languages, but with variation. Languages with fixed word orders, such as English, allow a wide range of agents in the subject position, including both intentional beings (e.g., "The boy cut the bread") and tools (e.g., "The

knife cut the bread"). On the other hand, languages of variable word order, such as Korean, restrict their category of causal agents to exclude tools, such as knives or keys.

Force dynamics refers to the interactions between forces in an event, moving beyond spatiotemporal causality to classify these events into categories of *cause, prevent, enable,* and *despite*. Force dynamics introduces hierarchies in event structure, moving to a higher level of representation by highlighting the relations *between* the relations of spatiotemporal causality, path, and goal. For instance, the statement, "The boy *helped* the girl get to her house" implies a figure (the girl) with a path or intent for a given goal (the house), another figure (the boy) with a concordant path or intent, the presence of spatiotemporal causality (the boy causes motion in the girl), and an achieved goal (the girl reaches her house). Force dynamics is also universally encoded and varies across languages. The emphasis on intentional agents in languages such as Russian focuses attention towards forces of internal energy at the expense of external forces such as friction. This yields a broader category of *enable,* as motion cues are not required to attribute an intention for a goal. For example, witnessing a parent push a child in a sled in the direction the child faces is considered *enabling* in Russian; the direction the child faces is considered a sign of intent. English is more apt to classify this as *causing* the child to move, requiring a visible effort on the child's behalf before applying a label of *enabling*.

Infants discriminate causal from non-causal interactions on the basis of spatiotemporal properties by 6 months of age, but categorization has yet to be examined. In contrast, no research has confirmed the presence of force dynamics categories in childhood, with the only evidence coming from work with adults.

Events and Grammatical Structure

Research at the intersection of event processing and language development reveals that language does not transparently map concepts into semantics, but rather encodes meaning through the syntax-semantics interface. Though infants attend to nonlinguistic event components that will carry semantic meaning, they must learn to package these semantic elements into the specific grammatical structures of their language. Tracking statistical regularities between language and events, children learn the lexicalization biases of their language, first discerning relations between parts of speech and information in events (e.g., verbs primarily encode manner in English and path in Spanish). Second, they must recognize how semantic meaning surfaces with respect to argument structure. For instance, complementary terms such as give/receive and chase/flee are only distinguished by noting which nouns appear as the agent and object of the sentence. Conversely, the case of force dynamics highlights the need to understand that certain grammatical structures require attention to specific components of events. For instance, the phrase, "Mary *blicked* Greg go home" requires attending to the relation between the forces of the two agents in the event (e.g., *helped*) over simpler cause-effect relations (e.g., *pushed*). Understanding these relations between events and grammatical structure is fundamental to a full mastery of language.

The Role of Language in Packaging Event Components

Given the vast differences between languages, how might children go from a universalist foundation to hone what are often very different ways of processing events for language? Research shows that the language children hear informs them as to the way their native language packages these components in events. When language is present, children show increased attention to semantic categories in events. For instance, when presented a novel verb (e.g., *javing*) accompanying videos of either a single path performed over varying manners or a single manner performed over varying paths, infants were successful in forming categories of path and manner three months earlier than in non-linguistic contexts. Moreover, as language highlights relations repeatedly over time, children track statistical regularities in how their native language encodes events, forming biases concerning how each new word will relate to the world. English-speaking 29-month-olds with larger vocabularies, or who know the word *on* were less likely than their lower-vocabulary counterparts to distinguish the degree-of-fit relations encoded in Korean. Similarly, at 19 months of age, Japanese infants continue to attend to the Japanese distinction between *waturu* and *tooru*, whereas English infants pay less attention to it. Language appears to act as a spotlight, heightening attention to contrasts the child's native language encodes while dampening attention to non-native distinctions.

Additionally, language can help make sense of ambiguous events. Take the example of *chase* and *flee*. These two complementary concepts are both present within a single event: when a fox *chases* a rabbit, the rabbit also *flees* the fox. How might children learn these two tightly tied but distinct concepts? Four-year-olds use syntactic bootstrapping, tracking the syntactic structure of the novel verb and the accompanying noun phrases to disambiguate the meanings of verbs and gain a point of view on the event. Children who hear, "The fox is *glorping* the rabbit" think *glorp* means *chase* but children who hear, "The rabbit is *blicking* the fox*"* think *blick* means *flee.* This important tool can provide clarity in events that can be packaged in a variety of ways. While not an exhaustive list, these varied influences of language on perception demonstrate the critical role that language plays in moving children towards mastery of their native tongues.

The Language-Thought Debate

What does the study of verb learning tell us about the relation between language and thought? The presence of non-native semantic categories in infancy strongly suggests that language is not the source of concepts, as would be dictated by the Whorfian view of linguistic relativity. What emerges is a weaker version of the Whorfian hypothesis that recognizes the presence of prelinguistic categories, while still asserting a role for language in helping children learn what Dan Slobin called *thinking for speaking*. As is the case in phonemic development, the process is one of *semantic reorganization*. Over the first year and a half of life, infants notice a common set of foundational components of events regardless of the language they are learning. Then, influenced by distinctions encoded in the native language, infants appear to focus on a subset of these categories that are relevant to their native language. Language, in this case, has the function of orienting infants' attention to some relations over others. Through this process, infants develop new perspectives in their interpretations of event categories in linguistic contexts, effectively *trading spaces* as they develop.

What remains is the issue of which system, the conceptual or the linguistic, drives the learning of relational terms. In their *Typological Prevalence Hypothesis,* Dedre Gentner and Melissa Bowerman suggest that those categories found in many of the world's languages are likely more "natural" and therefore easier to form in childhood. Consequently, more "natural" concepts will appear earlier in language development because of the ease of mapping them into language forms. For instance, the more widely encoded distinction between *in* and *on* is acquired sooner than the less frequent relations of *solid support*, *tenuous support*, and *encirclement with contact* seen in Dutch. Here we see both processes for language and concepts learning at work. In the case of *in* and *on,* perceptually based concepts are driving the acquisition of relational terms. In the case of *solid support*, *tenuous support*, and *encirclement with contact*, however, language must direct attention to the categories that are not as natural to the infant. Thus, both concepts and language have influences on language learning, but their effects are weighted differentially across concepts.

Conclusion

The partitioning of events for language is a complicated process, requiring researchers to bridge the gap between perceptual, conceptual, and semantic development. Linguists have provided the foundation for answering this challenge, delineating the components of events that help to carve the world into the units underlying relational terms. By looking at those components of events that are perceptually available, prevalent in all languages, and encoded differently across cultures, the study of language development in psychology has made great strides in understanding how these two worlds intersect. Children are uniquely prepared for the challenges of verb learning, progressing from universalists who encode a wide array of event components present across languages, to sophisticated specialists who use the ambient language to master the packaging of these components in their native tongue.

See also: Argument structure (acquisition of); Aspect (acquisition of); Conceptual foundations of early word learning; Labeling effects on cognitive development; Motion expression (development of); Relational terms (acquisition of); Semantic development; Spatial cognition and language development; syntactic bootstrapping; Thinking for speaking; World-to-word mapping;

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