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Intentionality and word learning

Paul Bloom

Humans intuitively think about the actions of others in terms of mental states - beliefs, desires, emotions and intentions. This 'theory of mind' plays a central role in how children learn the meanings of certain words. First, it underlies how they determine the reference of a novel word. When children hear a new object name (e.g. 'Look at the fendle'), they do not use spatio-temporal contiguity to determine what the word describes; instead they focus on cues to the referential intention of the speaker, such as direction of gaze. Second, an understanding of purpose and design is sometimes necessary to enable the child to understand the entities and actions that nouns and verbs refer to. This is particularly relevant for nouns that refer to collections of objects such as 'family' and 'game', and for verbs that refer to actions defined in terms of an actor's goals, such as 'give' and 'make'. Finally, intentional considerations partially underlie the generalization of names for artifact categories, such as 'chair' and 'clock', which can refer to entities of highly dissimilar appearance.

Humans intuitively view other members of the species as possessing beliefs, desires, emotions, and intentions, and we use this 'theory of mind' to predict and explain their actions. Even 12-month-old babies have sufficient theory of mind to generate expectations about how an agent should act based on its previous goal-directed behavior¹. The ability to think of the actions of others in mentalistic terms bears all the hallmarks of a domain-specific cognitive ability: (1) it is clearly of adaptive benefit, (2) it emerges spontaneously at an early age, (3) it can be specifically impaired in the case of autism, and (4) it is present, in an attenuated form, in other primates².

What role does theory of mind play in language acquisition? I will review evidence that the ability to infer the intentions of others is a central part of word learning. When an adult uses a new word, the child determines what the

word describes by inferring the adult's referential intention. Furthermore, some words refer to entities we construe as distinct individuals, in part because of our appreciation of social and psychological factors, and others correspond to categories that are generalized on the basis of these factors. These claims are perhaps obvious enough for the acquisition of abstract nouns and verbs such as 'opinion' and 'guessing', but there is evidence that they apply equally to words that denote more concrete objects and actions, such as 'chair' and 'open', the types of nouns and verbs found in the speech of two-year-olds.

There is more to word learning than theory of mind, of course, and hence the hypothesis proposed here is intended to supplement theories that focus on the role of conceptual constraints and linguistic cues³⁻⁵; it is not an alternative to them. For reasons discussed below, however, it is incompatible

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with the view that the child's sensitivity to spatio-temporal contiguity is sufficient for word learning, as postulated by associationist models of language acquisition, in both their traditional⁶ and modern computational⁷ versions.

Determining the referent of a new word

When children are exposed to a new word, how do they determine what this word refers to? Under associationist theories, adults teach words to children in circumstances in which there is strict spatio-temporal contiguity between the word and what it refers to. An adult will say 'dog', for instance, if and only if the child is looking at a dog, leading the child to create a connection between the word and the percept which will enable him or her to use the word in the future to describe entities of similar appearance.

Studies of the conditions under which children actually learn words, however, suggest that this procedure cannot work. For one thing, the Western model of adult-child interaction in which parents carefully name objects (or depictions of objects in picture books) for their children is not universal; there are cultures in which this sort of ostensive labeling does not typically occur⁸. Nevertheless, children from these cultures have no difficulty in learning words⁹. Even in Western societies, words are not typically used at the same time as their referents are being perceived. This is particularly true for verbs; for instance, most of the time that the verb 'open' is used in the presence of a child, he or she is not observing something being opened; conversely, most of the time something is being opened, the child is not hearing 'open'; yet children learn verbs, such as 'open', quickly and with few errors⁵. Consider also the problems that arise with an associationist account of the acquisition of abstract terms, such as 'idea' or 'mistake', which refer to entities that cannot be localized in time and space. Finally, despite their impoverished perceptual experience, blind children learn words, even color words and verbs of perception, at a similar rate to sighted children¹⁰, which further militates against the associationist proposal.

In fact, even for object names that are explicitly presented to sighted children, there is evidence that the mapping from word to object is established through an intentional process, not through a sensitivity to spatio-temporal contiguity. If an 18-month-old child hears a novel word as she is playing with a novel toy, she will assume that it is a name for the toy only if the word is spoken by someone who is also attending to the toy. If she just hears a disembodied voice naming the object as she is looking at it (e.g. 'A dawnoo! There's a dawnoo!'), the word will not be mapped on to that object¹¹. Furthermore, children will only map a new word on to what they are looking at when the word is spoken if the speaker is looking at the same thing; if the speaker is looking at something else, the child will spontaneously follow her line-of-regard, and conclude that the object the speaker is looking at is the referent of the new word¹².

More sophisticated intentional capacities are displayed by 24-month-old children. In one study, an adult announced her intention to find an object; 'Let's find the toma!', and then picked up and nonverbally rejected (by frowning) two other objects before picking up a third object

and smiling. Despite the temporal gap, children in the study inferred that this third object was actually what 'toma' referred to¹³. In another study, an adult used a novel verb to declare her intention to perform an action, proceeded to do an action 'accidentally' (saying: 'Whoops!') and then performed another action, with satisfaction (saying: 'There!' with a pleased expression); children connected the verb with the action the speaker seemed satisfied with, not the accidental one¹⁴. In conclusion, even very young children infer the referential intention of the speaker (through attention to cues that include line-of-regard and emotional indications of satisfaction) when determining the meaning of a new word.

Understanding the entities that words refer to

Once children infer the intended reference of the speaker, they are faced with the further problem of determining the scope of this reference. How do they parse the world into units of the appropriate size (for nouns) and duration (for verbs)? For instance, if an adult is looking at a chair when using the word 'chair', it is not enough for the child to follow the direction of the gaze, she also has to figure out whether the word refers to the top third of the chair, the whole chair, the arm of the chair, the chair and the dog next to it, and so on¹⁵. Similarly, the child who hears an adult use the new verb 'give' to refer to an action has to determine somehow the boundaries of the action: when it begins and ends.

Some of this parsing of the world into distinct entities and actions is done by mental mechanisms entirely independent of theory of mind. Children apply unlearned principles that parse the world into distinct physical objects¹⁶, and are highly prone to assume that such objects are the referents of nouns, as with 'dog', 'chair', and 'rock'³. Similarly, even six-month-old babies can parse motion into actions on the basis of non-intentional properties, such as when the action is bounded on either side by motionlessness, or when the same pattern of activity is repeated over and over again¹⁷. Such a capacity might underlie their appreciation of the referents of certain verbs, such as 'kick', 'jump', and 'fall'.

For other words, however, the scope of their reference is understood through an appreciation of the mental states of others. Verbs such as 'give', 'make', and 'play' refer to events whose temporal boundaries begin when the act is purposefully initiated and end when the intention or goal is satisfied. This type of event-parsing emerges relatively early in development; 18-month-old children who watch an adult attempt to perform an action, but fail, will often imitate the entire action that was intended, even though they never witnessed this¹⁸. Note also, that the acquisition of nouns that refer to events, such as 'game' or 'party', often requires a similar process of individuation; when a game or party begins and ends is based on subtle intentional and social factors, not psychophysical ones.

Other nouns, especially those that refer to artifacts, sometimes refer to entities that are spatially discontinuous. Nouns such as 'bikini', 'game', and 'suit' refer to entities that can be composed of multiple physical objects; they are nameable with singular nouns because there is a singular

intent connecting the objects^{19,20}. In the course of learning such words, children's sensitivity to the functional and intentional unity of these entities must override their instinctive tendency to construe new nouns as names for single objects. Other spatially discontinuous notions that the child must come to appreciate are social institutions such as countries and universities, and collections such as families and gangs. Interestingly, many collective nouns are understood by two- and three-year-olds, despite their intentional basis¹⁹.

To explore the acquisition of such terms, we exposed children and adults to novel collections, such as piles of five identical objects, and used novel words to describe them. When such a pile is simply named (e.g. 'Look! Fendle.') the natural response is to think the name refers to the distinct objects, so that the pile would contain five fendles. But this bias can be overridden if there is reason to believe that the collection of objects exists as a single entity in the mind of another person. One cue that could guide a person to this belief is if the collection is given a single name, as in: 'This is a fendle'; the single-count noun syntax of 'fendle' establishes reference to a single individual and the person infers that 'fendle' refers to the collection as a whole¹⁹. One can also get a collective interpretation without syntactic cues. For instance, four-year-old children will interpret a word as referring to the entire group of objects if a picture frame is placed briefly around the group, giving the impression that it is intended as a singular artistic creation²⁰. Adults are sensitive to even more subtle intentional cues: if five objects are simply dumped on a table, the adult tendency is to interpret a new word as naming the individual objects, but if the objects are carefully *placed* on the table (again giving the impression that the group is thought of as a single entity in the mind of the creator) they tend to construe the word as describing the group as a whole²¹.

Generalizing words to novel instances

Once the child has determined the focus of a speaker's intent and the scope of that focus, she has to encode the word mentally to enable it to be applied correctly in the future. For instance, once a child knows that an adult intends a word to refer to a chair or a clock, she must have some mental representation of the category (a concept) that underlies her intuition about which other objects are chairs and clocks. Even for basic-level categories, this determination cannot be done on the basis of appearance alone: some chairs are four-legged and made of wood; others are plastic contraptions shaped like hands; or wicker monstrosities that resemble satellite dishes; some clocks are analog, others are digital, some are cubes that say the time aloud when you touch a button. While there exist cases that are difficult to categorize, there are many instances in which atypical exemplars are immediately recognized despite their novelty. This potential diversity of appearance is typical of artifact categories; consider also superordinates such as 'toy', 'furniture', and 'weapon', all of which refer to objects that share no common shape and have very few physical properties in common²².

At least for adults, part of our intuitions as to the nature of artifact categories are based on our inferences about the intent of the creator. In support of this, when given some-

Outstanding questions

- Sighted children use the direction of an adult's gaze as a cue to referential intent, and exploit this cue when learning object names, but what cues to reference do blind children use?
- Unlike human children, non-human primates learn words very slowly and only through extensive training. Why?
- Older children and adults are more sophisticated at explaining and predicting the behavior of others than three- and four-year old children. What effects, if any, do these differences have on the process of word learning?
- As children get older they gradually change from a preference to extend the name of a novel object to similarly shaped objects (regardless of function) to extending the name to other objects with the same function (even if they have different shapes). Does this developmental shift indicate a move from a non-intentional shape-based categorization to a notion based on intentionality, or does it reflect a developmental shift in the relative importance of cues to intended function?
- It has been proposed that children are biased to interpret a novel word as naming the kind of a whole object and that they use syntactic cues to ascertain aspects of word meaning. To what extent could these hypothesized acquisition mechanisms be by-products of the child's use of intentional cues to determine the word's meaning? Evidence from children with developmental disorders (e.g. autism, Specific Language Impairment) might bear on this issue.

thing that looks equally like two different types of artifacts (such as a lampshade and an umbrella), adults will categorize it based on what they are told it was intended to be^{23,24}. More generally, our intuitions about when an artifact is created, destroyed and transformed can be captured adequately only by an account that involves intuitions about design and purpose^{22,25}.

What about children? Some investigators have proposed that children are oblivious to such intentional considerations when learning and using artifact names. In support of this position, when shown a novel artifact and given a name for it, a four-year-old child will focus on the object's shape to a greater extent than an adult, often ignoring its function²⁶. While this is consistent with the view that children have only a non-intentional understanding of artifact kinds, an alternative account is that their focus on shape is itself rooted in intuitions about the creator's intent. After all, an object's shape is perhaps the best cue as to what it was intended to be. If two objects are of the same shape, it is a reasonable inference that they were created with a common intent; something is very unlikely to be shaped like a typical chair unless it was constructed with the intent to *be* a typical chair, and hence one can usually determine what someone intended an object to be by focusing on its shape²².

One relevant question, then, is whether children have any appreciation that artifacts of the same kind need not have the same shape. There is some evidence that they do. Preschool children do learn superordinate terms like 'toy' and 'furniture', and artifact names like 'clock', 'game' and 'radio', showing little difficulty appreciating that members of these categories are of dissimilar shapes^{27,28}. The way children name pictures is particularly interesting in this regard, as it is consistent with the implicit assumption that something is a picture of X, regardless of its shape, if and only if the artist intended to depict X. Even three-year-old children will describe arbitrary shapes as 'horses' and

'lollipops' in a context in which they believe these shapes were sincerely intended to depict horses and lollipops²⁸. At least in the domain of pictures, then, children have an intentionalist understanding. Further research is necessary to determine the extent to which this holds for artifacts more generally.

Concluding remarks

The research reviewed above suggests that theory of mind is a central aspect of learning and understanding the meanings of words. In support of this, children with autism (a disorder that involves a specific impairment in theory of mind) typically have serious problems with language development, including word learning³⁰. But learning a new word also requires non-intentional capacities on the part of the child, including: (1) the phonological capacity to parse the sound stream (or the sign stream, for deaf children) into words; (2) the syntactic ability to identify the category that the word belongs to; (3) the conceptual ability to grasp the concept (for artifact names, this relies on intentional understanding, but for other words, such as names for natural kinds, it does not); and (4) the capacity to store and access the word in the lexicon^{29,31}. The child's theory of mind is one of many cognitive capacities that interact in quite intricate ways to underlie the ability to learn new words.

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