Grounding Meaning in Affordances

Arthur M. Glenberg
University of Wisconsin — Madison

Consider which of the following sentences is sensible, and which is less so:

1a. After wading barefoot in the lake, Erik used his shirt to dry his feet.
1b. After wading barefoot in the lake, Erik used his glasses to dry his feet.

Sentence 1a is sensible, whereas sentence 1b does not make much sense. But why? Both sentences are grammatical. Both meet obvious semantic constraints (e.g., shirts and glasses are inanimate). Both sentences generate coherent, integrated, well-formed propositions. Finally, the sentences do not differ in the associations among the terms. That is, both “shirt” and “glasses” are associatively unrelated to “dry.”

The ability to discriminate between sentences such as these is taken as support for the Indexical Hypothesis. The hypothesis is based on three claims about how we understand words and sentences. First, words and phrases are indexed to objects in the world or to analogical representations of those objects such as pictures or perceptual symbols (Barsalou, under review). Second, we derive affordances from the objects. Third, and most importantly, the affordances, not the words, constrain the way ideas can be coherently combined or meshed.

Affordances (Gibson, 1979) are ways in which perceiver with a particular type of body can interact with an object. For an adult, a chair affords sitting, standing-on to change a light bulb, and throwing to use as a weapon. For a child, a chair affords sitting and standing on (to get to the cookies), but not throwing. For an agile person, a floppy disk affords grasping and it affords scratching. A thread also affords grasping, but it does not afford scratching. Because we use affordances to understand sentences, we judge a sentence such as “Danielle used a small floppy disk to scratch her back” as sensible and understandable: Everyone knows that a floppy disk can be used to scratch one’s back even if no one has ever tried it or read about it. Similarly, everyone knows that the sentence “Danielle used a short length of thread to scratch her back” does not make much sense.

According to the Indexical Hypothesis, grammatical constructions direct the combination, or mesh (Glenberg, 1997), of affordances through a process of envisioning. That is, if we can envision how the combination of affordances can accomplish the goal described by the sentence, then we understand the sentence and judge that it makes sense. Because humans can grasp and manipulate a floppy disk, and because floppy disks are rigid enough to afford scratching, we can envision how Danielle can use the disk to scratch her back. In contrast, because short lengths of thread are not rigid enough to afford scratching, we can make little sense of the alternative sentence.

Consider another example taken from a compass learning task used in one experimental investigation of the Indexical Hypothesis. In using a compass to identify landmarks, one step is “Point the direction of travel arrow at the mountain.” Comprehension of this sentence requires an understanding of what it means to point, but how one points depends in part on the affordances of what one is pointing with. It means one thing to point an index finger, another to point a rifle, another to point a car, and quite another to point a direction of travel arrow. Do we have in memory a huge listing of what it means to point, and select the appropriate meaning based on a search of memory? Perhaps, but consider this alternative. Our knowledge consists of a general notion of what it means to point (aligning the long axis of an object with a reference, or to-be-pointed-at, object). Also, we have a repertoire of bodily skills, such as how to grasp and turn objects of different sizes and hefts. To understand the sentence about pointing the direction of travel arrow, we need to index the words (“direction of travel arrow”) to the actual object so that its affordances are made available. Then, we can mesh our general knowledge of pointing, the affordances of the direction of the travel arrow, and our repertoire of bodily skills to envision
a coherent set of actions that result in pointing the
direction of travel arrow at the mountain.

In contrast, if we did not know the affordances of a
direction of travel arrow, then we could not compre-
hended the sentence: We would not understand how to act
on it. Or, if a direction of travel arrow did not afford
pointing (like the glasses in 1b do not afford drying),
then the sentence would be nonsense. For example, if
a direction of travel arrow was a vector that indicated
the mean direction and duration in which one had been
walking, it is not clear what it would mean to point this
vector at a mountain. Although the vector has a di-
rection, it is not something that can be changed by the
usual actions of pointing.

The Indexical Hypothesis has several implications
for meanings of words. First, language understand-
ing requires that the affordances of objects be readily
available. In turn, this requires that a component of
word meaning be an analogical representation such as
a perceptual symbol. That is, word meaning cannot be
restricted to descriptions using arbitrary symbols and
their relations. Although the descriptions may provide
affordances for how an object is be used in some situa-
tions, an analogical representation is needed to derive
affordances for how the object might be used in novel
situations, such as using one's shirt to dry one's feet,
or using a floppy disk to scratch one's back.

The indexical hypothesis has been tested in several
different types of experiments. In one experiment, par-
ticipants were asked to judge the meaningfulness of
sentences such as la and lb. Of course, people were
quite good at this. Interestingly, the time it takes to
read sentences such as la was no longer than the time
to read a control sentence such as lc.

lc. After wading barefoot in the lake, Erik used his
towel to dry his feet.

This result demonstrates that people do not treat la
as unusual. It also demonstrates that the affordances
of shirts (that they can be used to dry feet) are not
derived from a long chain of inferential reasoning. In-
stead, the fact that a shirt affords drying is as readily
available as the fact that a towel affords drying. The
point is that using affordances is not a special or un-
usual comprehension strategy; it may well be the norm.

In a second type of experiment, participants were
asked to learn (from reading) how to perform a new
task, using a compass and map to identify landmarks.
In the first part of the experiment, participants learned
background information about parts of a compass, such
as the direction of travel arrow. Participants in the In-
dex group were given the opportunity to index terms
to an actual compass. Participants in the Read group
were given the opportunity to reread the background

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