



# Analogical Cognition: an Insight into Word Meaning

Timothy Pritchard<sup>1</sup>

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## Abstract

Analogical cognition, extensively researched by Dedre Gentner and her colleagues over the past thirty five years, has been described as the core of human cognition, and it characterizes our use of many words. This research provides significant insight into the nature of word meaning, but it has been ignored by linguists and philosophers of language. I discuss some of the implications of the research for our account of word meaning. In particular, I argue that the research points to, and helps account for, a key explanatory role that linguistic meaning must play. The research also shows how words contribute to thought as opposed to merely being a means of conveying thought.

## 1 Introduction

Over the past thirty five years, psychologists have extensively investigated ‘analogical cognition’. This is the ability to apprehend shared relations and roles that items and situations may display, even when those items and situations differ considerably in many respects. Mountains are thoroughly dissimilar to puddles of water, yet we have no difficulty in apprehending that both can play the role of preventing the passage of something else. We mark this, in appropriate contexts, by applying the same term, *barrier*, to both items: a mountain can be a barrier to aircraft, a puddle can be a barrier to ants.

This characteristic pervades our use of language, and analogical cognition has been described as a ‘core mechanism of human cognition’ (Gentner and Smith 2013). Yet this work on analogical cognition has been almost entirely ignored in the philosophical discussion of words and linguistic meaning. This is a serious oversight (see also Bach 2012). The purpose of this paper is to show that the insights gained from the study of analogical cognition can make a major contribution to the vexed question of how to characterize a word’s linguistic meaning.

By linguistic meaning, I mean the context-independent aspect of a word’s meaning that is sometimes called the word’s standing meaning or meaning of the word type.

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✉ Timothy Pritchard  
t.pritchard@ucl.ac.uk

<sup>1</sup> Department of Linguistics, University College London, Chandler House, 2 Wakefield Street, London WC1N 1PF, UK

English speakers have an understanding of the word *barrier* prior to its use in any particular utterance, and I take the linguistic meaning of *barrier* to be in part constituted by the content of this understanding. Consideration of analogical cognition suggests that the meaning we grasp, when we understand a word, must take on a particular form in order to explain the analogical perspective from which we use many words.

I am not claiming that all words can be dealt with by reference to analogical cognition. But very many can, and consideration of such words gives us general insight into the topic of linguistic meaning.

In section 2 I describe analogical cognition. In section 3 I discuss how analogical cognition is facilitated. In section 4 I suggest an account of word meaning that draws on insights from the empirical research. In sections 5 to 7 I consider some consequences of the account and some problems that need to be addressed.

## 2 What Is Analogical Cognition?<sup>1</sup>

A striking feature of human cognition is our ability to handle higher-order relations. Consider first the following task of making a perceptual match between the base sample (the letter A) and one of the target letters:

Base	Target
A	A B

An ability to evaluate the perceptual similarity between two stimuli, such as the ability to match the base A to the target A, has been described as ‘the sine qua non of biological cognition’ (Penn et al. 2008). The matching is based on comparing features of the various tokens. But now consider the following different type of matching task:

Base	Target
AA	BB CD
XYX	ZZW UVU

This is a relational-match-to-sample test, and it is not solved by looking for perceptual similarity between the letters in the base and the target. Instead, the match is based on recurrence of a relation that holds between the tokens. AA matches to BB, and not to CD, because the same relation holds between A and A (namely, sameness) as holds between B and B. Similarly, XYX matches to UVU, not to ZZW, because both display the relation of symmetry.

Two situations are analogous if they share a common pattern of *relationships* among their constituent elements, even though the elements themselves differ

<sup>1</sup> See Holyoak 2012; Gentner and Smith 2013; Gentner and Hoyos 2017. From a philosophical perspective, see Bach 2012.

across the two situations. (Holyoak 2012: 234; similar definitions are found across the literature, see Dumas et al. 2013).

A railway engine can have the same relation to a carriage as a tractor does to a cart. We are sensitive to this shared structure and express it with terms such as *pulls*. A brick building, boat, or cave, can all stand in the relation to a person that we express by use of the term *home*. Appreciation of such relations illustrates our analogical ability.

There is general agreement that human thought is specially characterized by an ability to engage in this kind of relational matching and that this ability greatly exceeds the limited relational matching abilities that some animals may display (Obozova et al. 2015). Analogical cognition is ubiquitous in human cognition and has been described as the hallmark of human intellectual ability:

The ability to perceive and use purely relational similarity is a major contributor—arguably *the* major contributor—to our species' remarkable mental powers. (Gentner and Smith 2013: 668)

Discussion of analogical thinking has looked at its role in areas such as problem solving (Catrambone and Holyoak 1989), expertise (Dunbar 2001), transfer of learning (Goldwater and Schalk 2016), and metaphorical interpretation (Gentner and Bowdle 2008; Wearing 2014). The emphasis in such studies is on cognitively demanding tasks that require serious reflective thought. But it is also the case, as illustrated in the examples of *barrier*, *pulls*, *home*, that analogical thinking is pervasively present in the mundane processes that drive our everyday use of many words.

For example (see Gentner 2003), we can think of nouns such as *cause*, *prevention*, *source*, *result*, *advantage*, *ally*, *accident*, *threat*, *lie*, *promise*, *excuse*, *identity*, *weapon*, *gift*, *target*, *screen*, *filter*; *haven*, *barrier*, *conduit*, *carnivore*, *scavenger*, *prey*, *parent*, *weed*, *parasite*; or verbs such as *cause*, *prevent*, *foster*, *engender*, *permit*, *inhibit*, *deter*, *accelerate*, *force* (and so on). The criteria for applying these terms depends on some form of relation. Almost anything can in principle be a cause, but we will not describe something as a cause unless it stands in the appropriate relation to some other situation. Something is a gift by virtue of an appropriate relation between giver and recipient. The term *weed* does not name a biological classification, but it is used for types of growth that enter into unwelcome relations with other plants in a garden.

Distinctions can be made between terms used for items that play a role in a situation (such as the nominal use of *hindrance*; *robber*; *weed*) and terms used for a relational structure into which other role-playing items may enter (such as the verbal use of *hinder*; *rob*; *weed*). Theorists sometimes distinguish role terms and relational terms to capture this contrast (see Markman and Stilwell 2001; Gentner and Kurtz 2005; Goldwater and Markman 2011). I will, though, speak generally of relational (equivalently, analogical) terms for all these cases.

It is important to clarify that this talk of relational terms, in the context of analogical cognition, has a different and broader focus than found in the discussion of what have also been called relational terms in linguistic semantics. Trivially, verbs that take more than one argument are said to express relations, because such verbs relate two or more items (the tractor pulls the cart). More significantly, many nouns have also been described as relational on account of a direct need to be understood in terms of a

relation to something else. The paradigms for this are kinship terms: someone is a mother, or brother, only in virtue of standing in a relation to someone else. Barker (2011) speaks of such words as analogous to two-place verbs in this respect. This characteristic holds for many other nouns, such as *pet* (of so-and-so), *cause* (of such-and-such), but it does not hold for nouns such as *weapon* or *screen*. Only two-place nouns can occur in the postnominal genitive possessive construction ('The mother of John'), whereas this is not available for other nouns (we say 'John's weapon' but not 'The weapon of John'). (See Barker 2011.)

From this perspective, some words can be used in both relational and non-relational ways (Partee and Borschev 2003). 'That portrait belongs to John' would be a non-relational use of *portrait* (cf. 'That weapon belongs to John', but not 'That mother belongs to John'); whereas 'The portrait of John is over there' would be a relational use (cf. 'The mother of John is over there', but not 'The weapon of John is over there').

The focus in linguistic semantics is, therefore, on nouns that appear to have an argument structure, this being reflected in linguistically marked behaviour. By contrast, when I speak of 'relational terms' the focus is on a fundamental condition of use that is not linguistically marked at all. The condition is the analogical characteristic of thought that is as necessary to our use of *weapon* or *screen*, and *portrait* in all its uses, as it is to our use of *mother* or *brother*.<sup>2</sup>

Asmuth and Gentner (2005) report that relational nouns made up half the nouns in a representative corpus of adult vocabulary. In fact, the prevalence of relational terms could be broader than they allow for. They contrast relational categories with what they call 'entity' categories, these being defined as categories whose members, unlike those of relational categories, typically share many intrinsic properties (such as lions and bananas). Asmuth and Gentner (2017) suggest the following as a test to distinguish relational from entity categories: *Could you identify a member just by its own properties or would you have to consider its interactions/relations with other things?* For example:

While you know which items in the room are *bananas* just by looking at them, you can't tell which things are *gifts* without knowing about their relations to other entities. (Asmuth and Gentner 2017: 2008)

This is a poorly phrased criterion. There is no inconsistency between being a member of a relational category and being identifiable by just being looked at. You can often identify something as a carnivore, or a barrier, or dangerous (and so on) just by looking. As a result, by using this criterion, Gentner makes some surprising claims about what counts as terms for entity categories, including *fence*, *chasm*, *musical instrument* (Gentner and Kurtz 2005; Asmuth and Gentner 2017). Such terms arguably have a relational basis for their use, irrespective of the fact that we may often identify such items 'just by looking at them'.

The main point is that a considerable swathe of word use, wider perhaps than Gentner allows for, is based upon the kind of roles and relations that analogical cognition covers. And yet despite the widespread extent of such terms, they have been

<sup>2</sup> Thanks to a reviewer for this journal for pointing out the importance of clarifying these distinct approaches to relational aspects of meaning, and for helping to clarify the nature of the distinction.

mostly overlooked in the empirical literature ('largely ignored', Asmuth and Gentner 2017). This focus has obscured the importance that analogical relations have in our use of words.

### 3 Facilitating Analogical Cognition: The Role of Abstraction

Analogical cognition cannot be taken for granted. It is only very poorly represented amongst non-human animals (Penn et al. 2008). Further, while the way that animals respond to stimuli is influenced by the need for consistent behavioural responses to ecologically equivalent events, the human application of words to items and situations is not a behavioural response but arises as a reflective response based on understanding. Understanding often involves awareness of analogical relations. A word such as *predator* is not extended to items on the basis of a grouping that has been selected by a perceptually-based similarity judgement for which a particular behavioural response is appropriate. Rather, we have an understanding of the term *predator*: we understand that the term indicates animals that kill and eat prey. Judging that something is a predator may indeed be helped by perceptually based similarity to known examples of predators, but our understanding of the term *predator* operates independently of the perceptual relations that may or may not hold between predators.

While shared perceptual features can be evidence that an item can be correctly named by a relationally-based word,<sup>3</sup> if a word is extended to items purely on the basis of shared perceptual features, with no concern for a relational role, this is likely to result in a figurative extension that does not represent the usual use of a word. For example, the word *mouse* for the computer accessory was initially motivated, according to its inventor Doug Englebart, on grounds of similarity in appearance to a mouse. This, though, is a case of a word acquiring a new meaning (homonymy). And while shape was the motivating factor for the origin of this new usage, shape is not the basis for further use of the computer word *mouse*. Computer mice often no longer have tails, but this is not important for the extension of the word, which is based on a relation that the item enters into between a user and a computer.

While humans show considerable facility with analogically based cognition, there is also evidence that, unless certain conditions are in place, analogical perspectives easily lose out to similarity judgements based more on perceptual similarities than on relational equivalences. The classic demonstration of this is found in Gick and Holyoak (1980, 1983). In the 1980 study, some participants first read a story about a general who wants to capture a fortress. Several roads lead to the fortress. The general's troops need to be at full strength in order to capture the fortress, but the troops cannot all pass safely down any single road. So the general splits up the troops into smaller groups and sends them down the several roads simultaneously. Arriving at the fortress at the same time, the small groups join up again and, with the force back together at full strength, capture the fortress. This is called the convergence solution: the small groups all converge on the final point, and thereby full strength is regained.

<sup>3</sup> The importance of shape as evidence for word extension is well documented. See the special issue *Developmental Science*, 11(2), 2008.

The participants were told to read and remember this story (along with distractor stories). The participants were then asked to solve the following problem. A doctor wants to use rays to destroy a stomach tumour. But a high intensity ray will destroy the surrounding healthy tissue as well as the tumour. A lower intensity ray that does not destroy the surrounding healthy tissue will also not destroy the tumour. How can the doctor destroy the tumour without destroying any surrounding healthy tissue?

The problem is analogous to the problem faced by the general. The solution is to administer several low intensity rays simultaneously from different directions. The rays will converge and add up to full strength only when they reach the tumour. No surrounding tissue is destroyed, but the tumour receives the full dose.

Three conditions were tested. One group of participants were not given the General story to read, but only heard the tumour problem. From this group, only 10% produced the convergence solution to the problem. A second group read the General story, but were not given any hint that it could be useful in helping to solve the tumour problem. From this group, 20% solved the problem. A third group both heard the General story and were given a hint that one of the previous stories they had heard may be useful in solving the tumour problem. From this group, 75% of participants solved the problem.

The results indicate that many participants in the second group failed to appreciate the analogical similarity between the superficially dissimilar General and Tumour stories. Research shows that retrieval of prior cases is 'typically driven largely by surface similarities ... rather than by similarities in relational structure' (Gentner and Smith 2013: 674). This phenomenon has been widely observed, both with children and adults.

This lack of spontaneity in analogical cognition can, though, be overcome in various ways. One way to improve transfer is by choosing a source analogue that has easily noticed similarities with the test situation (Keane 1987). We can illustrate with a variant on the General story (Gick and Holyoak 1983). A tank commander wants to capture a military headquarters. The headquarters is situated on an island in the center of a lake. The only way to reach the island is by way of several pontoon bridges, each of which can only carry a few tanks at a time. This story has obvious similarities with the General story.

Gick and Holyoak (1983) found that if participants read both the General and Commander stories, 45% of those participants transferred the analogical solution to the Tumour story, in comparison with only 21% of participants who only read the General story. These results were obtained without providing any hint to the participants that they could use the General or Commander stories to help with the Tumour problem. This suggests that the similarity between the General and the Commander stories facilitated an initial (and unprompted) comparison, and with this comparison the participants implicitly became aware of shared relational features between the stories. When comparison is undertaken, there is an easy mapping from the items in one story to the items in the other story (Commander/General; infantry/tanks; roads on land/roads across bridges; fortress/camp). With these simple mappings made, it is easy to see that just as the general split up the forces and sent them along different roads, so also the commander should split up the forces and send them along the different bridges, with simultaneous arrival at the objective. The initial mapping between obvious similarities facilitates the recovery of shared relational structure, and hence enables participants to transfer the relevant structural features of the solution from the General/Commander cases to the Tumour case.

So the initially easy comparisons provide a starting point from which less obvious structural similarities can be accessed. Further, once the shared structural similarities have been observed, people are able more easily to discern when that structure recurs in situations that do not share surface similarities with the original situation. Gentner calls this ‘progressive alignment’, and it has been widely demonstrated in empirical work (Gentner and Hoyos 2017).

Where situations do not share obvious surface similarities, a way to facilitate recovery of shared analogical structure is by providing participants with explicit instructions to compare the situations. Gentner et al. (2003) report on experiments that showed the degree to which participants could learn and apply negotiation techniques from reading accounts of different negotiations. The participants were first familiarized with accounts that exemplified one of two basic types of negotiation strategy (the ‘trade-off’ and ‘contingency’ strategies), both of which contrast with the often less efficient strategy that is typically used by untrained negotiators (the ‘compromise’ strategy). Participants who read stories exemplifying one of the expert strategies, but who were not explicitly told to compare the stories, performed poorly when asked to develop a negotiating strategy for a new situation. There was a strong tendency for them to use the non-expert compromise strategy. In fact, they did not perform appreciably better than baseline participants who were given the negotiation problem without any prior familiarization with negotiation stories. By contrast, when participants were told to compare the initial sample stories, there was a marked improvement in performance, with over twice the likelihood of transferring one of the more expert negotiation strategies to the test cases. This improvement over the baseline performance of those who had not been asked to compare the negotiation stories highlights the importance of comparison for drawing out relational commonalities.<sup>4</sup>

Similar results have been found with young children, who can be helped to pick up on relational commonalities when comparisons are introduced into the experimental paradigms (Gentner 2010; Gentner and Smith 2013).

Both theory and empirical evidence points to an intimate link between the process of making comparisons and analogical cognition. Analogical cognition involves appreciating the relational structure of a situation and the ability to discern this structure in different situations. This involves identifying the relations that are found in both situations, and also in mapping correspondences between the items that enter into those relations. Gentner has proposed a ‘structure mapping theory’ that provides basic principles along which this mapping of structure takes place (Gentner 1983; Bach 2011).<sup>5</sup> This same mapping of structure is also taken to be involved in the process of judging how similar two situations are. Judgements of similarity arise not merely from comparing shared object features between scenes but also from aligning relations that hold between objects. With a picture of a boy looking at a snake, and a picture of a boy looking at a fish, comparing the scenes will include noting the shared relation of looking at something (Gentner and Markman 1997). There will also be a mapping

<sup>4</sup> Thanks to a reviewer for this journal for pointing out the significance of the comparison with the baseline performance.

<sup>5</sup> The theory has been computationally implemented by a ‘Structure Mapping Engine’ (Falkenhainer et al. 1989).

between the objects that enter into that relation (boy/boy; snake/fish). Alignment of *structure*, as opposed just to features of objects, is said to be a ‘general comparison mechanism’, and it gives rise to an important distinction between alignable and non-alignable differences (Markman and Gentner 1996). The difference in the scenes between snake and fish is called an ‘alignable difference’ because it is a difference that occurs in one of the terms of a relation (looking at something) that occurs in both scenes. Other differences between the scenes that are not linked to shared relations are ‘non-alignable’ differences. An empirically confirmed prediction of this approach to comparisons is that people will focus on the alignable differences, these being more salient, rather than the non-alignable differences, when making comparisons.

When structural alignment is achieved, ‘the common structure becomes more salient and may be retained and reused’ (Gentner and Hoyos 2017: 5). When participants in experiments were asked to write down the commonalities between the General/Commander stories or the negotiation stories, the quality of their answers—measured in terms of how well the basic features of the analogical structure had been represented—predicted the degree of transfer of the analogical solution to new test cases. According to Gentner’s structure mapping account, the higher quality answers should contain more relational commonalities and (hence) also more alignable differences than lower quality answers.<sup>6</sup> The abstraction of structure facilitates awareness of relational commonalities between situations, along with awareness of how situations may differ while still manifesting those relations, and it is this that facilitates subsequent transfer of analogical insight to new situations. Successful participants do better at extracting the common relational structure.

The claim that abstraction of a structural schema helps with analogical retrieval and transfer is well motivated. Burgoon et al. (2013) treat abstraction as the process of identifying invariants across situations, and they note that this can be seen as ‘a process of information reduction that allows for efficient storage and retrieval of central knowledge’. Retrieval is facilitated given that ‘the abstracted schema will have fewer idiosyncratic details and therefore will conflict less with the surface features of the current case’ (Gentner et al. 2003: 394). The plausible suggestion here is that awareness of a structure, represented in some format that is independent of particular concrete instances, provides people with a focus that enables them to see the relevant structure in situations that might otherwise appear diverse.<sup>7</sup>

Analogical retrieval may also be facilitated by describing situations in more domain general terms (reducing the concrete content), or by using idealized entities in training tasks (Day and Goldstone 2011). In each case, ease of use can be associated with representations that simplify, with clearer focus just on the structural elements. The evidence suggests, therefore, that analogical cognition is facilitated through implicit awareness of a schema in which the basic structure is represented (and see Bach 2011, who speaks of relational schemas as being ‘put in the conceptual foreground’).

A caveat is needed here. A referee for this journal points out that the ‘difficulty’ of analogical retrieval stems in part from the experimental contexts. The Gick and Holyoak studies, for example, assume that the newly acquired knowledge (from the

<sup>6</sup> Thanks to a reviewer for this journal for stressing the importance of this aspect of Gentner’s theory.

<sup>7</sup> Hochmann et al. 2016 show that very young infants (14 months) can represent the abstract relation of ‘same’. This both illustrates, and is a necessary condition for, the general ability to represent abstract relations.



stories) should be immediately generalizable to an analogous situation; further, participants are ‘sequestered’, meaning that they have no opportunity to confer with others, receive feedback, revise, or try ideas out. In these respects, the experimental studies lack naturalistic plausibility, and they may not accurately capture the degree of transfer of learning that actually takes place (Bransford and Schwartz 1999). More naturalistic studies have shown that analogical retrieval may be less constrained than the experimental paradigms suggest. A striking example of long-term analogical retrieval is shown in Chen et al. (2004). American and Chinese participants were presented with a target problem, and were then assessed as to how well they retrieved a well-known folk tale (from their respective cultures) that had analogous structure to the target problem and that could therefore help with providing a solution. The results showed that participants were reminded of the folk tale to a surprisingly high degree, even though these tales had not been heard for up to 10 years. (For discussion of this and other naturalistic studies, see Trench and Minervino 2017.)<sup>8</sup>

But while the experimental paradigms may not provide an entirely accurate measure of transfer, the explanation for recall and transfer in the naturalistic settings is still based on the idea that participants have extracted a representation (from the potentially distant source analogues) that focuses on the relational commonalities. In other words, these studies reinforce the claim that our ability to transfer insight between analogous situations depends on the extraction of a schematic representation.<sup>9</sup>

#### 4 Language and Analogical Cognition

Gentner argues that even if the basis for analogical cognition is present pre-linguistically, it is language that enables this to develop in the way that we see in human cognition:

Humans are born with exceptional relational ability, but language lets us carry that ability further. Relational language gives us abstract systems of representation that scaffold our ability to perceive relational analogies and to map relational structure across domains. (Gentner 2016: 655).

Evidence for the influence of language on analogical cognition comes from experimental work with both children and adults (Gentner 2016). Christie and Gentner (2014) tested young children with a relational-match-to-sample test. Paralleling the task of matching AA to BB or CD, cards with two geometric shapes pictured on them were matched to one another. Some cards pictured two identical shapes, whereas other cards pictured two different shapes. A card that displays two squares (for example) can be categorized together with a card that displays two circles, as they both picture two

<sup>8</sup> See also section 4 for other ways in which more naturalistic settings can aid analogical transfer.

<sup>9</sup> Geach 1957 criticizes appeal to abstraction, but he treats it as a process of selective attention to those perceptual features of an item that are shared by other items. He notes the absurdity of this for relational concepts, and states that ‘relational concepts in general raise difficulties of which abstractionists are usually unaware’ (p. 32). But it is precisely to account for relational concepts that psychologists have appealed to a (different) account of abstraction. For critical discussion of the type of abstraction that Geach considers, see Gentner and Namy 1999.

identical shapes. This is a relational basis for categorization, and is independent of how perceptually alike the shapes on one card are to the shapes on another.

The children were first shown a standard, a card with two identical shapes (such as two rectangles). They were then shown two further cards. One also pictured two identical shapes (such as two circles), and the other pictured two different shapes (such as a triangle and a cross). The children were then asked which of the cards was ‘more like’ or ‘matches’ the standard. The non-identity alternatives (such as the card with the triangle and the cross) contained no shape matches to the standard (such as two rectangles). This means that there were no competing non-relational similarity matches that might influence the children’s decisions. 4 year old children chose the relational match at above chance levels (though only 65% of the time), while 2 and 3 year old children chose at chance. Given that there was no competing non-relational similarity match, this suggests that the relational similarity is not initially apparent to children (Christie and Gentner 2014: 387). Results did not change significantly when the children were trained for the task with four initial trials in which feedback was given about what the correct choice was. But a significant improvement was found when the children were given a novel label for the standard (a *truffet*). After hearing that the standard was a truffet, the children were asked to say which alternative was also a truffet. In distinction from the first experiment, all age groups now chose the relational alternative at above chance levels. Gentner and Christie describe this effect as ‘quite remarkable’ given that the children in this condition received no training with the novel word nor any prior feedback on their responses in a training session. The use of the novel label in this experiment appears to play a significant role in facilitating relational responses.

Goldwater and Markman (2011) tested how adults categorize with respect to thematic relations (e.g. a bodyguard has a thematic relation to a celebrity) and role relations (a bodyguard has a role similarity to a forcefield). The thematic choice (celebrity) was predominant when participants were asked ‘what goes best with *bodyguard* to form a category’. In a separate condition, a label was introduced, with the task now one of word extension. Participants were told: ‘The bodyguard is a *goppin*. Which of these two others [celebrity, force field] is better called a *goppin*?’. In this condition there was a strong shift towards a relational criterion, with 66% of participants choosing the force field, the role-governed alternative.

This raises the question of why linguistic labels have this effect (see Gentner 2005, 2010). One suggestion that Gentner puts particular emphasis on is that a label acts as an invitation to compare (and see Goldwater and Markman 2011). Any given linguistic label will apply to multiple entities and situations. Use of a single (identical) label across multiple situations could very plausibly act as a signal that there is some important commonality that holds between the situations. Comparing the situations will in turn lead to insight into the structural relations that hold between the situations.

A linguistic label also plausibly acts to aid memorization of a particular analogical construction, helping to ‘desituate’ the relation from the original concrete context in which it occurs, and helping to establish a uniform relational encoding across uses (Gentner 2003, 2010). A. Clark (2006) similarly speaks of the symbols of language as helping us ‘better control the disposition of selective attention’. The recurrence of particular words appears to reinforce and stabilize our memories for recurring relational structures.

But there is also an evident difference between use of novel linguistic labels, such as *truffet*, and the use of words with established meanings. While there is a generic benefit in the use of symbols as such (Son et al. 2010), there is also the particular contribution made by the meaning of known words. Gick and Holyoak (1983), though not discussing linguistic labels as such, describe two options in the context of problem solving:

1. The new problem may be mapped directly with a prior analogue to generate the analogous solution. ‘While the mapped identities will mediate the transfer process, the schema need not exist as a separate concept independent of the two analogues’. This is *reasoning from an analogue*.
2. ‘an independent schema may already have been induced from one or more prior analogues and stored in memory. The person can therefore map the new analogue directly with the schema in order to construct a solution.’ This is *reasoning from a schema*. (Gick and Holyoak 1983: 9 f.)

The first option is relevant to examples in which novel linguistic labels are used: use of the label *truffet* encourages a comparison. It is the second option that I want to emphasize, for it relates to the use of words with known meanings.

Many words are used, pervasively, habitually, and unreflectingly, in ways that align with analogical similarities between situations. This requires explanation. We have seen that when it comes to comparing two situations, superficially different features can hinder awareness of shared analogical structure. This can be overcome by prior awareness of that structure. The natural suggestion for explaining our ease of word use is that the type of knowledge that a language user has, when they understand a relational word, is knowledge of a schema that represents a relational structure. The hard work of drawing out the analogical relation has already been done and is packaged in the meaning of the word. When the word is used, this schema will play a direct role in our thought and thereby facilitate the easy perception of analogical sameness across instances.

Further, the ease with which we apply many words to such a variety of items would suggest that word meanings are maximally abstract in the sense that they do not include the kind of feature-based details that may negatively prejudice a particular application even when the analogical relation is satisfied. Rehder and Ross (2001: 1273) note that ‘there are a virtually infinite number of feature combinations that might satisfy the relational structure’, which in turn suggests that a given word does not typically rule out any particular feature combination.

So the hypothesis is that we construe word meaning, for relational words, as an abstracted schema that represents a relational structure. The use of the word focuses our attention on this relational structure, and as a result we can effortlessly apply terms such as *barrier*, *cause*, *problem*, *emergency* (and so on) across items that may bear little or no perceptual relation to one another. (This general form of argument parallels many of the points made by Bach 2011, though Bach is looking to theory of mind, not word meaning as such.)

Before considering some of the consequences and problems of the account, I want to mention a further supporting factor. Experimental work on categorization and analogical relations has typically used either visual paradigms (as with pictures of items) or

verbal presentations (whether in story form, or with comparisons based on responses to words). Neither has great ecological validity with respect to language use, given that the context for learning language is, as K. Nelson pointed out forty years ago, that of interacting with the world around us. It is through our relations with items and situations, as manifested, for example, in actions, that a great deal of learning takes place (see Nelson 1974; more recently, Nelson 2008; Nelson and Ware 2002). Insofar as experimental work has been able to take this into account, the results help to confirm the hypothesis that people, including young children, are able to gain implicit knowledge of abstract relational commonalities through interactions with the world around them.

Catrambone et al. (2006) note that representations of targets and base situations, such as the General and Tumour stories, have typically been in language form. Catrambone et al. showed that a positive effect on analogical reasoning could be attained by having participants physically enact the kinds of situations and relations that the stories represent. They found that participants who were asked to re-create the General story using wooden blocks showed, prior to any hints being given, much higher rates of analogical transfer (52%) in comparison with participants who were merely given the story in verbal form (19%). Similarly, Day and Goldstone (2011) showed that analogical transfer is facilitated by having participants physically manipulate a physical system with analogous structure to the test task that the participants were set. They suggest that ‘concreteness of the training task—and specifically its spatial, dynamic instantiation—is critical in supporting this kind of transfer’.<sup>10</sup> With respect to learning individual words, D. K. Nelson has shown (e.g. Kemler Nelson et al. 1995) that young children can learn to apply novel terms on the basis of functional relations that they learn of from interacting with items.

## 5 Insights into Word Meaning

By suggesting that a central facet of word meaning is an invariant representation, the hypothesis might seem to run directly against the emphasis that is often found, in psychology, linguistics, and philosophy, on the context sensitivity of our conceptualizations. In psychology, Barsalou has written extensively on the context sensitivity of our situated thinking about objects and events (see Yeh and Barsalou 2006; Barsalou et al. 2010). If we are talking about pianos in the context of moving furniture, our thinking will highlight not the musical properties but the weight and size of a piano. If we are talking about basketballs in a gym setting, the activated conceptual content will highlight qualities such as bounciness, whereas in a pool setting the activated conceptual content will relate to qualities such as floating.

From this perspective, Barsalou speaks of words as points of access to bodies of general knowledge from which the situated representations can be constructed. Yeh and Barsalou speak of a word, such as *car*, as an ‘index’ under which our knowledge of cars is integrated. Words are being treated as akin to headings in an encyclopaedia, such that when we process a particular word, we gain access to the entry associated with that

<sup>10</sup> Recent work that shows that direct perceptual manipulations aid the learning of scientific concepts. Kontra et al. 2015. Thanks to Léna Kervran for the reference.

heading. On this understanding, there may be no reason to posit any constant word meanings (Casasanto and Lupyan 2015). The body of knowledge that a word indexes may change, and there may appear to be no theoretical or empirical reason for looking to something that is constant.

This general model for word meaning appears to be quite widespread. In Relevance Theory, the ‘conceptual address’ that a word is linked to ‘is treated merely as a point of access to an ordered array of encyclopaedic information from which the hearer is expected to select in constructing a satisfactory overall interpretation’ (Wilson and Sperber 2004: 619; see Sperber and Wilson 1998 for words as pointers). Pietroski suggests that the meaning of an expression might be ‘an instruction for creating a concept from available mental resources’ (Pietroski 2005: 271). We can think of the word *dog* as providing ‘instructions for accessing one or more concepts already available for natural use’ (ib. 275). Rayo (2013: 648) suggests that we associate words with a ‘grab bag’ of mental items (e.g. memories, images, pieces of encyclopaedic information, and so on), from which the language user, ‘exercising sensitivity to context’, will ‘come to a sensible decision’ about what an expression is being used to express on a given occasion.

Whether we speak of pointers, indexes, or points of access, each of these suggestions has the same fundamental shape, akin to how we envisage an encyclopaedic entry. The role of a word, on this view, is to publicize which body of knowledge is being (selectively) accessed, perhaps manipulated, and then communicated. Insights from analogical cognition suggest that this view is problematic. I discuss three issues. 1. The word/extension relation needs to be explained and should not be treated as a primitive fact. 2. We need a hypothesis for what enters immediately into the understanding when a word is used. 3. Context sensitivity in our thought is consistent with fixed standing meanings and may even be facilitated by them.

### 5.1 The Word/Extension Relation Needs Explanation

The ‘pointer’ approach to word meaning appears to treat the relation between word and whatever it points to as a primitive fact whose explanation is not itself part of linguistic theory. We are just meant to accept that the word *predator*, for example, happens to coordinate with general knowledge about members of the extension of this term. While formal semantics does not have a cognitive orientation to the topic of words and meanings, the same point can be applied to aligning words with extensions. This alignment is stipulated, expressed by an ‘interpretation function’ that provides all words with appropriate extensions, while implicitly treating the reason for the alignment as not in itself of semantic interest.

Against this view, research into analogical cognition indicates that we cannot take the word/extension relation for granted. Explanation is needed for why we use relational words in the way we do. This explanation relates to knowledge of a schema, and I have argued that this is the proper locus for an account of the meaning of many words. Accounts that treat word meaning in terms of a relation between a label and a body of knowledge or extension presuppose what they ought to be explaining. On the alternative that I am proposing, word meaning is that which underpins this relation and that plays a direct role in our understanding that can be specified prior to any decisions as to whether such-and-such an item is correctly labeled by the word.

## 5.2 Words and Understanding

The pointer approaches to word meaning are not easily reconciled with two features that characterize our use of language. First, there is the striking phenomenological immediacy of our understanding of an utterance. As Pettit (2010) puts it, awareness of speech content ‘is typically immediate and unreflective’. Second, we process words at very high speed:

When a reader seems to fully comprehend a text at three hundred words a minute, how are hundreds of concepts accessed, deployed, and interrelated each minute? ... [F]or concepts to work in this way, they must impose a very low cognitive load. (Keil and Kominski 2015)

Prima facie, the word as pointer type of view, with its attendant implications about possibly complex inferential processes having to be undergone before a situated meaning can be accessed, seems ill-suited to explaining these features of language use. By contrast, if word meaning is understood in terms of specific analogical structures, this provides the immediacy of content that the phenomenology and speed of language use seems to require.

If we treat a word as a label for some body of conceptual knowledge, it follows that grasp of the word itself is not intrinsic to understanding. Our immediate grasp of the word is nothing more than grasp of a label, while questions of understanding pertain to the concept that the word points to. The alternative that I am proposing is importantly different: grasp of the word is itself in part constituted by a basic understanding, independently of further knowledge that we may gain about the items that a word can be used of.

## 5.3 Context Sensitivity in Thought and the Role of Analogical Structure

Theorists who stress context sensitivity in language use do not in general deny a place for constant linguistic meanings, though there is little by way of explicit debate as to the nature of those meanings.<sup>11</sup> In particular, context sensitivity in situated interpretation is not as such inconsistent with the hypothesis that many words have a context-independent analogical structure as their meaning. In virtue of its abstract nature, a schema is consistent with a vast array of different manifestations of whatever item or situation is being spoken about.

But we can go further than merely argue for consistency. Gentner’s work provides positive reasons for seeing an important role for context-independent meanings. Gentner suggests that words are tools that contribute aspects of cognition that are either not found or are under-represented at the more basic biological level of thought: ‘One function of language may be to augment natural modes of cognition with an alternative representational scheme that permits abstract cognition’ (Gentner 2003: 222). In particular, words may contribute by providing memorizable and context insensitive building blocks (as Clark 2006 puts it), and this is possible by virtue of the shift to analogical cognition that the use of linguistic form facilitates: recurrent

<sup>11</sup> Carston has done more than most to address this issue (see e.g. 2012); also Recanati 2004, chapter 9.

symbols can be associated with the invariants that analogical insight makes available. In other words, our power of thought, and this includes our ability to think flexibly, is facilitated by the clear structure that (by hypothesis) word meanings provide us with. Rather than projecting the flexibility of our thought into language, such that language is treated itself as a thoroughly context-sensitive medium, it may be better to view language as providing a stable, context-insensitive scaffold which combines with the more primitive biologically-endowed cognitive abilities and results in a marked increase in the extent of our cognitive abilities.

## 6 (Not) Categorization

If the meaning of many words can be characterized in terms of a relational schema, it follows that knowledge of word meaning is not in general equivalent to the kind of knowledge that may be accessed in categorization. By categorization I mean the decision that such-and-such an item is a chair, a motor, a barrier, and so on.<sup>12</sup> In general, such decisions may draw on general aspects of knowledge rather than the specific understanding that knowledge of the word provides. The word *motor*, for example, could indicate something that stores energy and imparts motion. This relation is readily exemplified in our experience and does not require great knowledge in order to be understood. But faced with a complex piece of machinery, it may take an expert to know which part is the motor. This decision may be based on general knowledge about the forms and appearances that motors can display, rather than on specific observation of a relation into which the part enters. While observation of the relations that an item enters into could elicit use of the term *motor* in a given case, categorization decisions in general need not be limited to this. In line with this, Markman and Stilwell (2001) speak of a distinction between two kinds of representation (the relational form, and the form of representation more usually associated with concepts, such as sets of features). They note that much of the information that is used to categorize an item may be unrelated to any relational role, though still useful for identifying members. Likewise, Rehder and Ross (2001: 1272) note that ‘what it means for... features to be compatible with respect to a relationship is not encoded as part of the category representation but rather depends on general background knowledge’. That is to say, the knowledge of which features provide evidence that something is a motor is not itself part of the knowledge of the basic relational structure that is represented in the meaning of the word *motor*.

Categorization decisions exemplify one kind of interface between language use and the world. Given the request ‘Give me the motor’, we need to decide which worldly item is the motor. Similarly, if we are given a set of directions, or are asked to pick out a suitable gift for someone, or need to decide whether a situation is an emergency, complex decisions need to be made about which are the appropriate bits or states of the world that correspond to the words used. In the respective contexts, it may be

<sup>12</sup> Sloman et al. (2001: 74) usefully note that this task is in fact rather ambiguous. If we ask ‘Does such-and-such belong to category X?’, a participant might take it to mean ‘Is X an appropriate name for this object?’. With this perspective, we might categorize a stuffed bear as a bear. Alternatively, the participant might think that the question relates to some notion of the object’s underlying nature (such as biological organism), which rules out the stuffed bear.

unclear how to interpret ‘turn sharp left’, or what counts as a suitable gift, or what counts as an emergency. It does not follow that this indicates any deficiency in our linguistic understanding of ‘turn sharp left’, ‘suitable gift’, or ‘emergency’. It is important to distinguish linguistic understanding, and hence our account of word meaning, from the highly context-sensitive factors and abilities that are relevant in the task of interfacing between language and the world.

## 7 Some Problems

There are, of course, problems and limitations. Not all words have a relational basis. Even for relational words, the proposal may not capture all aspects of meaning. The appeal to something in common is challenged by Wittgenstein and polysemy. I discuss these points in this final section.

### 7.1 Not all Terms Are Relational

Many words, such as names for species, or terms that sub-classify various scientific categories, do not have any obvious relational basis for their use. Appeal to (possibly complex) arrays of intrinsic features, rather than looking to some simple relational characteristic, may seem the more likely approach for thinking about what constitutes our linguistic understanding of the words used for such items.<sup>13</sup> But while not all terms can be accounted for in the relational kind of way, it is worthwhile looking for a plausible generalization.<sup>14</sup> The following is a tentative suggestion.

The discussion so far has suggested centrality for two factors in the account of our grasp of a word: sameness and understanding. That is to say (setting aside polysemy, for which see below), a word suggests a sameness that is found across those items or situations to which the word can be truly applied, with this sameness captured in terms of an ‘understanding’ of those items and situations. Different barriers are the same with respect to the general structure of prevention of movement, and prevention of movement constitutes an understanding of barriers. Sameness, along with the requirement of explaining the analogical basis of our use of relational words, constrains this notion of (linguistic) understanding, so it does not extend to general knowledge (about barriers).

Can we extend these two factors to an account of the linguistic understanding of natural kind terms? There are hints that this may be the case. Keil (1989), though not considering word meaning as such, provides extensive evidence that how things look does not have the last say for children’s concepts of natural kinds.<sup>15</sup> Even pre-school children are influenced in their categorizations by what look like incipient theoretical considerations, shown in their ability to make judgements about kind-membership that can, in some situations, override surface perceptual similarities. In particular, Keil argues against the suggestion that children start with an atheoretical grasp of

<sup>13</sup> Markman and Stilwell 2001 suggest that sub-categories of role-governed categories (such as: beverage[water, lemonade, tea]) are ‘feature-based categories’. Vicente 2018 also suggests that words may split into two types, with some having richer based representations than more underspecified schematic accounts.

<sup>14</sup> Thanks to a reviewer for this journal for raising this point.

<sup>15</sup> Thanks to Brent Strickland for the reference to Keil.



(surface) similarities, only later developing more theoretical insight of natural kinds. Rather, from the outset a child's understanding appears to have a theoretical aspect to it. Gelman (2003) likewise argues that children's concepts are informed by a 'powerful capacity to look beyond the obvious'.<sup>16</sup>

Both Gelman and Keil's focus is on the requirements of categorization. But, arguably, the aspects of their work that look beyond the obvious, and that they frame in terms of a more theoretical understanding than merely the appreciation of surface features, point to factors that may play a central role in our account of the words used for these natural kinds. In particular, both Keil and Gelman suggest that this non-obvious dimension to children's concepts of natural kinds relates to the guiding principle that the *identity* of this kind of item can persist across even quite massive perceptual changes. If so, something like a theoretical understanding of a natural kind plays a role in judgements of sameness across perceptual change, even if the items named by the kind term are typically strongly associated with particular visual characteristics.<sup>17</sup>

This may suggest that for natural kind terms, just as for relational terms, the account of word meaning should be phrased in terms of some (quite basic?) theoretical understanding that facilitates judgements of sameness, both across different instances of that kind and in terms of the identity of an instance that undergoes perceptual change. As with relational terms, understanding this word meaning would not be equivalent to the abilities and knowledge utilized in categorization decisions. It would not, on this account, be the role of linguistic understanding to decide whether something really is a horse, for example. The focus, instead, is on construing word meaning in terms of a type of understanding that allows for sameness between instances to which the term applies. Whether expressed in terms of relational structure, or an incipient theoretical understanding, or something else, this understanding will in general be constituted in a way that allows for a dissociation between obvious visual features and what ultimately underpins use of the word. This may provide a theoretical framework for approaching word meaning in general.<sup>18</sup>

## 7.2 Further Non-relational Factors

On the other hand, even for terms for which a relational perspective is well motivated, it may be unclear how to account for the distinctions in use that hold, for example, between *obstacle*, *barrier*, *impediment*, *obstruction*, and so on. Some of the distinctions may be explainable by reference to subtly differentiated relational factors. For example, the reason why we speak of an obstacle race (rather than a barrier race), and why we speak of police setting up barriers (rather than obstacles), seems to relate to how the term *obstacle* doesn't preclude reaching the goal, whereas *barrier* indicates something that is meant to prevent reaching the goal. This raises the question as to how far relational distinctions can be used to explain different uses of closely related terms.

<sup>16</sup> Though not all agree that appeal to incipient 'theories' is warranted; see Sloutsky and Fisher 2011.

<sup>17</sup> I am not necessarily endorsing the 'psychological essentialism' that Gelman proposes, which is only one way of explaining the data.

<sup>18</sup> In support of a dissociation, in general, between visual features and word meaning, Landau and Gleitman's 1985 study of blind children found no reason to suppose that lack of visual experience distorts linguistic concept formation.

Another difference is that *obstruction*, but not the other terms, is often used for the act of preventing/impeding. But when it comes to considering *impediment* and *obstacle*, while we appreciate that they have a different distribution (we say ‘a speech impediment’ not ‘a speech obstacle’), it is also the case that they very often seem interchangeable and some fine-grained relational distinction is perhaps unlikely. Rather than always reflecting relational distinctions, perhaps usage is in part determined, as a reviewer suggests, by contingencies of historical accident and custom.

These complexities arise because language aids cognition not only by providing individual terms, but by providing a multitude of related terms. This creates a complex multi-dependent framework of word usage that both induces a fineness of grain in our understanding of a given word and also leads to contingencies of usage that may be beyond the explanatory reach of theory. Use of terms such as *athletics* (for track and field events), or *swimming* (for pool events), seems to block the use of *game* for these events, whereas there is no such block for football, cricket, and hockey. On the other hand, we also speak of the Olympic Games (a point noted by Hoyningen-Huene 2015), which illustrates the contingencies that can be displayed in word use.

There may be a concern about the implicit appeal to invariances that is found in accounts of analogical cognition. Wittgenstein (1953: §§66–7) famously suggested that there may be nothing ‘in common’ between uses of the term *game* (German *Spiel*), with extension of a word perhaps based on nothing more than family resemblances. I do not want to underplay this concern, though Wittgenstein’s briefly made comments cannot by themselves bear the weight of the claims that are sometimes made in the light of them. Wittgenstein appears to have had features, rather than relations, in mind (for discussion, see Hoyningen-Huene 2015; Pritchard 2017). And there is nothing in Wittgenstein’s account that provides a convincing explanation for the way in which we actually use many words, which, as we have seen, does not arise from grouping items and situations according to surface similarities, whether or not these similarities are further structured by family resemblances.

The appeal to invariances is not a claim that we can isolate a single analogical relation to account for all the uses of a word. Consideration of polysemy suggests that words often have different though related meanings (Vicente and Falkum 2017). At least for what are called ‘irregular’ polysemies (an open mouth/offer/meeting; drop a brick/course/charge), this can be accommodated by the claim that a word may have a series of related schematic meanings. There is, though, a complex two way challenge here. On the one hand, as Vicente (p.c.) has pointed out, there may be a problem for the proposal of explaining why and how different, but related, schemas arise for a given word. On the other hand, the basic data for polysemy is itself very difficult to judge given that we lack clear criteria for sameness and difference of meanings. The current proposal may help to provide some such criterion and thereby help to clarify the nature of polysemy.<sup>19</sup>

The complexities of word use raise undoubted challenges for the proposal. Schematic accounts of word meaning have been sketched—and sometimes rejected—by

<sup>19</sup> For example, so-called ‘regular’ polysemy (she visited the school; she spoke to the school) might be judged not to involve different word meanings at all. Frisson 2009 appears to treat the school examples as involving different meanings of *school*. We need, though, to distinguish the meaning of the word *school* from the constitutive means by which talking to a school, or visiting a school, is manifested.

other theorists (Carston 2002, ch. 5; 2012, though for criticism, now see Carston 2016; Recanati 2004, ch. 9; Vicente 2018). But these discussions have not been supported by reference to analogical cognition. I take the evidence from analogical cognition to be sufficiently robust to legitimate taking some sort of abstract schema as a starting point for the meaning of many words. Otherwise, it is not clear that an account will be able to explain the way in which we use words.

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