THE PERCEPTUAL BASIS OF ABSTRACT CONCEPTS IN POLYSEMY NETWORKS – AN INTERDISCIPLINARY STUDY

by

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The Perceptual Basis of Abstract Concepts in Polysemy Networks – An Interdisciplinary Study

Abstract

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A corner stone of grounded cognition and concept empiricism, the perceptual basis of concepts states that concepts are modality-specific representations derived from experience. While many studies have offered accounts on the perceptual basis of concrete concepts, accounts on abstract concepts have been somewhat lacking in comparison. This thesis explores the perceptual basis of abstract concepts by looking into polysemy networks in language, which contain senses that overlap in the conceptual constructs they evoke. By examining the overlap between a concrete sense and an abstract sense that extends from the former, this thesis sheds light on how abstract constructs can be derived from concrete constructs, which in turn can be readily derived from modality-specific experience. In addition, this thesis combines the Cognitive Grammar framework and the Perceptual Symbol System framework to account for the structures of the conceptual constructs in question and how they can be represented in a perceptually-based manner.

1. Introduction

In the studies of concepts, many contemporary theories reject amodal representations of concepts and favor modality-specific representations. By doing so, these theories adopt the point-of-views of concept empiricism and grounded cognition, which argue that conceptual knowledge is derived from and represented in perceptual, motor, introspective, affective and other states that constitute our experience (Prinz, 2002, 2005; Barsalou, 1999, 2016; Barsalou et al., 2003 etc.). Because studies on this perspective of concepts have largely focused on the perceptual modalities, which are arguably the most fundamental modalities for forming and representing concepts, the dependence of concepts on the modalities are often referred to as the perceptual basis of concepts (Prinz, 2005). While many studies have explored and provided evidence for the perceptual basis of concepts, they have always faced great challenges posted by abstract concepts. Unlike concrete concepts, which refer to perceptually salient phenomena in the physical environment, abstract concepts refer to perceptually intangible phenomena such as complex events, hidden relations, and logic, making it difficult to account for how the mental representations of these phenomena can be derived from perceptual experience. This difficulty has been considered one of the weak points of modality-specific theories of concepts and become the main objection to these theories.

In response to this objection, theorists from a variety of disciplines have come up with different strategies to ground abstract concepts in experience. Barsalou (1999) proposed that abstract concepts can be directly represented with perceptual symbols by framing them against background events that are perceptually tangible. For example, the concept TRUTH can be framed against a background event where a verbal description matches the perceived environment. Selective attention then picks out the core content of the concept – in this case, the correspondence between perception and the mental simulation derived from the verbal description. This strategy provides us with a direct way of representing abstract concepts with perceptual information while also capturing the perceptually intangible properties of these concepts. Other less direct strategies to ground abstract concepts include sign-tracking (Prinz, 2002), linguistic labeling (Prinz, 2002; 2005), and conceptual metaphor (Lakoff & Johnson, 1980; Lakoff, 1990; Johnson, 1987) etc., and they explore how we can use language or other tools to help us reason with abstract concepts without appealing to direct representations. These strategies complement each other and together build toward a greater picture of how abstract concepts can be grounded in perceptual experience.

Based on these existing strategies, this thesis turns to language to explore the perceptual basis of abstract concepts by looking into polysemy networks. Some lexical items have entrenched usage patterns whose referents range from conceptual constructs that are immediately perceivable to those that are highly abstract. For example, the word "barrier" has a concrete sense that refers to an object that prevents one from moving through a path, as well as an abstract sense that refers to any "thing" that prevents one from achieving a goal. These two senses are not only connected by the same linguistic form that they share but also by the similarity between the things that they refer to. More specifically, the second sense is extended from the first and there exists an overlap between the constructs evoked by the two senses (Langacker, 1987, 1991, 2007; Goldberg, 2006). Since such overlaps, which are usually abstract, are present in the concrete constructs evoked by the extended sense, they can serve as linguistic evidence on how some abstract conceptual constructs can be derived from constructs that are perceptually tangible.

In this thesis, I analyze two polysemy networks with focus on the overlaps between the conceptual constructs evoked by the entrenched concrete and abstract usage patterns. The analyses adapt a framework that combines the Cognitive Grammar framework (Langacker, 1987, 1991, 2007) and the Perceptual Symbol System framework (Barsalou, 1999). While the former provides us with the tools to describe the semantic structures of the phenomena in a linguistically precise way, the latter allows us to further explore the representations of these semantic structures in a way that is perceptually based and psychologically precise. Attested data are recruited from Corpus of Contemporary American English (COCA) to help identify the senses in the networks. At the end, several implications of the analyses are discussed, including implications on the perceptual basis of abstract constructs and implications on the application of the Perceptual Symbol System framework in Cognitive Linguistics.

2. Perceptual basis of concepts

This thesis adopts the point-of-view that conceptual representations are perceptually based or modality specific. Although some studies adapt the name “concept empiricism” for their studies under this perspective (e.g. Prinz, 2002, 2005), others prefer the name “grounded cognition” to avoid confusion with traditional empiricist view of concepts, which exclusively centers on perceptual modalities and has little considerations for other modalities or possible biological constraints (e.g. Barsalou, 2016). Regardless of the name preferred, these studies are all based on the assumption that concepts are dependent on the perceptual system as well as other modalities that might play a role in the acquisition and representation of concepts (e.g. motor system, introspective system, affective system). As far as this thesis concerns, “concept empiricism” and “grounded cognition” refer to the same perspective on concepts and will be used interchangeably.

The perceptual basis of concepts can be broken down into two tenets. First, concepts share casual relations with the categories they refer to – that is, concepts are acquired from encounters with members of the category they refer to and are reliably activated by such encounters (Prinz, 2002, 2005). In other words, concepts are learned mental representations of entities in the world and they exist to help us identify and interact with these entities. Second, conceptual representations are modality-specific, meaning that they are implemented by the same systems responsible for modality-specific experience, such as perception and action, and are coded in the same formats that these states are coded in – visual, auditory, motor etc. (Prinz, 2005; Barsalou, 1999; Barsalou et al. 2003). These two tenets address two fundamental problems in the studies of concepts – the origin of concepts and the nature of conceptual representations.

2.1 Origin of concepts

On the first problem, concept empiricism proposes that while we possess basic capacities for forming and processing concepts, specific conceptual knowledge is learned from our interaction with the environment. This is in contrast to the nativist claim that some knowledge is innate to us, including linguistic structures and basic ontological domains such as object physics, biology, and psychology (Prinz, 2002; 2005). Many reasons for these claims come from the observations that infants and young children demonstrate possessions of specific knowledge very early on (Spelke, 1994; Keil, 1989; Dennett, 1987; Chomsky, 1980). These findings lead to the general argument that some knowledge must be innate because of the lack of time and means for young children to acquire them after birth.

However, closer examinations usually reveal alternative explanations that do not involve innate knowledge. For example, infants seem to understand the principle that objects move as connected wholes. Experiments show that if a moving bar with an occluded part is later revealed to be two bars moving in sync, infants stare at the bars for a longer time than when there is only one bar (Kellman & Spelke, 1983). This is interpreted as evidence for innate knowledge because it is understood so early while other more perceptually salient principles such as gravity are not (Spelke, 1994). However, expectations for cohesion can be learned because objects with synchronized movements are almost always connected. Gravity, on the other hand, is usually violated in an infant's world because of hanging objects such as toys and because infants have little experience of their bodies falling (Prinz, 2005). These alternative explanations are more theoretically sound than nativist ones. Comparing to specific knowledge, learning mechanisms based on neurological structures are more likely to genetically specified (Elman et al., 1996; Cowie, 1998). Therefore, before attending to the conclusion that a concept is innate, we should always examine carefully if the concept can be attained through learning.

2.2 Nature of conceptual representations

On the second problem, concept empiricism proposes that conceptual representations are perceptual or modality-specific in nature. Amodalism, on the other hand, although not completely at odds with concept empiricism on the first problem, have a completely different position on this problem. Amodalism assume that concepts are language-like symbols that are separate from the perceptual and other modality-specific systems (e.g. Fodor, 1979; Pylyshyn, 1984; Machery, 2016; Leshinskaya & Caramazza, 2016). While the perceptual system might be responsible for the image-like representations of concepts, these representations are epiphenomenal and associated with a random amodal symbol, which encodes the core of a concept in a format unrelated to the formats of the modalities. Detailed comparisons of perceptual and amodal accounts of concepts can be found in Barsalou et al. (2003), Prinz (2005), and Barsalou (2016). In the following paragraphs, I highlight two reasons why perceptual accounts offer better solutions on the second problem than amodal accounts. For empirical evidence supporting perceptual accounts, see Barsalou et al. (2003).

The first reason comes from considerations of how the human brain evolved. From an evolutionary point-of-view, perceptual representational mechanisms are much more likely to evolve because they are extended from the perceptual mechanisms that have existed for a long time in the history of evolution (Barsalou, 1999; Prinz, 2005; Churchland, 1986). Oftentimes, existing mechanisms evolve new features that allow them to perform new functions (Gould, 1991). In this case, perceptual mechanisms might have first evolved the ability to store perceptual records of the entities encountered, then the ability to re-activate these records in their absence and manipulate them (Prinz, 2005). Amodal representational mechanisms, on the other hand, have little basis in evolution. It is difficult to see how amodal systems could have evolved from the more basic systems, especially when there is little neurophysiological evidence for amodal systems in the first place. The relatively short history of our own species also seems to reject cognitive and neuro structures that take significant leaps from the ones that support perception, which have much longer histories in evolution.

The second reason revolves around the origin of concepts. Many amodal accounts share similar opinions with perceptual accounts on this problem and agree that concepts are derived from our experience. This necessarily means that concepts are acquired through perception because it is the only mean through which we can receive information from the outside world. This gives rise to the first tenet mentioned above, which states that concepts can be considered recognition mechanisms that are acquired from and reliably activated by encounters with the category instances. In order to successfully detect category instances upon perception, a concept needs to contain features of the category instances at a perceptual level. Otherwise, concepts would be ungrounded in the things they refer to. This is precisely the problem that amodal accounts face – amodal symbols do not contain any perceptual information and therefore run the risk of disembodiment.

Some amodalists try to address this problem by proposing that amodal symbols are associated with mediating perceptual representations (Harnad, 1987; Neisser, 1967; Höffding 1891; Fodor, 1990). These perceptual representations are activated by perceptions of category instances and in turn activate the amodal symbols that they are associated with. The problem with this proposal is that the amodal symbols are redundant during recognition and the perceptual representations are doing all the work (Barsalou, 1999; Prinz, 2005). This echoes with the first reason mentioned above – systems dedicated to amodal symbols seem to have no place in the evolution of the brain.

Perceptual accounts, on the other hand, avoid this problem by proposing that concepts ARE the perceptual representations that activate during perception. In addition, these perceptual representations are capable of performing all the conceptual functions that amodal symbols are usually credited for (Barsalou, 1999; Barsalou et al., 2003), leaving even less reasons for adopting an amodal view of concepts.

3. Perceptual approaches to abstract concepts

As mentioned at the beginning, concept empiricism faces challenges posted by abstract concepts. Despite convincing reasons and empirical evidence that favor the perceptual basis of concepts, empirical views of concepts are usually questioned on their abilities to account for abstract concepts like DEMOCRACY and TRUTH, which seem to be have little basis in perceptual experience. In our everyday life, we come across a wide range of concepts that are not perceptually tangible. For example, if we try to map the meaning of every word or phrase we come across to a perceivable entity in the environment, such as the words in this very sentence, we would soon run into great difficulties. Depending on the topic and genre, a discourse can contain very few words that have concrete referents. If concept empiricism is only equipped to account for concepts with perceptually salient referents, its explanatory power would be severely limited. Fortunately, this is not the case. Concept empiricists have come up with various strategies that allow us to explore the perceptual basis of abstract concepts.

Before we take a look at these strategies, it is necessary to specify what we mean by abstract concepts. Here, the term “abstract” refers to the property of not being perceptually tangible. Unlike concrete concepts, abstract concepts often do not refer to things that have salient and stable correspondences in perception. While we can point to a scene of people lining up behind the voting booth and say that this is DEMOCRACY, it is not quite the same as pointing to a furry creature and saying that this is DOG. Unlike the furry creature called "dog", the perceptually tangible scene of people lining up does not itself capture the critical features of a democracy. In fact, it is only a perceptual manifestation of democracy. At the same time, democracy can have many other manifestations, such as scenes of presidential campaigns or people raising their hands to vote for something. Although our understanding of democracy might be supported by a variety of such perceptual manifestations, the nature of democracy is captured by its inner structure (e.g. a system based on mutual consent), which is schematic, not perceptually salient, but, in the view of concept empiricism, derivable from modality-specific experience.

Finally, I would like to mention that concept empiricism is not the only view challenged by abstract concepts. As long as some amodal accounts share the opinion that concepts are learned from experience, they are just as much challenged as concept empiricism (Prinz, 2002). At first glance, it seems that amodal symbols are perfect for representing abstract concepts because they are not perceptual. However, this does not automatically ground these symbols in the situations they refer to. Like the case for concrete entities, a random symbol cannot come to represent an abstract being without being casually related to it. This means that no matter how unlikely it might seem for abstract concepts to have perceptual representations, these concepts must be derived from modality-specific experience. The only other alternative is to assume that abstract concepts are innate, which, as mentioned earlier, is very unlikely.. Therefore, exploring the perceptual basis of concepts seems to be most viable strategy for grounding concepts.

3.1 Direct representation

The most direct approach to the perceptual basis of abstract concepts is direct representation with perceptual information. In particular, Barsalou (1999) proposes a way to perceptually represent abstract concepts using what he calls perceptual symbol system.

Perceptual Symbol System (PSS) is a perception-based system proposed by Barsalou (1999) that is capable of implementing full conceptual functions. A perceptual symbol is a mental representation derived from perception and stored in long-term memory. In the absence of perception, the perceptual symbol can be re-enacted to create a **simulation** of the original perceptual experience. However, a system with only storing and re-enacting mechanisms is a recording system that is not capable of conceptual processing. In order for perceptual symbol system to achieve conceptual functions, two more mechanisms are required – **attention** and **integration**. With attention, specific components of experience can be selected to form their own representations. Related representations from different modalities are then stored and integrated in what is called a **simulator**, a collection of specific representations that underlie a category. For example, a simulator for the category CAR stores a variety of car-related representations, including representations of cars with different color, shape, maker etc., representations of different subparts of cars, and representations of cars from different perspectives, modalities, scenarios etc. All of these representations are stored in the CAR simulator and integrated into a coherent knowledge structure or frame that underlies our understanding of car.

Furthermore, the CAR simulator is also hierarchically connected to subordinate simulators that are responsible for conceptualized sub-regions within the frame (e.g. SPORTS CAR, ENGINE). Under the PSS framework, concepts are equivalent to simulators and thinking is equivalent to simulation.

According to Barsalou (1999), three mechanisms are central to the direct representation of abstract concepts in perceptual symbol system. First, an abstract concept is framed against a background event sequence. Since an abstract concept can have many different perceptual manifestations, its representation can also take many different forms, depending on the specific background event being simulated. Second, selective attention highlights the core content of the concept within the simulated background event. In this sense, a specific representation of an abstract concept is a focal part of the event sequence it is framed against. Finally, simulations of abstract concepts usually involve perceptual symbols for introspective states. Without this kind of perceptual symbols, it would be impossible to perceptually simulate many abstract concepts.

Consider the concept TRUTH. In order to represent this concept perceptually, we need to first find a specific event sequence that serves as context. In the example offered by Barsalou (1999), the event involves an agent hearing the utterance “There’s a balloon above a cloud outside”. The agent then constructs a mental simulation of the meaning of

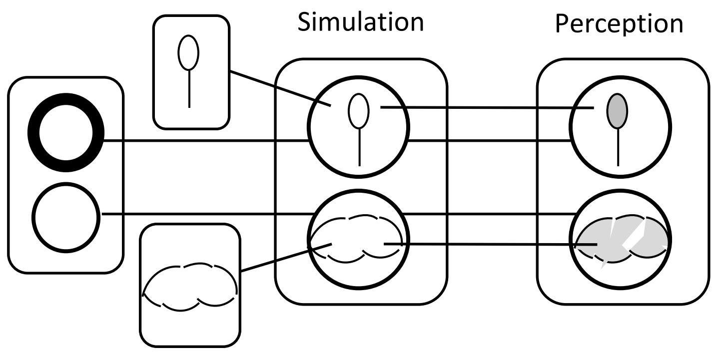

Figure 1 (adapted from Barsalou 1999: 601)

the utterance, including the simulation of ABOVE, BALLOON and CLOUD. In a following event, the agent perceives a physical situation, where there is a balloon flying above a cloud. The agent then attempts to map the simulated situation to the perceive situation and finds that the mapping is a success (see Figure 1). If the mapping is a failure, the simulation would be a representation of FALSITY instead. Remember that the two events are both part of the simulation that represents the category TRUTH. In this simulation, selective attention focuses on the part where the perceived situation successfully map onto the simulated situation. The distinction between simulation and perception within the simulation of the concept comes from the ability to form representations of the things attended to during introspection. By repeatedly attending to cognitive processes, such as simulation, perception, and comparison, we are able to encode representations of these processes and re-enact them in simulation (Barsalou, 1999). Although this example only accounts for one sense of the concept TRUTH, it demonstrates that it is possible to perceptually represent abstract concepts using the three mechanisms proposed in Barsalou (1999).

3.2 Mental operations

The example above involves another approach to abstract concepts proposed by Prinz (2002) – identifying abstract concepts with mental operations. In the case of TRUTH, our understanding of the sense of TRUTH as CORRESPONDENCE is grounded in the comparing operation between expectation and reality. According to Prinz, such mental operations are rules that are separate from representations and concepts like TRUTH should be identified with rules instead of representations. Barsalou (1999), on the other hand, views mental operations as something that can be represented by perceptual symbols through introspection. Despite the different opinions on what can enter the representational system, Prinz's stress on mental operations complements Barsalou's stress on introspection. Together, these two approaches suggest that many abstract concepts involve introspections on mental operations. Our ability to attend to these mental operations and form memories of them is what underlies the perceptual basis of many abstract concepts.

3.3 Sign-tracking

Another approach proposed by Prinz (2002) is sign-tracking. This approach is based on the theory that concepts share casual relations with the things they refer to as well as the observation that perceptually intangible concepts are often correlated with features that are perceptually tangible. By keeping track of these features, we are able to ground abstract concepts in the category instances that they are casually related to.

Prinz (2002) proposes four kinds of sign-tracking. The first kind utilizes stable superficial appearances that are unique to a category. Take HUMAN BEING for example. This concept could refer to members of the human species, who are characterized by qualities based on the human genome. Among these qualities is the superficial appearance of a human being, which is stably and almost exclusively produced by the human genome and can therefore serve as a reliable sign for detecting members of the human being category. The second kind of sign-tracking involves perceivable instantiations of abstract qualities. For example, while the quality of being humorous is not in itself perceivable, some of its instantiations are, such as jokes, comics, exaggerated appearances and performances, etc. The third kind can be considered a type of appearance tracking but with the help of scientific instruments, which allows us to perceptually keep track of things that are unperceivable to the naked senses such as atoms, cells, and planets. The last kind of sign-tracking involves words in natural language. The entrenched associations between words and the categories they designate allow us to indirectly track the signs of the categories using resources within linguistic communities. For instance, knowing that the word "Neptune" refers to a planet, one can track the appearance of the planet simply by searching "Neptune" on the internet. Furthermore, words can serve as placeholders for concepts that are too complex to hold in mind all at once (Prinz, 2005). Language, then, can facilitate reasoning by combining these placeholders to designate more complex situations.

Prinz (2002)'s sign-tracking approach revolves around the manifestations of abstract concepts mentioned earlier. While the essence of abstract concepts might not be captured by perceptual manifestations themselves, these manifestations help us ground these concepts in the environment and, as we saw in section 3.1, provide concrete materials for simulations. Even though abstract concepts are not perceptually tangible, they are usually grasped and understood through the perceptual traces they leave behind.

3.4 Conceptual Metaphor

The last approach I review is the Conceptual Metaphor Theory (CM), a cognitive linguistic framework that attempts to ground abstract concepts through metaphorical projections. Established by Lakoff and Johnson (Lakoff & Johnson, 1980; Johnson, 1987; Lakoff, 1993), this theory proposes that many abstract domains are understood by projecting them to concrete domains that they share similar structures with. For example, according to the conceptual metaphor CLASSICAL CATEGORIES ARE CONTAINERS, the classical all-or-none model of categories is understood metaphorically as a container. In particular, a unidirectional mapping from CONTAINER (the **source** domain) to CLASSICAL CATEGORIES (the **target** domain) can be established because the two share similar structures – the former has the structure *boundary-interior-exterior* and the latter has the abstract structure *criteria-member-nonmember*. While structures like *boundary-interior-exterior* are said to be image-schematic – that is, they are image-based schematic representations derived from embodied experience, structures like *criteria-member-nonmember* are abstract and can only be understood through mappings to image-schematic structures. This claim comes from the invariance hypothesis (Lakoff, 1990, 1993), which states that metaphorical mapping preserves the "cognitive topology" (i.e. image schema structure) of the source domain in a way that is consistent with the inherent structure of the target domain. Through metaphorical projections licensed by the invariance hypothesis, all of our abstract reasoning is said to be extended from of our image-schematic reasoning.

There are at least two problems with this approach. First, in order for a mapping to take place, the source and the target must have contents that exist prior to the mapping, meaning that the abstract domain, like the concrete domain, must have direct representations in the conceptual system (Barsalou, 1999). Conceptual metaphor, however, relies solely on mapping to ground abstract contents in perceptual experience, making it insufficient to solve the problem of disembodiment. Second, metaphor only captures the part where the source and the target are similar and leaves out where they are different (Prinz, 2002). While the structure *criteria-member-nonmember* and the structure *boundary-exterior-interior* might be similar in their cognitive topologies, they refer to very different things from different frames. Without independent knowledge of the abstract domain, we are not only unable understand it adequately, we also cannot distinguish it from the concrete domain that it projects to.

However, the Conceptual Metaphor Theory does provide us with a few valuable insights on abstract concepts. First, it shows that we systematically think about many abstract domains in terms of concrete ones, suggesting that conceptual metaphors might be an important vehicle for reasoning with abstract ideas. Second, the invariance hypothesis implies that there are invariants in the metaphorical mapping that are shared by both the abstract and the concrete domain, which, as we will see in the next section, leads us to a new direction in the studies of the perceptual bases of abstract concepts.

4. Mapping, invariants, and abstraction

The second insight offered by the conceptual metaphor theory points us to a new direction in exploring the perceptual basis of abstract concepts. At the core of this new direction lie the invariants in the mappings between abstract and concrete concepts. To say that two things are similar to each other is to say that there are things they have in common. Since conceptual metaphor highlights the similarity between a concrete domain and an abstract domain, it implies that the structures of the two domains share some qualities that are invariant in the metaphorical mapping.

This idea is further developed in the Conceptual Blending Theory (Fauconnier & Turner, 2002), in which the formation of metaphor is modeled in terms of conceptual integration. According to this theory, conceptual constructs (inputs) with similar structures can be integrated to form metaphorical constructs (blends) through mapping and selective projection. Like conceptual metaphor, conceptual blending also preserves the cognitive topology of the dominate construct (equivalent to the source in CM) in projection. In addition, conceptual blending adds in what is called a generic space, which highlights what that the inputs have in common. The content of generic space needs to be general enough to be common to different input constructs. As a result, this content – the invariant structure across the input constructs – is usually schematic and abstract.

When we apply this model to conceptual metaphors, we will find that the concrete structure in the source domain and the abstract structure in the target domain share invariant structures that are highly abstract. Consider again the conceptual metaphor CLASSICAL CATEGORIES ARE CONTAINERS. A mapping can be established between the structure *boundary-exterior-interior* and the structure *criteria-member-nonmember* because they share an invariant structure pertaining to the concept DISJUNCTION. In the case of a container, something is located in either the interior or the exterior of the container but never both, and the boundary is what separates the two from each other. In the case of a classical category, something is either a member or a nonmember of the category, and the criteria are what separate the two from each other.

Hence, we can see that the abstract construct DISJUNCTION is contained within the structure of the perceptually tangible concept CONTAINER. This finding is hardly surprising if we combine this approach to the approaches reviewed earlier. Both CONTAINER and CLASSICAL CATEGORY can be considered instantiations of the abstract concept DISJUNCTION. In addition, the former can be considered a perceptually tractable background event that can be used to represent DISJUNCTION. The mapping in this approach, then, serves as a means to identify the hidden abstract construct that the concrete domain instantiates, which can be used as a mean to study the perceptual bases of abstract conceptual constructs.

The approach described above is closely related to the career-of-metaphor account on metaphor and abstraction (Bowdle & Gentner, 2005). According to this account, when repeated mappings of the same base with different targets share the same invariants, this invariant can become crystalized as a new sense of the base. For example, from the metaphors “negotiation is a muscle”, “reading is a muscle” and “small talk is a muscle”, we can derive the same invariant shared by the source and the targets – the property of enhancing with training (Jamrozik, 2016). This invariant can serve as an abstraction of the base and become entrenched as a new sense of the base. Like the current approach, the career-of-metaphor account offers a way to explore the perceptual basis of abstract constructs by examining the invariants between abstract and concrete representations in mappings. However, instead of metaphorical mappings, the current approach focuses on examining polysemy networks, which often contain pairs of abstract and concrete constructs that share invariants. In addition, the career-of-metaphor account points to a view of abstraction in which abstract features can be distilled from more concrete ones and entrenched as abstract categories (Barsalou, 1999, 2016; Jamrozik, 2016). As we will see later, this process might be partially responsible for the acquisition of abstracts senses in some polysemy networks.

5. Polysemy networks

A linguistic unit is polysemous when it has a number of different but related senses. The key word here is “related”. A polysemous word is not a form that happens to be associated with a number of distinct senses. Instead, the different senses of the word are related in their conceptual constructs. In cognitive linguistics, polysemy is considered a psychologically real phenomenon of categorization (Langacker, 1987, 1991, 2007; Lakoff, 1987; Goldberg, 2006). From a usage-based perspective, a word acquires its meanings from its usages. When a usage fully instantiates an existing conceptual category designated by a word, it is said to **elaborate** an existing sense of the word (Langacker, 1987, 2007). On the other hand, when a usage only partially or imperfectly instantiates an existing category, it is said to **extend** an existing sense of the word (Langacker, 1987, 1991, 2007). If the same extended meaning is used repeatedly, this meaning then has the potential to be entrenched as a new sense of the word within the linguistic community. An entrenched sense has a basic meaning that is relatively context-independent (Tuggy, 1993; Tyler & Evans, 2003). This means that meanings that are derived mostly from context are not distinct senses of a word. Instead, they are different interpretations of a vague sense in different contexts. For example, the examples in (1) should not be considered distinct senses of the preposition “over” (Tyler & Evans, 2003). Both meanings of “over” elaborate the same sense that does not encode directly on whether there is contact with the landmark during the movement.

(1) a. The bird flew over the wall.

b. Sam climbed over the wall.

The different senses of a polysemous word usually originate from a prototype, which is usually the earliest sense of the word in history (Tyler & Evans, 2003). Throughout history as well as individual developments, new usages that extend the prototypical sense give rise to new senses of the word, resulting in a network centered on the prototype (Langacker, 1987, 1991, 2007; Lakoff, 1987; Taylor, 1995; Goldberg, 2006). While each sense in this network has connections with other senses, there might not be a common schematic meaning shared by all the senses in this network. An example of such networks is the lexical item "baby", which has a number of senses that extend the prototype HUMAN INFANT (Goldberg, 2006). Each of these senses contain a subset of the prototype, such as being the youngest in the family, small in size, or emotionally immature. Because these senses extend the prototype in different directions, there is not a structure or schema that all of these senses fall under.

Extension in polysemy is closely related to mapping in metaphor. Both metaphorical mapping and categorization of usage events involve the comparison of conceptual constructs. While a target construct is compared to a source construct in the former, in the latter, a usage is compared to the established senses that it activates. During the comparison, some parts of these constructs overlap while others do not. In the case of metaphor, the overlaps (i.e. the invariants) underlie what is similar about the target and the source while the non-overlaps distinguish the two from each other. In the case of extension, the overlaps are the parts of an existing sense that the new usage instantiates while the non-overlaps are the parts that it distorts. In both cases, the constructs being compared are conceptually related through their overlaps. Furthermore, some extensions could very likely start from metaphorical usages of the prototype. As mentioned earlier, repeated metaphorical use of the same source can result in abstraction and the entrenchment of the abstraction as a new sense of the source. In this case, the extended sense is a sub-part of the prototype and entirely overlaps with it. Another possibility is that the abstraction of the prototype from metaphoric usages becomes integrated with the contextual elements in these usages and the resulting sense only partially overlaps with the prototype (more on this point in the discussion section). Based on these observations, we can say that extension and metaphorical mapping involve the same cognitive process and are two similar and closely related phenomena.

By identifying the overlaps between more concrete and more abstract senses in polysemy networks, we are able to discover the abstract constructs that are present in the network and track their perceptual basis through the concrete senses that instantiate them. One benefit of analyzing the perceptual basis of abstract structures in polysemy networks is that we can observe how a concrete construct is processed and extended to form more abstract constructs. From these observations, we can derive insights on how human beings acquire concepts that do not directly designate things that are perceptually salient, both historically and developmentally. Another benefit is that it is easy to gather attested data for different usage patterns of a lexical item. These attested data could serve as linguistic evidence for how some abstract conceptual constructs can be derived from modality-specific experience. In addition to examining the overlaps between senses, the current approach also examines the representations of the senses and their overlaps at the level of simulation. This way, we can fully explore the perceptual basis of the abstract constructs in question by shedding light on both their empirical origins and the modality-specific nature of their representations.

6. Cognitive Grammar and PSS

Before entering the analyses, it is necessary to specify the framework that the analyses adapt. In examining the conceptual constructs behind the senses and the overlaps between them, the analyses adapt the Cognitive Grammar framework developed by Ronald Langacker (1987, 1991, 2007). Under this framework, a linguistic unit is a form-meaning pair or, in Langacker's words, consists of two "poles". While the **phonological pole** consists of the sound and phonological structure of the unit, the **semantic pole** consists of the conceptual contents that the unit evokes and designates. A polysemy network, then, consists of multiple units that share the same phonological pole but have semantic poles that are different but related to each other. The conceptual contents in the semantic pole, called the **conceptual base** of the linguistic unit, are oftentimes organized relationally. A relational structure, or frame, contains multiple roles, which can be considered placeholders for the components of the relation that can take novel instances (e.g. *upper object* and *lower object* in the relation ABOVE). According to Cognitive Grammar, a linguistic unit **profiles** (i.e. designates) a substructure of the conceptual base, directing attention to certain roles within the relational structure. For instance, in order to conceptualize a hypotenuse, which is the side opposite to the right angle in a right triangle, one cannot simply conceptualize a line by itself but also has to conceptualize the triangle (Figure 2). The word "hypotenuse", therefore, evokes a conceptual base of a right triangle, which can be considered a structure of three lines that share a certain spatial relation, and profiles one specific line within this structure.

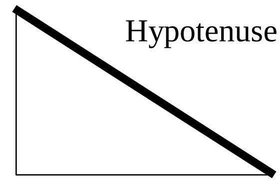

Figure 2

In addition, the analyses incorporate the Cognitive Grammar framework with Barsalou's Perceptual Symbol System framework, a sophisticated implementation of concept empiricism / grounded cognition. As Langacker (1999) points out, Cognitive Grammar is broadly compatible with PSS. Cognitive Grammar argues that linguistic meanings are grounded in bodily experience and places great emphasis on the conceptual constructs that underlie meanings. In Cognitive Grammar, grammatical constructions and many lexical items are considered to have highly schematized representations (or **schemas**) that underlie their meanings. PSS, on the other hand, proposes that deep processing of the meanings of linguistic units involves simulations, which contain mental representations of what the linguistic units refer to. While Cognitive Grammar provides us with the tools to describe the semantic structures of the polysemy networks in a linguistically precise way, PSS allows us to further explore the representations of these semantic structures in a way that is psychologically plausible and consistent with the tenets of concept empiricism. This incorporation of the two frameworks is can be considered a kind of simulation semantics approach to linguistic meaning, which stands the view that simulation is involved in the construction of linguistic meanings. However, unlike the current approach, which equates the deep processing of linguistic meaning with simulation, many simulation semantics literatures remain reserved on whether simulation is necessary for meaning construction (Pulvermüller, 2003; Pecher & Zwaan, 2005; Bergen, 2012, 2015). Moreover, studies on simulation semantics have focused exclusively on concrete meanings and few have explored in detail the construction of abstract meanings through simulation, a vacuum that this thesis attempts to fill in.

Under this incorporation of the two frameworks, the conceptual base evoked by a sense can be considered a category encoded by a simulator. The profile of the sense is then another category encoded by another simulator. Such a simulator contains a variety of individual representations, which can be integrated to produce an idealized representation of the category or one that is appropriate to the context. These constructed representations are temporary and change with the context or situation in which it is produced (Barsalou, 1999, 2005). Furthermore, the individual representations stored in the simulator can be abstracted to produce **schematic representations** of the category. Such representations are abstractions that contain only the critical features of the category – features that characterize the category and distinguish it from other categories – and filter out the sensorimotor details (Barsalou, 1999). While schematic representations are also temporary and dependent on the context or situation, they are more stable comparing to detailed representations in two ways. First, because schematic representations only contain critical features of the category, there are less features to choose from and the variety of presentations that can be constructed is more limited. Second, once a temporary abstraction is constructed online, a record of it is stored in the simulator and the same abstraction is more likely to be constructed again in the future (Barsalou, 2005).

In the upcoming analyses, a **schematic construct**, equivalent to the schema in Cognitive Grammar, is proposed for the main conceptual contents (including the conceptual base and/or profile) evoked by each sense in a polysemy network. In this thesis, the term "construct" is used to refer to any conceptual type (i.e. a collection of related representations) that might or might not be an entrenched category. A schematic construct, therefore, is an abstract model that can be instantiated by a collection of alternative schematic representations in simulation. The schematic constructs proposed in the analyses are aimed to be highly generalized models that can account for most instances of their corresponding categories. While these constructs are useful for diagnostic purposes, they might not underlie what people actually construct to represent the conceptual bases/profiles in question. Since the proposed schematic constructs are highly generalized models of their corresponding categories, their internal structures (i.e. relations between conceptualized sub-regions of the construct) can serve as models of our intuitive theories of these categories. In this sense, the schematic constructs proposed are similar to Fillmore (1982, 1985)'s notion of frames and Lakoff (1987)'s idealized cognitive models, both of which provides accounts on the complex knowledge structures that underlie our theories of concepts. In the analyses, the internal structures of the proposed schematic constructs are analyzed by identifying the roles they contain and breaking the constructs down into smaller component constructs. The analyses then explore how these smaller constructs can be represented in simulation using the method proposed in Barsalou (1999) (see the TRUTH example in Section 3.1).

7. Case studies

In this section I analyze two lexical items that have senses with different degrees of abstractness. The analyses generally follow five steps: 1. Identify the senses of the word that might share extension relations; 2. Analyze the main conceptual contents evoked by each sense and propose a schematic construct; 3. Analyze the internal structure of the schematic construct; 4. Analyze how the schematic construct can be represented in simulation; 5. Identify the overlaps between the schematic constructs of the senses that might share extension relations. Attested data recruited from Corpus of Contemporary American English (COCA) are used to help with the first two steps. Comparisons between attested usages help distinguish between different senses and serve as the basis for proposing a schematic construct for each sense. The schematic construct is then applied to a large number of attested usages to test its validity. In the analyses, a few examples of each sense are listed for illustrative or diagnostic purposes. All of these examples are taken from the attested data recruited from COCA and are actual usages within the American English community.

7.1 Between

The first lexical item examined is the preposition “between”. With the help of attested data from COCA, four senses of the preposition “between” are identified (see (2)). While Sense I is the most perceptually salient and is most likely the prototype, Sense IV is the most abstract and differs the most from the other senses.

(2) I. Within a region bound by two objects or regions

II. Within a period bound by two moments or periods

III. Within an interval on a scale bound by quantities or qualities

IV. An abstract event/relation/entity is based on two entities/relations/events

7.1.1 Sense I

The first sense of “between”, as in (3), is spatial in nature. It is used to talk about the location of something in relation to the locations of two other things.

(3) Within a region bound by two objects or regions

a. When it's new, the Moon is **between** the Earth and Sun.

b. I strung a steel cable **between** the two oaks.

The conceptual base of this sense can be considered a spatial relation in which an entity is located within a linear region that has two other entities as its boundary. The linear region here is a quite superordinate category and refers to a single dimension extracted from any region, regardless of whether the region is one, two, or three dimensional. For example, the linear region can be a straight line in space (e.g. "between the two oaks"), a straight line on a surface (e.g. "between every two angles of a pentagon"), or a straight line in a two-dimensional projection of space (e.g. "between the two stars on the star map"). Depending on the context, this relation can have two variations when further specified – the entity in relation to the linear region can either take up a small part of the region ((3)a) or stretches across the region ((3)b).

In addition to the conceptual base, two other things about the conceptual contents evoked by this sense should also be taken into account – its profile and trajector-landmark alignment. In this case, the profile of the sense is the same as its conceptual base – a spatial relation that involves the locations of three entities. This relation contains three roles – an entity that is being located, an entity whose location serves as one end of a linear region, and an entity whose location serves as the other end of the linear region. I refer to these roles as 1) *target*, 2) *landmark A*, and 3) *landmark B*. A profile can be considered the part of a conceptual base that is being highlighted (i.e. attended to) while the rest of the conceptual base remains hidden in the background. When the profile is a relation, the attention is distributed to the roles in the relation. The roles can be considered are sub-regions of a construct that are conceptualized after being repeatedly attended to and are therefore attention-capturing (Barsalou, 1999, 2003, 2005). When the distribution of attention is uneven among the roles, the role of primary attention is labeled as the **trajector (TR)**, and the role(s) of secondary attention is labeled as the **landmark (LM)**. Usually, the trajector is conceived as the entity that is being located, described or evaluated, while the landmarks are, although less attended to, necessary for conceiving this entity in a certain way (Langacker, 1987, 1991, 2007). In the case of Sense I, *target* is the TR while *landmark A* and *landmark B* are the LMs.

Now we have arrived at a full schematic construct of the main conceptual contents evoked by Sense I (including the conceptual base, profile, and TR-LM alignment) – a primary focal entity is located within a linear region whose boundary consists of the locations of two secondary focal entities. This construct can be broken down into at least two smaller constructs. The first construct is for the linear region, which can be further broken down into two endpoints and the middle region. The second construct is for containment, where an entity is inside the spatial boundary of another entity. A graphic illustration of this internal structure of the schematic construct is provided in Figure 3. The bold box in the figure stand for the complex construct constructs. The rest of the boxes stand for the component constructs and the lines between the boxes stand for instantiations. The proposed schematic construct, therefore, can be considered to contain three focal roles that instantiate (i.e. can be interpreted by) two smaller constructs. First, the two landmarks instantiate the two endpoints (which are locations that can be occupied by entities) in the linear region construct. The then target instantiates the contained entity in the containment construct and the linear region

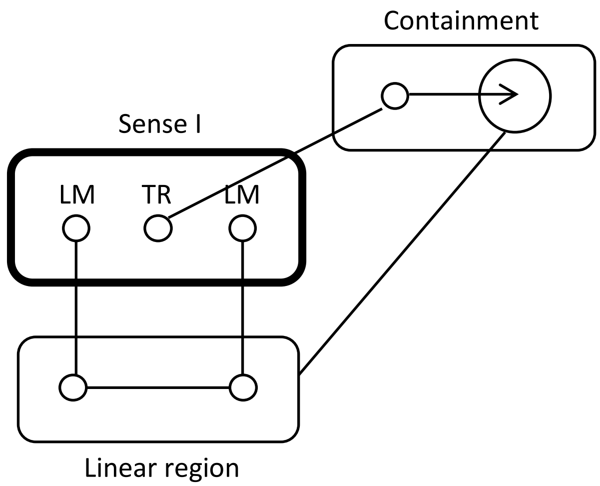

Figure 3

construct (instantiated by the LMs) instantiates the container. Furthermore, the TR-LM alignment should also be considered a construct that the roles instantiate. This instantiation is merged into the complex construct in Figure 3 so as not to overcomplicate the illustration.

In simulation, a representation of this proposed schematic construct can be thought of as representations of the smaller constructs embedded in each other. Frist, the representations of the TR and LMs might involve an introspective state in which some sub-regions in a structure are given less attention than some other sub-regions during perception. The representations of the two LMs then are embedded in (i.e. filling up an unspecified sub-region of) a representation of the linear region as the endpoints of an unspecified region in a single unspecified dimension. In a schematic representation of the linear region, only the relative locations of the endpoints are contained in the representation while details such as the distance between the endpoints or the exact locations of the endpoints in the background are filtered out (Barsalou, 2003, 2005). This is possible due to the ability of our neurons to code information qualitatively (Barsalou, 1999). Then, the representations of the linear region and the TR are embedded in a schematic representation of the containment construct, in which the boundary of an unspecified entity is within the boundary of another unspecified entity. In the total representation, the TR and LMs possess positions on the linear interval, making them spatial entities can be located in space. A schematic representation of a spatial entity can contain only an unspecified entity that has an unspecified location in space while the shape, size, and exact location of this entity are filtered out.

Furthermore, the schematic representation proposed above can serve as a base representation that can be further instantiated by more detailed representations through embedded simulation (Barsalou, 1999). The construction of the total representation can fail if features in the detailed representations are in conflict with the features in the base representation, such as when the absolute locations of the entities are in conflict with the relative locations provided in the base simulation (e.g. *"between the sun and the sun"). In other words, the simulator of the base representation provides enough information about the roles that their instantiations are naturally restricted to those that are compatible with this information.

7.1.2 Sense II

(4) Within a period bound by two moments or periods

a. Johnson died sometime **<u>between</u>** the afternoon of Jan. 10 and the morning of Jan. 11.

b. The students arrived in Canada **<u>between</u>** the fall of 2009 and the spring of 2011.

The second sense of “between” as in (4) is temporal in nature. Like in Sense I, the conceptual base and profile of Sense II cover the same conceptual contents – this time, a temporal relation in which a time is contained within a period with two times as its boundary. Here, “time” can either be a moment (no internal structure) or a period (has internal structure), both of which are portions of time that can be located in a greater temporal background. Again, this relation contains three roles – a time that is being temporarily located, a time whose temporal location serves as one end of a period, and a time whose temporary location serves as the other end of the period. I refer to these roles as 1) *target*, 2) *start time*, and 3) *end time*. While *target* is the TR, *start time* and *end time* are the LMs. Like in Sense I, this schematic construct can be broken down into two smaller constructs that the roles instantiate plus the TR-LM alignment. The first construct is for period, a type of time portion that can be broken down into a start time, an end time, and the time in the middle. The second construct is for containment. Different from but similar to the containment construct in Sense I, the containment here refers to the state where a portion of time is inside the temporal boundary of a period. The instantiation relations in this internal structure are identical to those in Sense I.

Again, to simulate the proposed schematic construct, we can simulate the smaller constructs it consists of and embed their representations in each other. The representation of a moment is the most straight-forward and consists of a single state of affair. The representation of a period then consists of a bundle of consecutive states of affairs, which can be further sectioned into a start time, a middle time, and an end time, with a time being either a single state of affairs or consecutive states. Schematically, these representations can contain unspecified state(s) of affair against the background timeflow while filtering out details such as the things contained in the state(s). A schematic representation of a time portion then can be a more abstract version of these representations in which the singularity and plurality of the state(s) are filtered out. A representation of the containment construct in Sense II can be similar to that in Sense I, with the entities and their boundaries replaced by time portions and the boundaries of periods in time. Finally, the TR and LMs can again be represented with an introspective state in which some roles in a relation are given more attention than some other roles in perception.

Furthermore, the simulation of a period can take place in a couple of ways. First, the simulation can take place dynamically, simulating one changing state of affair as it unfolds in time. For example, to simulate the period of a day, one can simulate the sky as it changes from sunrise to noon, to sunset, and to night. Alternatively, the simulation can take place statically, simulating states of affairs at different moments in a summary fashion (Langacker, 1987, 1992; Talmy, 1988, 2000; Tyler & Evans, 2003). In this case, the period of a day can be simulated by juxtaposing the sky at different moments of a day in a sequential order. One can understand the difference between the two ways of simulating time as the difference between the playing of a strip of films and the strip of films itself. While the former is perceived as a single moving picture, the latter is perceived as static frames juxtaposed next to each other. Cognitive linguists believe that while verbs evoke relations that are represented dynamically, spatial particles like "between" evoke relations that are represented statically (Langacker, 1987, 1992; Talmy, 1988, 2000; Tyler & Evans, 2003). Yet another possibility is to simulate using metonymic representations. For example, the season fall can be simulated metonymically using a representative image of falling leaves in the park. In this case, the simulation might involve both a detailed simulation of the image and an unspecified simulation of the period in which the image is located. This type of simulation can be distinguished from the construal of a period as a moment, where the states of affairs that constitute the period are conceived as a single state of affair and the internal structure of the period is not simulated.

As we can see, the schematic constructs proposed for Sense I and Sense II are very similar. Both are relational structures that involve three unspecified roles with two of them being the LMs and one of them being the TR. More specifically, both constructs involve an interval that has the two LMs as its two end-points. In Sense I, the interval is a linear spatial region bound by two objects or regions, while in Sense II, the interval is a time period bound by two moments or periods. Filtering out the differences between the two relational structures, we now have **an overlap between Sense I and Sense II**: a relation structure with three roles, two being the LMs that serve as the two ends of an abstract interval and one being the TR that falls within the interval. Just like the constructs of Sense I and Sense II, this relation can be broken down into smaller constructs – one for an abstract interval, and one for containment. The abstract interval here is a continuum of unspecified elements that vary continuously in a single dimension. The containment here is also an abstract one that refers in general to the inclusion of any conceptual contents within other conceptual contents. When this abstract construct is further specified, the instantiations of the three roles are restricted to those that possess the dimensions that the interval is based on. In Sense I, the roles are restricted to anything that can be spatially located, and in Sense II, anything that can be temporally located. In addition to the interval and the roles, there are a few other things that are unspecified in this abstract construct: 1. the directionality of the interval (e.g. bidirectional in space, unidirectional in time), 2. whether each of the roles takes up a single element or multiple consecutive elements in the interval, and 3. Whether the TR can occupy the entire interval (including the elements occupied by the LMs) or can only occupy the middle part of the interval. Like the interval and the roles, these uncertainties are resolved by the instantiation of the structure, which provides more information that helps settle on a specific model.

7.1.3 Sense III

(5) Within an interval on a scale bound by two quantities or qualities

a. The close reading typically lasted **between** 40 and 55 minutes.

b. The Saloon Steakhouse rating falls somewhere **between** fair and good

c. Becky made a face, somewhere **between** a smile and a grimace.

The conceptual base and profile evoked by third sense (as in (5)) involves an interval on a scale that is bound by two things. While a scale can consist of pre-conceptualized points within the scale that vary evenly in quantity or quality ((5)a), it can also be vague such as the example in (5)b. In this example, only the two ends-points of the interval are specified and no pre-conceptualized points with specific values are presumed to exist between them. Nevertheless, we know that there exists a continuum between "fair" and "good" and the rating falls on an unspecified point within it. A scale can also be creative like in (5)c, where the end-points are not typically associated with points on a scale but can be used to create one. In this example, the scale created by “smile” and “grimace” is most likely based on variation in the degree of naughtiness perceived from a face. Because all the points on a scale must possess the same type of quantity or quality, they can accordingly be categorized as the same category. While some of these categories are more entrenched (e.g. rating, facial expression), some are more ad hoc (e.g. length of time period), applying only to a small number of situations such as the scale.

A schematic construct for this sense is then a relation in which something falls within an interval on a scale that has two other things as its boundary. Again, this relation has three roles with the same TR-LM alignment in the previous senses. I refer to these roles as 1) *point A*, 2) *point B*, and 3) *target*. These roles are not restricted to any specific category but all possess and vary in the dimension that the scale is based on. This dimension can either be a quantity or quality, both of which refer to a particular aspect of things in a particular state. Because of this, each of the roles can only take up a single element in the interval. In Sense I and Sense II, the intervals are based on variations in spatial or temporal locations and it is possible for something to occupy more than one spot or one moment. In this sense, however, the interval is based on variations in quantities or qualities and it is impossible for something to have more than one quantity or quality (of the same dimension) at the same time. The internal structure of this construct is similar to that of the schematic constructs in the first two senses and the explanations are not repeated here. The simulation of this construct is similar to that of the temporal relation in Sense II. The sequential nature of scales determines that they are understood in a way similar to how time periods are understood. To simulate a scale, one can simulate a series of elements juxtaposed in an increasing or decreasing order with respect to the quantities or qualities that they possess.

By now, we can see that the first three senses of "between" are closely related in terms of their structures. The **overlap between Sense I and Sense III** is the same with that between Sense I and Sense II – a relation containing three roles, two being the LMs that serve as the two ends of an abstract interval and one being the TR that is confined to the interval. The first three senses, therefore, share the same skeletal conceptual structure and can be considered a "cluster" within the polysemy network. In addition, Sense I is most likely the prototype that Sense II and Sense III extend from. The main reason for this claim is that Sense I is spatial in nature, meaning that it is the most perceptually salient and therefore most likely to be acquired first. This claim is also supported by the spatial metaphors that we use to help us understand Sense II and II. Oftentimes, temporal periods and scales are represented graphically as lines between two points. We see this in artifacts such as timelines, meters, and all kinds of measures. All of these are achieved by projecting a spatial interval onto a time period or a scale interval. The result is a metaphorical "blend", in which the interval is represented by a line and the elements within the interval are represented by solid points on the line. This kind of spatial metaphors is also closely related to the static representations of Sense II and III, in which the elements of the interval are "juxtaposed" next to each other in a sequential order. The "juxtaposition" here implies a spatial metaphor and also reveals the deep connection between time and space – that time is conceived as space in motion (i.e. changes in spatial beings). Because both observing a display of changing elements and scanning through elements juxtaposed in space involve motion, we are able to represent time periods and, similarly, scale intervals in a static way through juxtaposition.

7.1.4 Sense IV

The last and most abstract sense of "between" is vastly different from the first three senses. The fourth sense no longer evokes an interval. Instead, it evokes an abstract relational structure that can have a variety of instantiations. Consider the examples in (6). Each of these usages of "between" evokes a different type of relation. For example, while (6)a evokes an event involving linguistic exchanges carried out by two interlocutors, (6)b evokes a statistical relationship involving two quantitative entities. Despite the differences, these usages should not be considered distinct senses because their meanings depend greatly on the context – that is, the noun or verb that precede the preposition, which introduces a schema from which the specific meaning of the preposition is derived. Instead, they should be considered different instantiations of one sense, which, in this case, has a basic meaning that is very vague and abstract.

(6)

a. Conversations <u>**between**</u> the teacher and children
b. A negative relationship <u>**between**</u> frequency of engaging in Facebook chat and time spent preparing for class
c. She saw that she had to choose <u>**between**</u> her talent and her life.
d. The secret <u>**between**</u> mother and son went on for months
e. There is a great difference <u>**between**</u> thinking about doing something and documenting the plans to do it.

(7)

a. A fight **between** father and son

b. *A beating **between** father and son

In order to explore this highly abstract basic meaning, it seems more tractable to start from identifying **the overlap between this sense and the prototype**. First of all, both Sense I and Sense IV evoke a relation that contains two roles that are the LMs. Regarding these two roles, we can say that they possess equal statutes in the relation – that is, they belong to the same category defined by the relation. For example, both of the LMs in Sense I are the end-points of the spatial interval and can be considered instances of the category ENDPOINT. The definition of this category is given by the relation that Sense I evokes, which contains a spatial interval that consists of an interior, an exterior, and two points that serve as the boundary. Similarly, the teacher and children in (6)a also belong to the same category INTERLOCUTORS and the talent and life in (6)c belong the category OPTION and so on. This feature of Sense IV is the reason why the usage in (7)a natural while the usage in (7)b is not. Second, the overlapping structure has a TR that is something other than the LMs in the relation. For Sense I, the TR is a role whose spatial location falls within the spatial interval. For Sense IV, the TR can either be a role other than the LMs in the relation or the relation itself. The former is illustrated by (6)d, where the TR is a piece of information known only by the LMs (keepers of the secret), and by (6)e, where the TR is the parts that the LMs (things being compared) do not have in common. The latter is illustrated by the rest of the examples in (6), where the TR can be an event ((6)a&c) or static relation ((6)b) that contains the LMs. Now we know that the overlap is an abstract relation that contains two LMs of the same category in the relation and an unspecified TR. In order to account for how the examples in (6) come to be recognized as instances of the same sense, we still need to know more about how the TR and the LMs are related in the basic meaning of the sense.

Another observation about the overlap is that the LMs provide specifications on the TR. In Sense I, the two LMs provide a mean to narrow down the spatial location of the target by serving as two reference points of a linear region, where TR is contained. When we specify the locations of the reference points, we also specify the location of the linear region and therefore specify the location of the TR. An abstracted version of this relation between the TR and the LMs also exist in Sense IV, where the LMs serve as two reference points of an unspecified relational construct and the TR is either contained within this construct or is the construct itself. For example, the interlocutors in (6)a can serve as two reference points of a conversation. Specifying the interlocutors also specifies the conversation.

The question then comes: why are the interlocutors the ones that serve as the reference points of the relation? Why the two roles of the same category instead of other roles within the relation? One reason might be that falling under the same category makes these two roles stand out from the other roles in the relation. A more important reason, however, might be that the information provided by these roles is minimal yet sufficient for constructing a detailed representation of the relation. For example, the locations of two endpoints are sufficient for constructing a representation of a linear region with a specific location and orientation. On the other hand, if we were to construct the representation using the middle region, we might need to specify the entire middle region holistically. Similarly, while the identities of the interlocutors already contribute greatly to a detailed representation of the conversation, they also allow us to infer other information about the conversation, including the possible content of the conversation, and the possible motive for having the conversation etc., based on our knowledge of the interlocutors. In sum, these reference points can be considered scaffoldings that allow us to maximally construct the details of a representation with minimal mental resources to begin with.

Right now it seems that the observations above about the overlap between Sense I and Sense IV are already sufficient for accounting for the basic meaning of Sense IV – an unspecified relation in which two roles of the same category within the relation are the LMs and either the relation itself or another role in the relation is the TR; in addition, the LMs are also the reference points for constructing representations of the relation. This means that the entire basic meaning of Sense IV is an abstraction of the prototype, which might be a result of repeated metaphorical usage as explained in the career-of-metaphor account (Bowdle & Gentner, 2005). The fact that the reference points of the unspecified relation are two roles of the same category reveals the nature of this relation and the relations that instantiate it – the situation it refers to contains two things that are involved in similar activities. In fact, the relation itself is a construal of the two things as belonging to the same category under the situation it refers to. For instance, the "talent" and "life" in (6)c might not be considered belonging to the same category under most circumstances. However, the CHOOSING relation refers to a situation in which these two things are involved in similar activities – namely, being potentially chosen by an agent. For this reason, we can categorize "talent" and "life" in this specific situation as the category OPTION.

(8) More than two LMs

a. But **between** the three of us, the four of us, the ten of us, maybe we can come to an understanding.
b. * There is a tree **between** the house, the river, and the car.
c. * The students arrived in Canada **between** the fall of 2009, the spring of 2011, and the fall of 2011.
d. * The close reading typically lasted **between** 40, 55, and 60 minutes.
e. * A negative relationship **between** frequency of engaging in Facebook chat, time spent preparing for class, and test score
f. The barriers **between** the three houses that Valois owned had been taken down
g. Highly significant differences **between** the three genotypes

While the number of reference points designated by the sense is usually two, it can also be extended to three or more (see (8)a). Note that this is not possible in the previous senses or in some instantiations of Sense IV (see (8)b-e). In these cases, the relations evoked have two reference points and two reference points only. Sometimes, even if the linguistic form designates more than two LMs, the relation evoked still only contains two reference points (see (8)f&g). In this case, the linguistic form refers to a situation where there are multiple relations, each have two reference points. Another interesting case is the relation implied by the word "secret". While a secret can be known to any number of people, it can also be known to no one and still be considered a secret (e.g. "the secret of the universe"). When the number is one or zero, Sense IV no longer applies. Therefore, we can assert that while a typical relation evoked by Sense IV has two reference points, the number can be extended to more than two in some situations but cannot be extended to less than two.

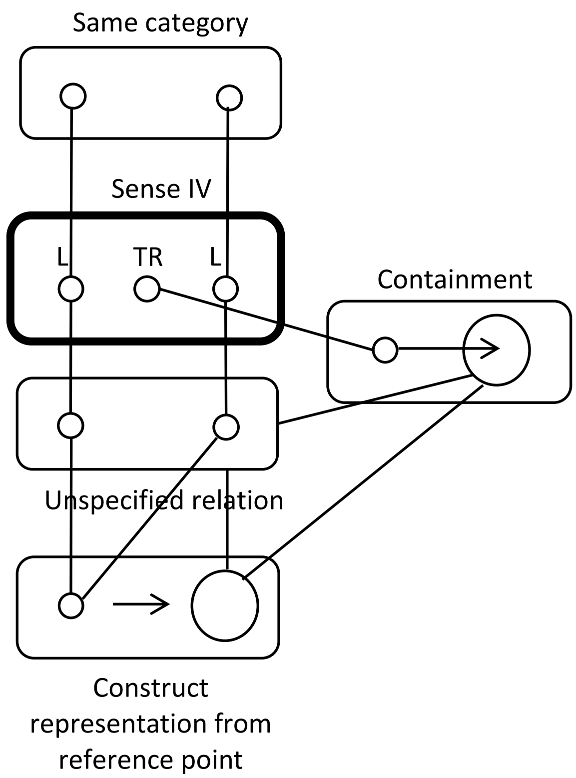

Figure 4

The schematic construct of basic meaning as described earlier can be broken down into three roles and a few smaller constructs (see Figure 4). I refer to the roles simply as the TR and the LMs. This schematic construct contains two more component constructs than the previous ones – one for being categorized as the same category and one for constructing representations the relation from reference points. Although unexamined in the previous analyses, these two constructs also apply to the first three senses and can be added in the previously proposed schematic constructs. The simulations of these new constructs rely on introspective states. The process of categorization involves activating simulators to interpret representations during perception or simulation (Barsalou, 1999). Categorizing multiple things as the same category then can be simulated using an introspective state in which multiple representations are interpreted by the same simulator. Similarly, constructing representations from reference points can be simulated using an introspective state in which a simulation starts with one or more partial representations of a construct and then expands to a complete representation. Finally, the case where the TR is the unspecified relation itself can be considered an atypical case of containment, where a bundle of conceptual contents is no longer a portion of but the entirety of another a bundle of conceptual contents. In simulation, containment can be represented with an introspective state in which a bundle of conceptual contents are detected within the background of another bundle of conceptual contents.

7.1.5 Summary

In this case study, four senses of the preposition "between" are identified and analyzed. Among these senses, Sense I is the most perceptually salient and seems to be the prototype that the other senses extend from. The conceptual contents evoked by the first three senses seem to share great structural similarity – all of them seem to contain the construct of an abstract interval. An interval is a continuum that consists of consecutive elements that vary in a certain dimension and is bound by two elements or bundles of elements at the two ends. In Sense I, the interval is implemented by a one dimensional spatial region bound by the locations of two spatial entities; in Sense II, the interval is implemented by a time period bound by two moments or periods; in Sense III, the interval is implemented by a scale bound by two quantities or qualities. This overlapping structure allows metaphorical projections from the prototype to Sense II and Sense III, resulting in the visual presentations of timelines and scales that we are familiar with. Sense IV covers a variety of abstract usages of "between" and has an abstract basic meaning that involves two similar roles in a relation serving as the reference points from which representations of the relation is constructed. This basic meaning is entire derived from the conceptual contents evoked by the prototype and is therefore also the overlap between Sense I and Sense IV.

7.2 Connect

The second polysemy item examined is “connect”. In the search for attested data, I included not only the verb “connect” but also the noun “connection”, past participle “connected” and present participle “connecting”. While these forms belong to different word classes, they differ not in the conceptual contents they evoke but in the way they construe the contents (Langacker, 2002), meaning that they share the same conceptual bases but differ in their profiles and TR-LM alignments. As a result, the usages of all these forms can be accounted for using a single polysemy network where every sense evokes a conceptual base that can be construed in different ways. To keep the analysis manageable, this case study only accounts for the conceptual bases evoked in this network and the overlaps between these conceptual bases.

Attested data from COCA reveals that “connect” and its variations have a vast variety of usages. Unlike in the fourth sense of “between”, where different usages instantiate the same basic meaning, many of these usages seem to have their own basic meanings. Instead of attempting to identify all the distinct senses and their extension relations within the network, I focus on identifying specific extensions that help us understand the perceptual basis of some of the abstract constructs in the network. In this analysis, I identified two tracks of extension, referred to as the free transfer track and the function-relation track.

Both tracks originate from a same perceptually salient sense – the structural sense (see (9)), which evokes a relation in which two objects are structurally joined together. By structurally joined together, I mean that two objects are stably fixed onto each other (e.g. through cohesion, lock, or blend) and cannot be easily separated, so that they can be perceived as two major components within one continuous structure. This sense could be an extension from another sense where two objects only have contact with each other but are not structurally fixed (see (10)).

(9) Structural connection

a. A short lever is attached to the handle and <u>**connected**</u> to a second, curved blade.

b. And there are other knee structures – such as tendons (which <u>**connect**</u> muscle to bone)

(10) Contact

a. The thin shell of an aluminum bat compresses or bends inward when it <u>**connects**</u> with the ball

The schematic construct of the structural sense contains three roles: 1) *object A*, 2) *object B*, and 3) *junction*. The junction is located between the two objects and can either be a contact area (e.g. between the handle and blade in (10)a) or a middle object that have fixed contacts with the two objects (e.g. the tendon in (10)b). An illustration of the internal structure of this construct is given in Figure 5. A representation of a fixed contact

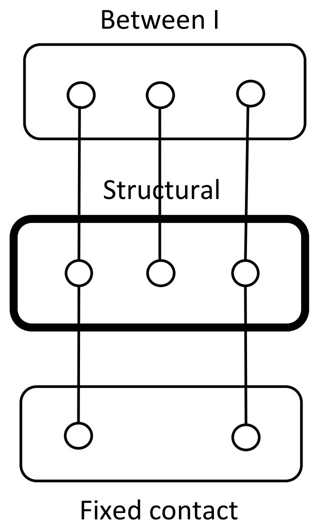

Figure 5

should contain 1. the structural continuity between the objects, and 2. the stability of the continuity. With the help of introspection, the structural continuity can be represented as a situation in which there is no detection of gaps when mentally scanning from one object to the other. The stability of the continuity, on the other hand, can be represented as the status of the continuity after attempts to break it (i.e. create a gap between the two objects), usually by applying forces to move the objects or the middle object. If the continuity remains intact after minor attempts to break it (what is minor is relative to elements such as the mass of the objects), the continuity can be considered stable and the two objects can be considered fixed to each other.

7.2.1 The free transfer track

(11) Spatial connection

a. Back when houses were small and cold the Keeping Room was the center of the home with a large fireplace, **connected** to the kitchen

b. The walkway **connects** the second-level spaces, spanning between the designers' office and a guest suite with a triangular shower stall in the bathroom.

c. Both the mouth and the nose are **connected** to the breathing tube

The first sense in the free transfer track is spatial connection, which evokes a relation in which two bounded spaces are joined together (see (11)). This relation most likely extends from a special case of structural connection where the insides of the two objects connected are hollow and open (e.g. (11)c). The three main roles in this relation – 1) *bounded space A*, 2) *bounded space B*, and 3) junction – are both structurally and spatially joined with each other. The bounded spaces are either fully or partially enclosed by surfaces (e.g. rooms, yards) have both structural and spatial continuity between them. The junction can either be an opening between two adjacent bounded spaces (e.g. a door between two rooms) or a third bounded space that share openings with two non-adjacent bounded spaces (e.g. the walkway in (11)b). In simulation, the spatial continuity can be represented as a situation where mental scanning reveals no interception between the two bounded spaces. The spatial continuity between bounded spaces affords that objects can move freely between them, hence the name of the track "free transfer".

(12) Transportational connection

a. With no paved roads to **connect** it to the rest of the country until the 1960s, this small but sophisticated enclave in the southern Andean highlands has remained off the tourist's beaten path

b. The 130-foot-long Quarry Garden Bridge now **connects** the museum to the Swan House mansion

c. Two daily flights **connect** the town to Reykjavik

The second sense on the track inherits the free transfer feature of the spatial sense and filters out its structural and spatial features. This sense, called the transportational sense, evokes a relation in which free transfers of objects take place between two locations through a means. The means can be anything that enables transportation between two locations, including roads ((12)a), bridges ((12)b), other infrastructures, and vehicle activities ((12)c). While the transportational sense overlaps with the spatial sense in terms of the free transfer of objects, it also covers situations that do not involve or emphasize the structural and spatial connection in the spatial sense. For example, in (12)a, although the enclave and "the rest of the country" can be considered regions that are separate from its surrounding space, neither of them is a typical bounded space enclosed by surfaces and are not structurally joined with the paved roads. Therefore, this usage is not an instance of the spatial sense but an instance of the transportational sense instead. The usage in (12)b, on the other hand, instantiates the structural sense and the transportational sense at the same time as the bridge structurally connects to the buildings and affords transportation between the two locations. This usage, however, might not be a typical instance of the spatial sense because the bridge might or might not be considered a bounded space depending on its design (e.g. whether it is surrounded by railings and ceiling).

A schematic construct for this sense consists of three roles – 1) *location A*, 2) *location B*, and 3) *means* – and two component constructs – one for the free transfer of objects and one for enabling (see Figure 6). In simulation, the free transfer of objects can

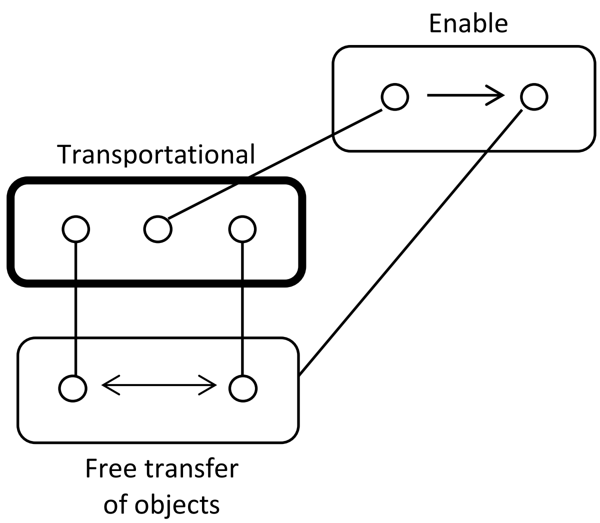

Figure 6

be represented dynamically as one state in which an object is at one location followed by another state in the same object is at another location. The enabling construct can be represented as a pattern of asymmetrical co-occurrence between the enabler and the enabled. In perception, we might perceive the enabler without perceiving the enabled but not vice versa. For example, we can perceive a bridge by itself without also perceiving transportations between the locations at the two ends of the bridge but we never perceive the transportations without also perceiving the bridge (e.g. when the bridge collapses).

(13) Communicational connection

a. The secure telephones that **connect** him with his command and with Washington

b. **Connect** the two computers with remote-control software, for instance, and anything you type on the keyboard of the guest appears on the screen of the host

c. Wireless fidelity, or Wi-Fi, is a type of network that lets anyone with a properly configured laptop **<u>connect</u>** to the Internet through a wireless signal.

The next sense on the track is the communicational sense, which evokes a relation in which there exists unobstructed communication between two communicators. In this relation, the free-transfer of physical entities shared by the first two senses is extended into the free transfer of information and the three main roles are now 1) *communicator A*, 2) *communicator B*, and 3) *means*. The communicators do not need to be human or agentive but can also be non-agentive such as computers and the internet ((13)d). Similar to the means in the transportational sense, the means in this sense enables the free transfer of information from between communicators and can be instantiated by a variety of things such as device ((13)a), software ((13)b), and media of transmission ((13)c) etc. In other words, as long as something plays a major role in the establishment of communication in a specific situation, it can be construed as the means of a communicational connection.

In this extension of the free-transfer construct, the spatial and material features of physical transportation are almost completely filtered out and replaced by epistemic ones. Although information does usually travel physically through some sort of media from one location to another, these physical aspects are no longer emphasized and the focus is now on the possession and transmission of information. The overlap behind this extension is very abstract and can only be examined at the simulation level. First, at the beginning and end of a transfer, the thing being transferred (referred to as the "transferred"), either an object or a piece of information, is present in a location or is possessed by a communicator (referred to as the "ground"). The overlap between these two states is that the transferred and the ground constitute a figure-ground relation so that the transferred can be construed as contained within the ground. The transfer can then be represented as the process in which the transferred is initially present within one ground and is subsequently present within another ground.

By now, we can see that **all the sense on this track of extension share the overlapping structure** that a means enables the free transfer of a figure between two grounds. While the implementation of this structure is concrete and strictly physical at the beginning of the track, extensions down the track gradually filter out the physical features add in features that are abstract and metaphysical. Finally, this track might not stop at the communicational sense and might extend to senses that are more abstract. One possibility is a mental or empathetic sense of connection, which involves the transfer of thoughts and feelings from one person to another (see (14)).

(14) Mental/empathetic connection

a. We were good friends, and we did have a **connection**, we did make each other, you know, feel better in times of crisis, and we just let it go.
b. He is someone to whom they feel emotionally **connected**

7.2.2 The function-relation track

(15) Functional connection

a. By failing to **connect** the lap belt, a passenger could *submarine beneath the restraint during a collision and be thrown from the car
b. I jogged on the beach and listened to the sounds around me, not music piped through earbuds **connected** to a phone.

c. The systems can take hours or days to perform the initial backup, but from that point on, whenever you're **connected** to the Internet, they constantly update the stored version to reflect what's on your computer

The first sense in this track, the functional sense, extends the structural sense to an entirely different direction. Observe that objects are often structurally connected to fulfill certain functions. For example, in (15)a, the seat belt and the socket are not only structurally connected to each other but also work together to trap the passenger in the seat at times of sudden stop. The seat belt and the socket, therefore, are functionally connected through their structural connection. However, it is not always necessary for two things to be structurally connected in order to be functionally connected. For instance, in (15)b, the earbuds and phone work together to enable the playing of music but they might not be structurally connected to each other (e.g. the earbuds are wireless). Furthermore, the things that are functionally connected do not even need to be physical. The internet, for example, is an abstract entity that involves information stored in servers and complex interactions between servers and terminals. In (15)c, the computer and the internet together enables the backups of files and therefore can be considered functionally connected. The functional sense, therefore, evokes a relation with two main roles – 1) *connected A*, and 2) *connected B* – that work together to fulfill a function. Note that the connections in (15)b and (15)c can also be interpreted as communicational connections where 1) and 2) are connected by the free transfer of information between them. Like many other usages we saw earlier, these two usages can be considered vague in the sense that they are capable of instantiating multiple senses within the network.

In order to propose a representation for the functional sense, we need to further examine what it means for two things to work together to fulfill a function. First, the fulfillment of function can be considered involvement in goal-directed activities. Consider (15)a again. Although the functional connection between the seat belt and the socket is realized through their structural connection, the structural connection is not what makes them functionally connected. Instead, the seat belt and the socket are functionally connected because they are involved in the activity of trapping the passenger in the seat, which is directed toward the goal of preventing the passenger from crashing into the windshield. Second, the two things that are functionally connected are each involved in a subpart of the activity. When trapping the passenger in the seat, the seat belt catches the passenger when he/she flies toward while the socket holds the seat belt to the seat. In other words, the seat belt and the socket each has its own function that serves as a subpart of the greater function. This point is more evident in (15)b, where in the activity of playing music, the phone is used to select the music and control its playing while the earbuds generate the sound (or alternatively, the phone sends out coded signals of the music while the earbuds receive them and convert them into sound). Therefore, we can say that the functional sense evokes a relation in which two things are involved in a goal-directed activity and each of them is involved in at least one subpart of the activity.

With the conceptual base re-interpreted in a representation-oriented way, we can now move on to its actual representation in simulation. First, a goal can be represented as a specified end-state of an unspecified event. For example, if playing music is the goal, then the activity that leads to the goal would always end with the state in which music is

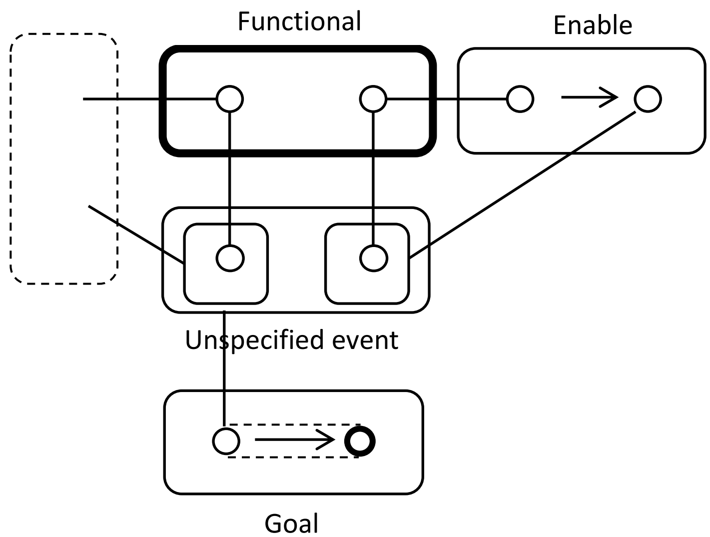

Figure 7

being played while the activity itself could vary. Events, like objects, can be coded without coding any of its details. Then, if something achieves a goal, it is involved in an activity that leads to the goal. In other words, the event that this something is involved in instantiates the unspecified event in the GOAL schema (see Figure 7). Again, introspection and the ability to conceptualize introspective states are necessary for representing the instantiation. Second, the subparts of the activity that 1) and 2) are involved in can be represented as sub-events within a greater event or event sequence. Furthermore, 1) and 2) are the enablers of these sub-events. For example, the phone is involved in the subevents of selecting music and controlling the playing of music. At the same time, the phone is also what enables these events to happen and is therefore the basis these events. Similarly, the earbuds are what enables the generation of sound and is therefore the basis of this sub-event. The representation of enabling, again, can be achieved through asymmetrical co-occurrences between the basis and the sub-event.

(16) Relational connection

a. CIA management wanted very much to **connect** the Soviet Union with the attempt to kill the Pope
b. Are your scientists not yet saying this drought is **connected** to climate change?
c. We identified several factors to include in our longitudinal latent growth curve model, including gender, SES, academic achievement, and two concepts **connected** to the idea of self-determination, locus of control and self-concept

The next and last sense in this track is the relational sense, which extends the relational aspect of the functional sense. This sense generalizes the relation between 1) and 2) so that they are no longer related to each other through a goal-directed activity but through any event or event sequence that they are involved in. Furthermore, the event or event sequence is completely unspecified in the basic meaning of the sense. For instance, in (16)a, the Soviet Union and the attempt to kill the Pope might be related in many different ways. The former might have directly executed the latter or only provided help to another party that executed the latter. Even though in (16)b, 1) and 2) seems to be causally related, the causation is not a part of the basic meaning but an educated guess derived from the knowledge that climate change could lead to natural disasters. In addition to events and event sequences, which are dynamic relations that unfold in time (Langacker, 2002), 1) and 2) can also be related through a static relation. An example of this is (16)c, in which the “two concepts” and the “idea” are related to each other through the contents they have in common. A connection in this sense, therefore, is equivalent to a relation in general and the sense evokes a conceptual base in which two things are involved in an unspecified relation (see Figure 8). The simulation of this schematic

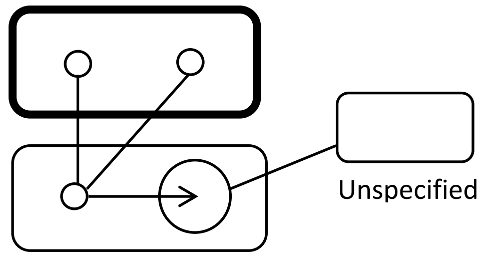

Figure 8

construct might involve an introspective state in which two entities are discovered present within an unspecified relation.

(17) Multiple LMs in a connection

a. “Your movements, thoughts and emotions are all <u>**connected**</u>,” says mental-game coach John Weir, author of A Golfer's Guide to Mental Fitness. Neuroscientists refer to this as "congruence" your mind and body striving to work in sync.

b. They were about 35 feet away from each other, all <u>**connected**</u> to a single rope.

c. The walkway <u>**connects**</u> the second-level spaces, spanning between the designers' office and a guest suite with a triangular shower stall in the bathroom.

In the function-relation track, the senses can be extended to have more than two things that are connected within a connection. As long as a number of things are involved in the same event, they can be construed as connected to each other under the same connection ((17)a). This is also possible for the prototype and the free-transfer track. In the prototype and the spatial sense, more than two objects or structures can together construct a whole that is structurally or spatially continuous ((17)b&c). In the transportational sense, a common means shared by more than two locations (e.g. the walkway in (17)c) might allow separate transfers to take place between every two locations. In the communicational sense, a single transfer might involve multiple communicators since a piece of information can be copied, broadcasted, and received by multiple communicators (e.g. talking to multiple people through a radio channel).

7.2.3 Summary

Although the verb "connect" and its variations belong to different word classes, their meanings are all derived from the same conceptual bases in the same polysemy network. This polysemy network covers a great variety of usages and the analysis above only addressed some of them. Many of the usages seem to have multiple layers of meaning or can be interpreted by different senses at the same time. Within this massive network of intertwined senses and usages, I identified two tracks of extension that start with the same sense – a structural sense in which two objects merge into one stable structure through a junction. The first track, the free transfer track, extends the structural sense into a spatial sense in which two bounded spaces are not only structurally merged but also spatially merged through a junction, which enables the free transfer of objects between the bounded spaces. This sense is then extended by the transportational sense, in which a means enables the free transportation of objects between two locations. The last sense in this track, the communicational sense, extends the free transfer of objects between two locations into the free transfer of information between two communicators. The function-relation track, on the other hand, extends a completely different aspect of the structural sense – the activities for which the two structurally connected objects are involved. In the functional sense, two things are not structurally connected but both involved in an activity that realizes a certain function. This relation is then generalized in the relational sense, in which the two things connected are involved in an unspecified relation in general.

8. Discussion

In the two case studies above, I explored two polysemy networks that contain senses with various degrees of abstractness. The focus of the case studies is on examining the mental representations of the conceptual constructs behind the senses in the networks as well as examining the overlaps between these constructs. In this section, I discuss some of the implications and limitations of the analyses as well as directions for future studies.

8.1 Perceptual basis of abstract constructs in language

One of the main implications of the analyses above is on the perceptual basis of the abstract conceptual constructs designated in language. The perceptual basis of concepts consists of the modality-specific nature of conceptual representations and the origin of these representations from modality-specific experience. The analyses in the case studies address both aspects of perceptual basis by 1. exploring modality-specific representations of the constructs evoked by the senses and 2. exploring how more abstract constructs can be derived from more perceptually salient ones by analyzing their overlaps.

First, a complex construct evoked by a sense can be broken down into smaller component constructs (Langacker, 2007). For example, the schematic construct proposed for the fourth sense of “between” can be broken down into at least five smaller constructs

– *the TR-LM alignment, unspecified relation, containment, belonging to the same category,* and *constructing representations from reference points* – each of which can be encoded by a separate simulator. The simulator that underlies the complex construct, then, might be considered an assembly of the mental resources of the simulators of these smaller constructs. While these smaller constructs might still be abstract and contains very few perceptual features, they are perceptual in the sense that the information they encode is derived from representations that are perceptually salient and that they can be instantiated by such perceptually salient representations. Note that some of these components are also found in the constructs evoked by other senses. The construct *unspecified relation*, for instance, is also found in the complex construct evoked by the relational sense of "connect", where two things are related through an unspecified relation. Other examples include the abstract *containment* construct, which is found in the fourth sense of "between" and the relational sense of "connect", and the *enable* construct, which is found in the functional sense of "connect" and the free-transfer track. These recurring constructs can be considered conceptual architypes that are used to construct complex abstract concepts in a way similar to how geons are used to construct complex three-dimensional objects (Biederman, 1987, 1900; Prinz, 2002).

The encoding and simulation of the abstract constructs above rely on two crucial mechanisms. The first mechanism is the ability of simulators to encode and re-enact information qualitatively. Representations of any constructs that leave out the details is only possible when information about a certain aspect of a category can be stored and reproduced separately from other information on the category. This mechanism is the reason why we can produce schematic representations that keep critical information of a category and filter out the perceptual details. The second mechanism, the ability of simulators to code introspective states, is necessary for representing meta-cognitive categories such as comparison and categorization. With these two mechanisms, it is possible to encode and re-enact none-perceptually-salient aspects of experience such as abstract relational structures and mental operations. As a result, the abstract features encoded through these mechanisms might have a similar status in the brain as sensory-motor features, which are also directly encoded from experience (Barsalou, 1999, 2016; Barsalou & Wiemer-Hastings, 2005).

(18) Between IV

a. Conversations **between** the teacher and children
b. There is a great difference **between** thinking about doing something and documenting the plans to do it.

(19) Between I

a. When it's new, the Moon is **between** the Earth and Sun.
b. I strung a steel cable **between** the two oaks.

Second, by identifying the overlaps between the abstract and concrete senses that might share extension relations, we can obtain insights on how some abstract constructs can be derived from ones that are perceptually salient. For example, the fourth sense of "between" (see (18)) evokes a construct in which an unspecified relation has two roles of the same category; at the same time, these two roles are also the reference points from which detailed representations of the relation can be constructed to specify a TR. This abstract construct can be considered an abstraction of the concrete construct evoked by the first sense of “between” (see (19)), which consists of two landmarks from which a specific spatial interval can be constructed to specify the location of an entity. In this case, the overlap is derived from the concrete construct by extracting the abstract features that the concrete construct directly contains. The overlaps between senses, however, can also be derived through other means. For example, the overlap between the transportational sense and the spatial sense of “connect” – the free transfer of objects between two locations – is not directly contained in but afforded in the construct evoked by the spatial sense. This means that while the spatial sense only evokes the spatial continuity between two bounded spaces, this construct always enables and therefore usually co-occur with the free transfer of objects between the bounded spaces. Another example is the overlap between the structural sense and functional sense – the involvement of two things in a goal-directed activity – is not contained in or necessarily afforded by the structural connection between two objects but correlates with it. In the last two examples, although the abstract constructs are not directly contained in the concrete constructs themselves, they are nevertheless derived from the constructs that occur with them in experience, hence revealing their perceptual basis.

The overlaps identified in the analyses also provide insights on how some of the abstract senses in polysemy networks can be acquired. As explained in the career-of-metaphor account (Bowdle & Gentner, 2005), an abstract sense of a word can be acquired through repeated metaphorical usage of the prototype sense. Using the prototype metaphorically requires one to rule out the features that are irrelevant to the new situations (usually sensory-motor) and pick out those that apply (usually abstract and relational). Repeated metaphorical usages then might result in entrenchment of the distilled abstraction as a new sense of the word. The current study echoes with and adds two more points to this account. First, in direction to abstraction, abstract senses can also be derived through affordance and correlation (e.g. transportational connection is afforded in spatial connection; functional connection correlates with structural connection). On this point, the current study is in accordance with the analysis of Tyler and Evans (2001, 2003) on the polysemy network "over", which suggests that extended senses can originate from correlation and context-dependent inferences. Second, the abstraction of the prototype can be integrated with other features in the new situations when entrenched as a new sense. An example of this is the second and third sense of "between". The constructs evoked by these senses contain the abstract interval, which is an abstraction of the prototype, as well as contextual features that implement the abstract interval such as time, quantities and qualities.

8.2 Application of PSS in cognitive linguistics

Another implication of this thesis is how PSS can be applied in and benefit cognitive linguistic studies. As demonstrated in Section 6 and 7, PSS and Cognitive Grammar are two highly compatible frameworks that can be combined to produce accounts of semantics structures that are both linguistically and psychologically precise. Furthermore, PSS can not only be applied to studies of polysemy networks but also other areas of studies that involve the representations of semantic structures, providing a way to directly account for abstract meanings in language instead of relying solely on the metaphorical projection between concrete and abstract domains.

The first application of PSS is, as demonstrated in the analyses, in the studies of extension relations in polysemy networks. In Cognitive Grammar as well as some other cognitive linguistic frameworks, an extension relation is characterized by two usages of the same linguistic form that partially overlap in the conceptual contents they evoke (Langacker, 1987, 1991, 2007). Under this view, a key element in identifying an extension relation is identifying the overlap between the conceptual contents evoked by two senses. However, not many analyses from previous studies have focused on identifying the overlaps between senses. For example, Lakoff (1987)'s analysis on the polysemy network of the preposition "over" focuses on how new senses arise through means such as image-schema transformation and conceptual metaphor. While these means do imply that there exists an overlap between a sense and the sense that it extends from, the overlap between the senses are not identified or explicitly addressed. Similarly, Tyler and Evans' (2001, 2003) analysis on "over" also focuses on how extended usages can be derived through correlation and context-dependent inferences but does not explicitly account for the overlaps involved. The current study, on the other hand, focuses on identifying and specifying the overlaps between senses in polysemy networks. By incorporating PSS into the analyses, the current study is able to examine with great precision in presentation the conceptual contents associated with the senses and the overlaps between these contents, further exploring the psychological plausibility of the conceptual basis of polysemy networks.

The second application of PSS is in any fields of study that previously rely on conceptual metaphors to represent meanings that are not perceptually salient. As discussed in Section 3.4, it is problematic to use conceptual metaphors as a way to ground abstract constructs in embodied experience and it is necessary to have an independent representation of the abstract domain before a metaphorical mapping can be established. However, many fields of study within the Cognitive Linguistics program, including Lakoff's analysis on "over" and conceptual metaphor itself, rely heavily on metaphorical projections of image-schematic structure to represent abstract meanings and account for their embodiment. As suggested by these case studies, by introducing PSS into the studies of abstract meanings, we can directly represent abstract constructs in a way that is structured and grounded. In addition to improving our understanding of abstract linguistic meanings, PSS can also improve our understandings of conceptual metaphors and metaphors in general. With independent representations of both the concrete and abstract constructs, we are able to account more fully for the mappings between them by identifying their overlapping structures and therefore specifying the cognitive topology shared by the source and target domain, which is often left unspecified in many conceptual metaphor accounts.

8.3 Limitations and future studies

Despite the implications offered by this thesis, the thesis is only an initial attempt to apply PSS to semantic analyses and comes with many limitations. One limitation is a technical one regarding some of the constructs encountered in the analyses. Take the free transfer of information between two communicators, for instance. While the analysis accounts for how the general structure of this construct – free transfer of figures between two backgrounds – can be represented in simulation, this account leaves out the representations of the communicators. To account for the representations of the communicators, we must break them down into smaller constructs that reflect their inner structures and account for the representations of these smaller constructs. Such analyses might be extensive and therefore not realistic to pursue in this thesis. Due to such technical difficulties, the accounts offered in this thesis on the representations of the senses might be incomplete. Another limitation of the thesis is the lack of direct empirical evidence for the proposed schematic constructs and their representations. The accounts offered in this thesis are highly theoretical and are only indirectly supported by the usages in the attested data and the overlaps between their meanings. The psychological validity of these accounts need to be supported by further empirical studies on what people actually simulate when processing the meanings of the senses in question.

The implications and limitations discussed above provide a few directions for future studies. The first direction is the further application of PSS in cognitive linguistic studies. As discussed earlier, PSS can be applied in the studies of phenomena that involve mappings and extensions such as polysemy networks, conceptual metaphor and other phenomena that involve examining the constructs and representations of meanings, especial the abstract ones. Other areas of study that can potentially benefit from PSS includes simulation semantics, construction grammar, and frame semantics. Future studies can explore the compatibilities between PSS and the existing frameworks in these areas, further integrating studies of language with studies of the mind. Second, future studies can also focus on collecting empirical evidence for the constructs and representations proposed in this thesis. Although it is difficult to directly measure what people actually simulate during language processing, it IS tractable to measure indirectly through property generation (e.g. Barsalou & Weimer-Hasting, 2005), property verification (e.g. Solomon & Barsalou, 2004), reaction time difference (e.g. Boroditsky, 2001), or neural correlation (e.g. Wilson-Mendenhall et al., 2013). Finally, future studies can also explore the architypes or recurring component constructs that are found in complex abstract constructs. After a number of such reoccurring constructs are identified in theoretical analyses, empirical studies are needed to examine their psychological validities as well as their validities as components of the complex constructs that they are identified in.

9. Conclusion

This thesis is based on the concept empiricist point-of-view that concepts are modality-specific representations derived from experience. While there are many sophisticated accounts on the perceptual basis of concrete concepts, accounts on the perceptual basis of abstract concepts are somewhat lacking in comparison. In this thesis, I looked into polysemy networks in language for insights on the perceptual basis of some abstract conceptual constructs. In particular, I do so by identifying the overlap between the construct evoked by a concrete sense and that evoked by an abstract sense extended from the former. Such overlaps, which are often abstract, suggest that there are abstract constructs contained within perceptually salient ones, and that these constructs can be abstracted and sometimes integrated with other information to form entrenched abstract categories. Another topic addressed in this thesis is the study of semantic structures at the level of simulation. In the analyses, I combined the Perceptual Symbol System framework with the Cognitive Grammar framework to account for the conceptual constructs evoked by the senses and the perceptually based representations that they can take. By doing so, we can further integrate Cognitive Linguistics, which places great emphasis on the psychological plausibility of any semantic theory, with theories of concepts from Cognitive Psychology and produce accounts of word meanings, concrete and abstract alike, that are even more psychologically precise and accurate.

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