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Introduction

James A. Hampton and Yoad Winter

Abstract By highlighting relations between experimental and theoretical work, this volume explores new ways of addressing the problem of concept composition, which is one of the central challenges in the study of language and cognition. An introductory chapter lays out the background to the problem. The subsequent chapters by leading scholars and younger researchers in psychology, linguistics and philosophy, aim to explain how meanings of different complex expressions are derived from simple lexical concepts, and to analyze how these meanings connect to concept representations. This work demonstrates an important advance in the interdisciplinary study of concept composition, where points of convergence between cognitive psychology, linguistics and philosophy emerge and lead to new findings and theoretical insights.

In every day of our conscious life, we are constantly busy manipulating abstract representations of the world around us. This human dexterity with mental representations, or *concepts*, has fascinated scholars since antiquity. Modern cognitive scientists formulate this fascination as two fundamental questions about the relations between language and thought. One question concerns the representation and organization in the mind and brain of concepts for words like *cat*, *big*, *sleep*, and *nearby*. How do these words refer to the external world? How do our minds represent their meaning? Another question is about how concepts interact and combine when humans use complex expressions like “the big cat that is sleeping nearby”. How do the meanings of individual words combine to create a sentence meaning, or a *proposition*? These two questions underlie studies of *simple concepts* and *concept composition*. This distinction between two problems is convenient, but it also reflects substantial gaps between current analyses of language understanding.

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Since the 1970s, cognitive psychologists and theoretical linguists have taken rather different routes in their study of concepts and how they compose. In Cognitive Psychology, much research on concepts has been framed by the work of Eleanor Rosch (1975), which focused on simple words and the everyday concepts they denote. By contrast, in Theoretical Linguistics, and especially in formal and generative paradigms influenced by Montague (1973), the focus has been different. In this framework, research on natural language semantics has predominantly addressed the compositionality of meanings in relation to syntactic theory, with special emphasis on a few logical concepts like *every*, *some* or *most*.

This analytical gap between Psychology and Linguistics is undesirable, as was acknowledged early on in the history of natural language semantics (Katz and Fodor 1963): psychological theories cannot ignore concept composition, and natural language semantics cannot ignore the complex mental aspects of meaning. Later on, works in Cognitive Psychology following Osherson and Smith (1981), Cohen and Murphy (1984) and Hampton (1987) have started to explore hard problems of concept composition, especially in relation to short nominal expressions. The importance of this line of work for formal semantics has been stressed in Kamp and Partee (1995). More recently, and especially since the 2000s, more points of contact between formal semantics and various aspects of concepts have been developed in the study of lexical representations and vagueness in natural language (Pustejovsky 1995; McNally and Kennedy 2008; Asher 2011; Nouwen et al. 2011). Yet, despite similar motivations and related insights, much of the work on concepts and meaning composition has been carried out independently in Linguistics and Psychology.

This volume aims to help in bridging this gap. The articles here represent a substantial sample of the recent work done on concept composition in experimental semantics and psychology. The authors include leading authorities in their disciplines as well as younger researchers. Together, these works show the centrality and complexity of the concept composition problem, and the many ways in which it affects current research in Psychology, Linguistics and Philosophy.

The chapters by *Barsalou* and by *Pelletier* are broad overviews of concept composition from a psychological perspective and a linguistic-philosophical perspective, respectively. *Barsalou* starts from the observation that we use concepts in everyday life to understand our environment, solve problems and achieve goals. In this respect, it could be claimed that we have a common heritage with other intelligent forms of life, with a difference in degree of complexity but not in kind. From this perspective, language, a late-comer in the evolution of humans, is positioned on top of a highly developed and integrated system of intelligent conceptual thinking. All human languages have the same basic structure. There are atomic units (words or lexemes) which are combined according to syntactic rules (grammar) into phrases and sentences. Barsalou stresses that in addition to such “formal” considerations, situations, pragmatics, and imagery have all been found to play a role in how language utterances acquire meaning. Consequently, language meaning could not be effectively studied without also studying its users. Barsalou proposes that a concept can act as a tool for simulating experience. “John stroked

the cat” leads to an imaginative construction of a scene in which previous visual and tactile experiences are recruited to fill out the meaning of the sentence. This process explains how the verb can change depending on the context—stroking one’s beard, or stroking a putt in golf capture something of the same meaning (a gentle movement in contact with an object) but at the same time the situation simulated leads to many differences. Barsalou’s point is that to represent the meaning of “stroke” as a single lexical symbol STROKE (Agent, Patient) fails to account for the different inferences that are to be drawn from the simulation. Hence the meaning of the word “stroke”, for example its propensity to allow us to think true and false thoughts involving acts of stroking, can only be determined relative to its context of use, which triggers complex interactions with the simulated situations.

Pelletier argues the case for the more formal approach to semantics and meaning. He provides a “natural history” of different positions held by philosophers of language, linguists of different schools, and cognitive psychologists. He draws attention to a critical question that one should ask about any utterance, namely “what was really said?” The difficulty that Pelletier points to is one that has long been a contentious issue between philosophers and psychologists. Can the mental representation of a concept be treated as being the “real meaning” of a term? Aren’t there external aspects of meaning that are not inside the head?

If there are, as Pelletier argues (see also Rey 1983), how is this externalist view of semantics connected to the efforts of cognitive scientists to provide a “micro” account of how individual meanings arise with particular speakers and hearers and particular contextual situations? How is it possible to integrate the important and valuable insights into how different syntactic forms construct meanings for sentences with the empirical evidence of how speakers themselves construct meanings in context-dependent ways?

In the chapter by *Hampton*, these issues are given a further airing. Hampton attempts to answer the conundrum of how concepts can combine to meet the constraints of compositionality in the case where those concepts are in fact vague or fuzzy prototypes. He outlines the Composite Prototype Model for combining prototype concepts. Concepts are seen as being constituted by frame representations containing features expressed as dimensions and values (e.g. COLOUR = [RED, ORANGE]). When people have to form a conjunction or disjunction of prototype concepts, the model provides an account of the processes by which the two frames are amalgamated into a single composite frame. Along the way some properties of the concepts are lost, while new emergent properties may also be added to the composite, either from knowledge of the world or from the need to resolve incompatibilities between the two concepts. A key result supporting the model is the finding that, because of the merging of the two sets of prototypical features, noun phrases that appear to express a conjunction (e.g. “sports which are also games”) do not in fact receive a strict conjunctive interpretation when people categorize different exemplars. In a second major section, Hampton explains how this result relates to the distinction between two important theoretical notions linked to prototype theory, namely Typicality and Graded Truth. These two notions are then further differentiated from lack of knowledge or ignorance. Hampton

concludes his chapter by defending the Internalist/Descriptivist theory of conceptual contents. Many concepts, he argues, (and particularly those that are not “natural kinds” like snakes or lemons), are constituted by a structured set of intensional properties. Because we understand concepts this way we are free to generate fanciful and creative new ideas, unconstrained by their need to provide reference or determine truth in the real world.

The three chapters by **Lee**, **Poortman** and **Winter** all address questions about truth-value judgements. **Lee** reports results of two new experiments. One experiment shows a natural tendency to prefer certain colors and materials to others with different concepts. This preference is related to truth-value judgements with complex nominals. For instance, 71% of the participants in this experiment accepted the description *wooden bike* for a picture showing a bike that is only partially made of wood. By contrast, only 42% of the participants accepted the description *wooden frame* for a frame that contains the same amount of wood. This shows an important effect of typicality on truth-value judgements, in agreement with previous results about the correlations between typicality and membership, also described in Hampton’s chapter.

Poortman shows more new results about the relations between typicality and truth-value judgements. As Poortman’s experiments demonstrate, participants’ truth-value judgements on plural sentences like “the men are walking and writing” show sensitivity to the (attested) fact that walking and writing do not typically occur at the same time. Poortman shows that this atypicality increases tolerance to “split situations”, with two men walking and two men writing. Such split situations are less acceptable for sentences like “the men are walking and singing”, where there is no incompatibility between concepts.

Winter uses the results of Lee and Poortman’s experiments in a proposal for a general procedure of concept composition in formal semantics. As Winter stresses, truth-value judgements are not simply a matter of how odd or commonplace different situations are. Situations where two men are walking, and two other men are singing, are not odd at all, yet in Poortman’s experiment they are often rejected for sentences like “the men are walking and singing”. In Winter’s account, the tendency to accept sentences is boosted by *potential atypicality* of alternative situations. This has much in common with other new results about *reciprocal sentences* like “the girls are pinching each other”. Winter proposes an account that unifies the analysis of these results with the analysis of Lee’s and Poortman’s data.

The three chapters by **Lai et al.**, **Gagné et al.** and **McNally and Boleda** all address the processes that add to the understanding of complex concepts, beyond what is directly said. **Lai et al.** analyze verb phrase concepts in sentences like “*John began the book*”. In such sentences, concept composition may require understanding John’s relevant activity in relation to the book (reading, writing etc.). Lai et al. compare such sentences with sentences containing psychological verbs “*John enjoyed/disliked the book*” which also allow understanding of a relevant activity, but through presumably different linguistic mechanisms. Based on a self-paced reading and an fMRI study, Lai et al. argue against previous analyses, where relevant entities for events like reading and writing are added in the process

of semantic composition. Instead, they test the proposal that verbs like *begin* (but not *enjoy*) involve concepts that require *structured individuals*. When describing such individuals, Lai et al. rely on the understood internal structure of books and similar objects. As they suggest, such internal structures can be established along spatial (pages in a book), informational (e.g. the informational content of a book) or other dimensions. They conclude that concept composition involves construing this structure out of the complement triggered by the meaning requirements of the verb.

Gagné et al.'s chapter is in two parts. In the first they discuss their research into a recently discovered phenomenon known as the Modification (or Modifier) Effect and originally reported by Connolly et al. (2007). When a generic statement such as “candles are made of wax” is changed by adding an adjectival modifier to the subject noun (e.g. “purple candles are made of wax”) then people consider it less likely to be true, even though they have no reason to connect the modifier to the property. Spalding and Gagné (2015) have also shown an inverse effect—if people consider a generic statement to be false, then the modified version becomes more likely in people's estimation. Gagné et al. discuss how this phenomenon is a part of a theoretically influential and important research area concerning the combination of concepts to construct noun phrases, either with adjectival modification (*red shirt*) or through noun + noun compounding (e.g. *football shirt*). The topic has been extensively researched since it was first thrown out as a challenge to prototype theory in the seminal article by Osherson and Smith (1981). In the second part of their chapter, Gagné et al. outline a different conception of concepts based on Aristotelian-Thomistic (AT) philosophy. This framework for understanding concepts forms an intriguing bridge between the externalist semantics defended in large part by Pelletier and the embodied cognition approach propounded by Barsalou.

Like the chapters by Lai et al. and Gagné et al., the chapter by **McNally and Boleda** focuses on the processes that add to our understanding of complex concepts. From a theoretical and computational perspective, McNally and Boleda propose two processes that affect concept composition. One process, which they call *conceptual affordance*, allows humans to use information within the composed concepts themselves. For instance, one understanding of the complex expression *red box* uses the information contained within the simple concepts *red* and *box*. This process leads to the interpretation “box which is colored red”. By contrast, in another process, called *referential affordance*, information about the referent described by the phrase is used to guide the way in which the concepts in question are composed. This process also allows other interpretations, like “box which contains red objects” for the phrase *red box*. McNally and Boleda argue for a mixed semantic model for composition using the two kinds of affordance, and propose an integrated account that combines a formal semantic framework with distributional semantics, a computational approach that models conceptual aspects of word meaning.

Westerlund and Pykkänen present an account of a particular cortical region, the Left Anterior Temporal Lobe (LATL) which appears to have a direct role in many of the conceptual modification and combination processes already discussed in other chapters in the volume. Using Magnetoencephalography (MEG) they show

how this part of the cortex responds to conceptual combination. The greater the degree to which the modifier leads to specialization of the head noun, the more powerful is the response in the LATL. Westerlund and Pykkänen discuss different accounts of conceptual combination—in particular schema based models that lead to modification of the head noun schema (e.g. Smith et al. 1988), and relation based models that propose that meaning of a compound is generated by seeking an appropriate semantic relation to link the two nouns (e.g. a *dog house* is a house built for a dog). This work is connected with the chapters by Hampton, and by Gagné et al., and the neurological data adds valuable criteria for how different accounts may be evaluated.

Sassoon addresses a systematic difference between the way concepts are expressed by adjectives and nouns, which surfaces in the acceptability of their composition with *comparative expressions*. Many adjectives show their gradability with comparative forms like *richer*, *more expensive* or *more American*. By contrast, nouns do not easily allow constructions like *more a millionaire*, *more an American*, or *more a duck*. In agreement with the prototype theory of concepts, Sassoon proposes that both noun concepts and adjective concepts involve gradability. However, according to her proposal, only adjectives have their gradable aspects open for modification by comparative operations (e.g. *more* or *-er*). Sassoon describes some empirical and preliminary experimental results supporting her views on the question of gradability and concept composition.

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