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Linguistic variation from cognitive variability: the case of English 'have'

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Abstract

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In this dissertation, I seek to construct a model of meaning variation built upon variability in linguistic structure, conceptual structure, and cognitive makeup, and in doing so, exemplify an approach to studying meaning that is both linguistically principled and neuropsychologically grounded. As my test case, I make use of the English lexical item *have* by proposing a novel analysis of its meaning based on its well-described variability in English and its embedding into crosslinguistically consistent patterns of variation and change.

I support this analysis by investigating its real-time comprehension patterns through behavioral, electropsychophysiological, and hemodynamic brain data, thereby incorporating dimensions of domain-general cognitive variability as crucial determinants of linguistic variability. Per my account, *have* retrieves a generalized relational meaning which can give rise to a conceptually constrained range of readings, depending on the degree of causality perceived from either linguistic or contextual cues. Results show that comprehenders can make use of both for *have*-sentences, though they vary in the degree to which they rely on each.

At the very broadest level, the findings support a model in which the semantic distribution of *have* is inherently principled due to a unified conceptual structure. This underlying conceptual structure and relevant context cooperate in guiding comprehension by modulating the salience of potential readings, as comprehension unfolds; though, this ability to use relevant context–context-sensitivity–is variable but systematic across comprehenders. These linguistic and cognitive factors together form the core of normal language processing and, with a gradient conceptual framework, the minimal infrastructure for meaning variation and change.

Linguistic Variation from Cognitive Variability:
The Case of English *Have*

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gratitude

what a trip! i write this bittersweetly, as the culmination of a ten-year, three-chapter life era here at yale, brimming with gratitude for the chance for my voice to surface directly in recognizing the rich personal context out of which this work has emerged.

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andy
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To 妈妈，爸爸，毛毛

Chapter 1

Introduction

Contents

1.1 The problem of meaning variation

Language, at its core, is a set of pairings between a sign and a meaning. These pairings are typically understood to stand in a one-to-one relationship and be stable between individuals, across speech communities, and over time. Crucially, these pairings are mutually exclusive within the system, such that if a given sign refers to a given meaning, both cannot refer to or be referred to by other signs or meanings. In fact, the value of the entire system is derived from this Saussurean principle. Yet, in the context of actual human communication, this one-to-one relation rarely holds. The sign-meaning linkings, packaged with morphosyntactic structure, form lexical items, the atoms of the language system, and readily enter into many-to-many mappings where the same sign can refer to multiple meanings, and the same meaning can be referred to by multiple signs. I begin this dissertation with a brief introduction to one well-discussed example of a one-to-many mapping from English.

1.2 The puzzle of English *have*

The case of English *have* is a perfect test case for enumerating a neurocognitively grounded model of linguistic meaning variation because it **(a)** shows breadth in the meanings it can convey, **(b)** is situated in a crosslinguistically consistent semantic domain, and **(c)** is a highly frequent lexical structure in the language.[1]

Have's semantic variability is a well-known phenomenon in the literature (Lyons, 1967; Ritter and Rosen, 1997; Myler, 2016, a.o.). As shown in (1), *have*-sentences show a semantic distri-

[1] *Have* is the second most frequent verb in the English language, following *be*, and is among the top ten most frequent lexical items overall, according to both the Oxford English Corpus (OED Online) which represents British and American English with eight additional global English varieties, as well as the Contemporary Corpus of American English (Davies, 2008). Its centrality to the language allows for more generalizable insights on the behavior of lexical items in meaning variation.

bution beyond the canonical possession relations it is associated with.

(1) Some of the many meanings of *have* from Myler (2016)

   a. John **has** a Playstation 3. [Ownership]
   b. John **has** a sister. [Kinship]
   c. John **has** blue eyes. [Body part]
   d. The stadium **has** two pubs flanking it. [Locative]
   e. This table **has** four sturdy legs. [Part-Whole]
   f. John **has** a cold. [Disease]
   g. John **has** a great deal of resilience. [Attribute]

The encoding of both locative and possessive meanings situates *have* in one of the most well-studied semantic domains, that of locative, possessive, and existential meanings (Kahn, 1966; Freeze, 1992; Beavers et al., 2010; Koch, 2012). Crosslinguistically, typologists have observed rampant lexicalization of these two types of relations with a single marker (Clark, 1978; Freeze, 1992; Aristar, 1996; Heine, 1997; Tham, 2004) as well as systematic trajectories of change within this domain (Deo, 2015a); this morphological syncretism is suggestive of an underlying conceptual syncretism between locative and possessive meanings. Beyond its ability to encode these relational meanings (between two entities); it also participates in causative (2a), experiencing (2b), light verb (2c), auxiliary (2d), and modal (2e) constructions (*have*, OED Online, 2015).

(2) a. The Federalist party **had** him before the bar of the house and tried to expel him.
   b. He knew that she **had** no joy in their union.
   c. Harry **had** an operation.
   d. Too much political change **has** lowered morale.
   e. You will **have** to enter the username and password that corresponds to your account.

The most up-to-date linguistic analyses of English *have* take *have* to be a semantically null identity function; the variability in the meanings of DP_1-*have*-DP_2 sentences is due to DP_2-

internal syntactic heads that encode the specific relational meaning (Ritter and Rosen, 1997; Harley and Jung, 2015; Myler, 2016). For example, for a possessive sentence such as *She has a Playstation 5*, the possessive reading comes from a silent PossP; *have* merely provides the two-argument structure that connects the first DP with the second. These analyses attribute the semantic variability to the fact that this identity function can compose with a theoretically unlimited number of silent functional heads, aligning with the proposal that nominals must be either inherently or type-shifted to be relational to enter into a relational meaning (Barker, 1991; Partee, 2000). While this analysis unifies *have* with the copula *be*, a goal of auxiliary selection theory (Freeze, 1992; Kayne, 1993), it does not address the question of why *have* has the meaning variation it does, nor why *have*-type lexical structures crosslinguistically convey meanings of location and possession. That is, by proposing that a theoretically unlimited number of functional heads are the source of the meanings of *have*-sentences, these proposals shift the compositional burden from the lexical semantics of *have* to a source outside the scope of the formal account of *have*'s syntactic and semantic composition. They show how the semantic variability observed can be derived within the formal system, but do not explain the origin of semantic variability itself. Crucially, the key aspect of this family of accounts is that *have* contributes no semantic content to the meaning of a sentence; it serves, instead, as a syntactic structure that connects two DPs–a "transitive" form of a copula, as it were. Other proposals that do attribute some degree of semantic content to *have* and *have*-like lexical items crosslinguistically attempt to structure this variability by proposing categories that are not well-characterized, formally or otherwise, such as stereotypical versus non-stereotypical relational meanings (Karvovskaya, 2018). Furthermore, there is anecdotal (Belvin and Den Dikken, 1997) and experimental (Zhang et al., 2018, 2022) evidence for variability in the acceptability of locative *have*-sentences without prepositional phrases, which others have claimed to be categorically ungrammatical (Ritter and Rosen, 1997; Harley and Jung, 2015; Myler, 2016). Overall, the existing approaches toward characterizing this one-phonological-structure-to-many-meanings phenomenon have offered formal descriptions of the compositionality of *have*-sentences, but have not explained *why* this set of meanings–and their underlying conceptual structure(s)–are lexicalized with a single phonological structure, not only in English, but also in languages across the world (see §3.4). What are the semantic and conceptual constraints on the silent functional heads or relational nominals that can enter into a meaning conveyed through a *have*-sentence? What about the meanings themselves, and their relationships between one another, allow for their capturing by a single phonological structure? To address these questions, as well as the goal shared across all proposals of characterizing the meanings of *have*, I take a cognitively contextualized linguistic approach.

1.3 My approach: situating linguistic behavior in the cognitive system

The case of English *have*-sentences serves as a perfect window into the nature of meaning variation–a property of a neurocognitive embedding of the linguistic system: its lexical boundaries are sufficiently variable and under question, and its primary meanings emerge from a rich conceptual domain known to show crosslinguistic variation in lexicalization. Altogether, the "too many meanings problem" that has been ascribed to it appropriately lends itself to a cognitively grounded investigation of meaning variation as an inherent property–the *status quo*, as it were–of the human language system. I hope to show that my approach, using evidence from crosslinguistic patterns of lexicalization patterns and diachronic trajectories, non-linguistic properties of the human conceptual system, real-time comprehension profiles, and measures of inter-speaker/comprehender variability, in addition to fine-grained linguistic analysis, can shed light on the nature of the meanings of *have* themselves and provide an analysis that explains not only how the meaning of a *have*-sentence is composed, but also why these meanings of location and possession are lexically associated in language after language.

I now turn toward explicating a framework of language in a cognitive context that provides a possible way to understand this phenomenon as a natural manifestation of the human language system.

1.3.1 The nature of the substance of meaning

What is the substance of meaning and how can it be understood such that lexical items can manifest one-to-one or many-to-many mappings with it?

When I refer to meaning, I am referring to **conceptual structure, the mental substance that is formed through the encoding of perceptual experiences into memory** (see Jackendoff, 1983; Pustejovsky, 1995; Jackendoff, 2002; Wiese, 2003; Culicover and Jackendoff, 2005; Jackendoff, 2007; Pustejovsky, 2011, a.o.). These memorized situations are rich sensory experiences embedded within physical and psychological contexts, meaning that they contain not only direct sensory percepts such as light, sound, temperature, among many others, but also the enrichment of these direct percepts by cognitive percepts. These cognitive percepts are evaluations of the direct sensory percepts, such as the evaluation of a series of patterns of light striking the retina, a series of sounds entering the cochlea, and perhaps a series of tactile and olfactory percepts, into a specific mental representation–one that speakers of English might associate with the sound/sign sequence symbolized by the orthographemic sequence "cat". Some other cognitive percepts, based on evaluations of various configurations of sensory percepts, are the chunking, labeling, or naming of individuals, objects, entities, events, as well as the evaluation of animacy, causality, familiarity, and even grammaticality. Lexical items are therefore conventionalized associations between a physical pronunciation and a chunk of conceptual structure (complete with both direct sensory and evaluated cognitive percepts), following a number of theoretical linguistic frameworks' treatment of the relationship between linguistic structure and conceptual structure, namely conceptual semantics (Jackendoff, 2019) and two-level semantics (Lang and Maienborn, 2019), among others. These lexical items are bidirectionally powerful: they enable us to manipulate this mental substance introspectively and manipulate the mental substance in other individuals' minds.

These associations, however, are incomplete and imperfect for two principal reasons. The first is a cognitive limitation on the memorization or encoding of the direct sensory percepts. These sensory percepts rely on direct physical and chemical stimulation and cannot be faithfully encoded in a memory, which means that the memory of a situation will always be incomplete with respect to the sensory detail of direct perception. The second is that the lexical system is not nearly enumerated enough to provide a perfect matching of one sign to every perceptual detail of a memory; lexical items can only trap subsets or simplifications of or generalizations over the substance of meaning. The relative informational richness of conceptual structure is indexable by lexical structures, albeit with limited resolution, but it cannot be quantized perfectly by those lexical structures (see Fodor, 1975; Jackendoff, 1985; Lakoff, 1987; Pinker, 1999; Murphy, 2002, a.o.). **This informational asymmetry is what manifests the phenomenon of meaning variation**: what about the rich experiential mental substance associated with 'cat' is being referred to in any given situation? It could be a specific property, such as its soft fur, quiet purr, anthropomorphized aloofness, or the whole network of properties: a sentence like *I have two cats* could refer to the entire situation beyond the physical entity (and all of its direct sensory percepts itself), such as the periodic purchasing of food and litter, the omnipresence of residual hair, or the inability for allergic friends to visit.

How, therefore, could the association of a lexical form and a chunk of conceptual structure emerge? To illustrate one possibility, we start with a parent-child dyad: the parent points to a visual scene, directing the attention of their baby, and utters a sign (and thereby a lexical structure). The baby memorizes this visual scene as the referent of that sign (and thereby that lexical structure); it contains a whole host of smells, feels, sights, as well as individuated objects, and perhaps even cognitive percepts like animacy (driven by heuristics such as the presence of eyes, which are already individuated objects evaluated from the raw visual signal).

The next time the baby interprets] that sign (and thereby that lexical structure), the scene may be slightly different. Assuming a well-intentioned parent, the baby removes the smells, feels, sights, objects, and other percepts that were present in the first scene but not the second from its association with that lexical structure. Over time, the degree of sunlight, the bird or siren sounds, the furniture, and carpeting are all removed, leaving only a single individuated object and all of its aforementioned related percepts standing in the association relation with the lexical structure 'cat.' The resulting *pan-situational reliability* of the term 'cat' is what allows it to be a useful tool for communication.

1.3.2 Lexical meaning and context as two sides of the same coin

The primary consequence of this asymmetric mapping is that **meanings are rich and that lexical items can refer to either a subset or the entirety of an experiential memory when deployed:** meanings are inextricably attached to their contexts because **(a)** a lexically sanctioned "meaning" will always include a rich experiential context and **(b)** the context can help identify the relevant component of the entire meaning for a lexical item's intended communicative purpose. The honing of a sufficiently pan-situationally reliable pairing is typically incomplete: take the example of the English word 'smoke' and the rich chunk of conceptual structure to which it can refer, as in (3) from Jackendoff (2012).

(3) a. The fire gave off a lot of smoke.
b. The fire smoked a lot.
c. Bill smoked the cigar.
d. Bill smoked the fish.
e. Do you have a smoke?
f. Let's smoke them out.

Here, the single lexical structure provides some degree of pan-situational reliability in that it can correctly communicate these situations, in contrast to a situation involving, say, a baby and a cat. But, it does not sufficiently distinguish between these six contexts for its use. The single lexical structure is cluing the comprehender into a rich conceptual structure through which the context is honing down on a specific aspect; this relationship between lexical and conceptual structure has been explicitly addressed in the Two-level Semantics framework (see Bierwisch and Schreuder, 1992, et seq., and Chapter 5 of this dissertation). The optimization of the "right" degree of pan-situational reliability can be taken to be an issue of finite memory: what is the right degree of semantic ambiguity that each lexical structure can have before the system is inefficient? Clearly, the fact that articulatory gestures that cue the lexical item 'smoke' can ambiguously refer to these six situations, at the very least, suggests that in this case, five potential lexical-structure-sized memory units can be conserved. So, this setup between optimizing between specificity and generality can be seen as the efficient capitalization of a rich conceptual structure and a finite memory system.

In sum, the whole point of this exposition is to motivate the question: where does "lexical meaning" end and context begin? In the framework I have explicated above, **there is not necessarily a clear line between lexical meaning and contextual meaning; composite lexical structures are tools to hone in on a sufficiently specific chunk of conceptual structure for a given communicative intent. I take the view that there is a constant tradeoff between lexically conventionalized and contextually specified meaning; the act of linguistic comprehension is therefore an active narrowing down of a large chunk of conceptual structure by lexical and contextual triangulation**, using the smaller chunks of conceptual structure referred to by specific lexical structures deployed in a communicative context. This means that some lexical structures can have the illusion of being maximally pan-situationally reliable (and therefore context-independent) resulting from a high degree of use, but in actuality, are as richly context-dependent as any other. For example, while comprehending the lexical item 'cat' in isolation may generate a visual image and a constellation of conceptual features for most comprehenders, the specific visual image generated emerges from that specific comprehender's individual memory, but the entire relevant conceptual structure chunk is still brought to attention for communicative use.

The context itself must be reconceptualized from the standard linguistic view: it is not an accessory to lexical structures, but inextricable from the comprehension of any lexical structure. This view of context and linguistic communication, however, enriches it with quite a number of linguistic, conceptual, cognitive, and even social factors. Out of this highly interactive milieu comes a number of questions. What are the factors that contribute to and create meaning variation? How do they interact with and constrain one another and relate to other forces that affect language use? Moreover, relating to the substance of meaning itself, how can we understand the units of meaning? That is, what constitutes "one meaning" such that there can be multiple meanings referred to by a single linguistic structure? What is the relationship between linguistic meaning and conceptual meaning, and where does linguistic semantics (and potentially Semantics[2]) fit into this system? And finally, how do the factors contribute to meaning variation interact with meaning in real-time processing? These are the main questions of interest in this dissertation, roughly corresponding to Part 1 and and Part 2, though they have different degrees of operationalization and therefore exploration.

[2]By using the capital form here in contrast, I am referring to model-theoretic semantics (Zimmermann, 2019), the dominant framework through which lower-case semantics, as the general scientific study of linguistic meaning, is carried out.

1.3.3 Meaning variation, as lexical underspecification, is a property of the system

Meaning variation is by no means an unbroached frontier of linguistic inquiry, though there is diversity in the precise research questions different efforts have sought to address.[3,4] The primary disciplinary area that has sought to characterize and understand meaning variation is the sociolinguistic variationist tradition (see Eckert, 2016, for a recent overview of this framework), particularly as 'sociosemantic variation' (Hasan, 1989) or socially driven semantic variation (Tredici and Fernandez, 2018). One fundamental tenet of the language system, in this body of work, is that of underspecification: a given form's ability to encode multiple meanings or serve multiple purposes, as described previously. Accordingly, specific meanings for an underspecified form can emerge only as a function of their use in context, which allows for the "binding of language to social action" (Eckert, 2016), setting up a linguistic capacity that is inherently flexible, variable, and thus creative and communicative. The primary focus of this effort is, however, largely complementary with my purpose here: these approaches seek to characterize and understand the way different lexical forms encode social meaning–information that communicates aspect of a speakers' identity or situation in a social structure. This social meaning is understood to be separate from the conceptual structure content, or

[3]There is a large literature on lexical-semantic variation of the inverse (relative to the topic here) kind, which relates to the plurality of lexical items that can exist, particularly across varieties of the same language, to refer to a given item. This is a case of one meaning and many markers, such as the use of the word *cooler* in the United States to describe a insulated container for storing cold consumables in contrast to the use of the word *chilly-bin* to describe that very item in New Zealand. Lexicographers have found a plethora of largely sociohistorical reasons for this multiple-marker system, such as in the case of the *soda/pop* distinction in the United States (von Schneidemesser, 1996), and connect the proliferation of these terms to interactions of sociocultural and linguistic factors, particularly in multilingual communities (e.g. Adegbija, 1989).

[4]Instead, the focus in this dissertation is on the situation in which one marker can encode or refer to many meanings (Deo, 2015a). This is largely related to the phenomenon described as polysemy, as in the case of the examples in (3), in which one marker can convey several related meanings. I do not use the term polysemy here for a few reasons, the principal one being the inherent dependence on the memorized listing of multiple forms, which may or may not be conceptually structured or constrained by capacity limitations. As discussed in Chapter 2, a polysemy account for meaning variation is not sufficiently explanatory to account for the phenomenon as a whole.

linguistic or conceptual meaning, that is directly captured in the process of lexicalization, as described above.[5]

Other efforts to understanding meaning variation have also been made through computational modeling, particularly for characterizing the relationship between quantified lexical forms and quantified word meanings ('senses') (see Eger and Mehler, 2016; Kulkarni, 2017; Tahmasebi et al., 2018; Schlechtweg and Walde, 2020). While such models may elucidate properties of the dynamics of lexical items competing for conceptual structure representation, they rely on measures of semantic relatedness that are quantified through emergent colocation frequences and other inductive techniques that "black-box" the structure and function of the mind. Therefore, they do not address the question of how the cognitive system generates meaning variation, so I consider these approaches to be complementary but distinct from mine here due to this fundamental divergence.

Finally, within more traditionally conceived linguistic disciplines, meaning variation, broadly construed, has been studied in the crosslinguistic differences in how language-specific lexical structures encode semantic categories such as the mass/count distinction (Chierchia, 2010) or property concepts (Francez and Koontz-Garboden, 2015). The extension of this instantiation of meaning variation naturally extends into meaning change, with a correspondingly wide array of proposals ranging from completely random and asystematic (Litty et al., 2016, a.o.) to crosslinguistically universal trajectories of change constrained by the properties of the linguistic (and presumably cognitive) system (Traugott, 1980; Dahl, 1985; Bybee, 1994; Heine, 1997, a.o.). These approaches, however, often still maintain a strictly quantized conceptual meaning system, exemplified by the seven property concepts defined by Dixon (1982), such that language-specific lexical structures can map onto them in one-to-one relationships. Each of

[5]Though, the division between conceptual meaning and social meaning is of course already porous and likely a mere construct put in place for "simplicity" of the act of studying them. This discussion leads naturally into understanding language and linguistic structures to be communicative resources and tools, a view that does not permit the setting aside of different theoretically imposed divisions in the study of meaning (Wiese and Rehbein, 2016).

these approaches described above addresses necessary components of the overall setup; while they acknowledge other implicated factors, they are often not focused explicitly on capturing the conceptual and cognitive rooting of linguistic meaning, due to research scope, methodological capability, or theoretical framework.

In sum, I define meaning variation, for present purposes, to be situations in which a single lexical structure encodes a superficially multiple number of non-identical chunks of conceptual structure, independent of the additional social meaning that can be communicated additionally through the use of the lexical structure. These situations have often been designated with a "problem" status because they violate the premise of one-to-one sign-meaning correspondences However, the cognitive embedding of the language system that I have described here shifts this perspective of meaning variation from being a problem to being a fundamental property.

1.3.4 Committing to a cognitively grounded linguistic analysis

My approach toward understanding the relationship between linguistic semantic variation and variability in the underlying cognitive system stems from the constraint of a psychological reality of language in linguistic modeling and theory. This constraint has two major consequences for the model of meaning variation: **(a)** each aspect of the analysis will be both motivated and constrained by cognitive principles and prioritize psychological plausibility and parsimony, and **(b)** each component of the model will be testable using neuropsychological methods and, crucially, falsifiable.

The above discussion has presented the relationship between lexical structure and conceptual structure: that conceptual structure is associated with a phonological structure to form a lexical item, and therefore lexical semantic content is rooted in conceptual structure and the behavior of this lexical item formation can serve as a psychological tool to study conceptual structure.

What sets this project apart is its cognitively constrained approach, which has two major ramifications for the investigation of linguistic meaning: **(a)** a real-time processing profile and **(b)** accounting for systematic cognitive variability. The first ramification means that a linguistic analysis must generate predictions for real-time processing, the processes by which individual language users produce and comprehend the linguistic structures under investigation. Specifically, how are the meanings constructed in real-time? These processing predictions must then also be testable and falsifiable through real-time processing methods. The second ramification means that variability must be taken to be intrinsic to the way that human language systems work. If variability is intrinsic to the cognitive system and language emerges from the cognitive system, then known dimensions of cognitive variability should contribute to and affect the processing of language. Through this dissertation, I hope to not only propose a neurocognitive model of the real-time processing of *have*-sentences emerging from a linguistic analysis, but also to substantiate this model with multi-modal evidence and incorporate into it quantifiable measures of cognitive variability.

I now return to the specific linguistic phenomenon through which I investigate the relationship between linguistic, conceptual, and cognitive variability–English *have*-sentences–and map out the major components of the research.

1.4 The origin of variants: three ingredients for meaning variation and change

Understanding meaning variation as an inherent property or natural phenomenon allows for a more cognitively broad approach toward understanding its properties. I take this phenomenon to emerge from variability in at least three components of the language system in its neurocognitive embedding: lexical, conceptual, and cognitive. Instead of tabling the property of variability due to difficulty in operationalizing it, we can create a more ecologically valid understanding of the language system by incorporating variability as a degree of freedom by implementing higher-dimensional models. So, in order to address the question above about the factors that contribute to meaning variation and their interactions with each other, I present a model centered around these three types of variability within the language system as the ingredients for a neurocognitive model of meaning variation.

1.4.1 Context-dependent lexical meaning

The first level of variability is at the level of lexical structure, specifically manifesting as context-dependent lexical meaning, which is lexical meaning that is continuous or connected with its contextual implementation. As described above in the 'cat' example, lexical items appear in larger morphosyntactic, physical, and social contexts associated with complete communicative acts; these contextualized lexical items are produced and comprehended by individuals, who designed them with specific goals and interlocutors in mind. Recognizing these contextual factors can help hone down the intended communication from the rich conceptual structure chunk identified by a specific lexical item.

To implement this for the case of English *have*-sentences, in Chapter 2 I propose a novel analysis of English *have* and *have*-sentences in which *have* encodes a generalized relational meaning that encompasses locative and possessive meanings that is disambiguated by the degree of causality perceived in a given situation. The lexical analysis specifically sanctions the role of context in the lexical meaning itself as a key contributor to the disambiguation between the possible readings of the generalized relational meaning.

1.4.2 Conceptual gradience

The context-dependence of lexical meaning serves the variability in its underlying conceptual structure, which is inherently gradient due to the rich set of gradient percepts that create it, in contrast to a view of conceptual meaning as a memorized list of atomic units. This means that often-atomized linguistic categories, such as locative or possessive relations, or even causality, are grown out of gradient distributions of underlying percepts rather than being categorical and homogeneous.

To implement this for the case of English *have*-sentences, in Chapter 3 I propose a gradient conceptual infrastructure (GCI) that organizes all the conceptually possible relational meanings in a structured fashion, which in turn gives rise to its attested crosslinguistic typological, diachronic, and developmental patterns. Its gradience emerges from the intersection of two independently studied conceptual features.

1.4.3 Cognitive variability

The use of a context-dependent lexical meaning with a communicative purpose is constrained by the properties of a given communicator's cognitive system, which is inherently variable across populations along a number of dimensions. Accordingly, linguistic variation is rooted, at least in part, the variable cognitive style of a speaker/comprehender, specifically in how an individual is able to make use of contextual information to facilitate downstream processing.

To implement this, in Chapter 4 I motivate a cognitive dimension of variability targeting an individual's ability to make use of contextual information and identify an independently arising psychometric tool to quantify it. The ability is *linguistic context-sensitivity*, defined as the capacity of a neurocognitive linguistic system to identify and integrate information from the communicative context required by the lexical meaning of a given expression in that context (Zhang et al., 2022).

1.4.4 Meaning variation emerges out of the real-time implementation of the three ingredients

These three ingredients together serve as the origin of meaning variation; the actuation of variation takes place during the real-time implementation of context-dependent lexical meanings by individual speaker/comprehenders, whose different degrees of context-sensitivity differentially highlight different parts of the broader conceptual structure invoked by the lexical structure used. That is to say, conceptual structure identified by lexical structures and context cooperate in real-time by modulating the salience of possible readings of an ambiguous *have*-sentence; the way that individuals are able to do this contextually guided comprehension process gives rises to structured variation in the meanings associated with the lexical item *have*.

This model of meaning variation is neuropsychologically grounded, allowing for neuropsychological research techniques to assess its viability. In particular, the linguistic analysis of the meaning of *have* generates real-time processing predictions that can be tested, grounding the linguistic behavior of the lexical item into the actual function of the psychological system.

1.5 Structure of the dissertation

The layout of the dissertation follows from the layout of the three ingredients for a model of meaning variation and their interaction during real-time language processing. In **Chapter 2**, I delineate the semantic repertoire of *have* and propose a linguistic analysis of *have* as a generalized causal relation meaning, which can be disambiguated by explicit lexical or contextual strategies; I also present **Study 1a**, which shows that bare locative *have*-sentences are acceptable to native speakers with the right context, the first evidence supporting this analysis. In **Chapter 3**, I model the underlying conceptual structure as a continuous space using two conceptual features underlying the perception and evaluation of causality, and show how this gradient conceptual infrastructure accounts for widespread crosslinguistic lexicalization and grammaticalization patterns of relational meanings. Crucially, *have* is situated as yet another crosslinguistically regular linguistic instantiation of this conceptual meaning, rather than an anomalous problem of meaning variation. In **Chapter 4**, I introduce a dimension of cognitive variability, linguistic context-sensitivity, that predicts the degree to which comprehenders show the contextual facilitation of *have*-sentences (**Study 1b**), and a novel psychometric tool for quantifying this variability.

In **Chapter 5**, I then tie together the three ingredients of a model of meaning variation compositionally and outline the real-time processing predictions generated from the linguistic analysis. In **Chapters 6 and 7**, I present two real-time processing studies that bear out the predictions of my analysis in that the comprehension of locative *have*-sentences is a standard semantic contextualization operation and not one of syntactic repair **Studies 2 and 3**. Furthermore, the degree to which individual comprehenders performed this semantic contextualization correlated with their scores on the measure of linguistic context-sensitivity. In **Chapter 8**, I present results from a neuroimaging that further illuminate the processing profile of *have*-sentences as a normal process of lexico-conceptual composition paired with semantic contextualization, as well as ground the linguistic representation of location and causality in neural function (**Study 4**). Furthermore, in both brain measures, comprehenders showed variability in the degree to which they relied on compositional or contextualization for comprehending these *have*-sentences; the degree of context-sensitivity predicted divergent speaker-strategies in assessing the boundary between and making use of lexical and contextual meaning.

In sum, the dissertation shows that the phenomenon of language and meaning variation is rooted in the structure of the mind. Lexical structures identify rich conceptual structures in an underspecified way, by virtue of their respective natures. Individuals deploy these structures in context with communicative intent; the formulation and interpretation of this composite message is subject to their individual cognitive styles and degree of context-sensitivity. Only through the variable real-time implementation of these linguistic structures can meaning variation emerge. The contributions, uniqueness/novelty, and takeaways of this dissertation all stem from the neurocognitive grounding of this linguistic model of meaning variation.

Part I

Ingredients for a model of meaning variation

Chapter 2

Context-dependent lexical meaning: the case of English *have*

Contents

2.1 Introduction

In this chapter, I introduce the first component of the model of meaning variation, which is a context-dependent lexical semantics. I present data illustrating the meaning variability observed in English *have*-sentences as well as the key analyses proposed thus far to account for such variability (§2.2). In this milieu, I situate my own lexical-semantic proposal in which English *have* lexicalizes a single relational meaning that captures the degree of causal potential between two entities (§2.3). Crucially, this proposal predicts that the meaning of a *have*-sentence is context-dependent; I support this prediction with an experimental study showing that relevant context can facilitate otherwise dispreferred readings of *have*-sentences (§2.4). I discuss the linguistic consequences of the main implications of how the act of communicating a *have*-sentence is an active contextual-modulation strategy. This last discussion leads to the second and third components of the model of meaning variation: a gradient underlying conceptual structure, which constrains the lexical semantics (Chapter 3), and systematic variability within a speech community in how individuals make use of context (Chapter 4).

2.2 The (too?) many meanings of English *have*

While the verb *have* is typically understood to be the canonical device to express possession relations in English, it is well-known that *have*'s meaning is highly variable. In (4-6), I present a few examples from some recent linguistic investigations of English *have*, labeled with their respective authors' categorizations, to illustrate this point.

(4) From Ritter and Rosen (1997)
  a. John **has** a hat on today. [Locational]
  b. John **has** a sister. [Inalienable possession]
  c. John **has** a new car. [Alienable possession]

(5) From Sæbø (2009)
  a. The vinyl shop **has** all the latest releases on vinyl. ["the 'true verb' *have*"]
  b. My father **has** the farm next to the pub. ["the 'true verb' *have*"]
  c. America **has** enough enemies as it is. ["existential *have*"]
  d. You **have** a rich daddy and a good-lookin' mama. ["existential *have*"]

(6) From Myler (2014)

a. John **has** a Playstation 3. [Ownership]

b. John **has** a sister. [Kinship]

c. John **has** blue eyes. [Body part]

d. The stadium **has** two pubs flanking it. [Locative]

e. This table **has** four sturdy legs. [Part-Whole]

f. John **has** a cold. [Disease]

g. John **has** a great deal of resilience. [Attribute]

Myler (2016) describes such lexical semantic variability as a "too many meanings puzzle," characterizing the distribution of *have*-sentences as "a possession construction that can convey a myriad of unrelated meanings, like kinship, body parts, permanent ownership, abstract attributes, etc." He extends this puzzle to other languages, noting that such variability is observed crosslinguistically with *have*-type possessive devices. In my view, such widespread patterns suggest a re-framing of the situation from a different perspective. What are the situations that can be described using *have*-sentences and why do they cluster together in a way that matches *have*'s counterparts in languages across the world? I now address the first question by identifying an exhaustive list of the ways in which *have* is used in English, and a unifying lexical-semantic analysis for them. The second question about underlying conceptual infrastructure that organizes these meanings will be addressed in Chapter 3.

2.2.1 The possible meaning space of *have*

The purpose of the following section is to delineate the boundaries of a possible meaning space for *have*, by identifying a comprehensive list of its uses. Furthermore, I take the assumption that all such meanings are conceptually licensed uses of *have*, and that all of them must be accounted for in any given lexical analysis.

Synchronic meanings of *have*-sentences

I begin by presenting, in (7) the main categories of *have* sentences, as identified by the Oxford English Dictionary:

(7) Principal denotations of *have* (*have*, OED Online, 2015)

a. To come into possession of, and related senses

b. To experience, and related senses

c. To keep, hold, or maintain (with respect to a state or action), and related senses

d. To cause to come or become, and related senses.

e. As an auxiliary verb, used with the past participle of another verb to form the perfect.

f. With to-infinitive, in senses corresponding to MUST V.

The first category is noted explicitly in the OED entry to encompass "a range of senses, from permanent possession (as in *I have a house*) to temporary access to something, whether owned or not (as in *do you have a pen?*)." Within it, I identify five sub-categories, based on well-described conceptual and linguistic relations, such as alienable vs. inalienable possession and location; the final set is presented below in (8), alongside the most recent examples in the OED entry.

(8) From the Oxford English Dictionary (*have*, OED Online, 2015)

a. **Part-whole** - Ordinary interest, interested calculated on the basis of a year **having** only 360 days.

b. **Kinship** - I also **had** four sisters, which means I grew up with the right attitude towards women.

c. **Ownership**- I'd like to **have** a really good job, a nice car, a nice house.

d. **Control** - I'll bet she **has** her spice rack arranged in alphabetical order.

e. **Location/proximity** - I thanked him and told him he **had** a dog turd on his shoe.

f. **Experience**[1] - I **had** weird dreams last night.

[1] I include in this category the so-called 'light verb' uses of *have*, e.g. *have a chat*, *have a bath* based on the OED organization; light verbs have been analyzed differently in terms of their semantic composition, in that they contribute Aktionsart to a deverbal noun (see Wittenberg and Piñango, 2011; Wittenberg et al., 2014).

g. **Causative** - The Federalist party **had** him before the bar of the house and tried to expel him.

h. **Auxiliary (perfect)** - Too much political change **has** lowered morale.

i. **Modal (deontic)** - You will **have** to enter the username and password that corresponds to your account.

The diachronic context

In order to understand any possible structure within the set of *have*-sentences, I turn to potential diachronic evidence. The various meanings of *have* are typically understood to have entered the language relatively wholesale during the later Old English period (Hayase, 2000; Abend, 2006); within Modern English, they do not show any sort of diachronic patterning. The earliest attestations of *have*, as 'to grasp/hold' lie in the 9th century AD, and are restricted to direct physical contact and manual control. By the end of the first millennium, however, the full range of possessive-related, causative, light verb, and modal uses are documented in *have*-sentences (Traugott, 1999; Cameron et al., 2018). The loss of the direct physical contact constraint follows known patterns of semantic bleaching in a variety of domains (Deo, 2015b). The auxiliary uses of *have* do not have a clear origin, but may have entered the language after the Norman conquest of 1066, which marks the beginning of Middle English and the influence of Romance through Anglo-Norman. The OED notes that *have* is connected to both the German *habban* and the Anglo-Norman/Old French *aver*, which shared some possessive meanings but was a key auxiliary verb; the period of Norman occupancy is understood to have contributed semantic influence from *aver* to *habban*, giving rise to the contemporary semantic variability of *have*. Figure 2.1 shows the oldest attested example for each of the meaning types in (8), contextualized in the timeline with key landmarks in the development of the English language.

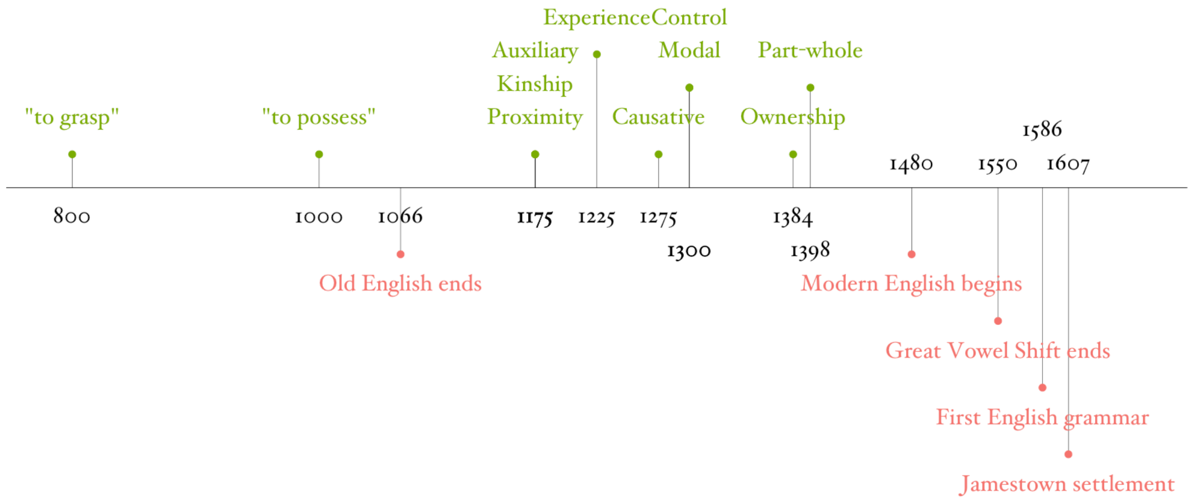


Figure 2.1: Timeline of first attestation of each *have*-sentence meaning from the OED.

Overall, I take the relative stability in the semantic variability of *have*-sentences over the past millennium to indicate the "core-ness" of these meanings of *have*; that is, it is not the case that any one meaning emerged clearly out of another as a recent development.[2] I return to this point later on in the chapter, in §3.2, when discussing well-described diachronic grammaticalization pathways that encompass these meanings. Without a clear diachronic pattern to structure the meaning variability, I turn to other evidence to identify possible sub-groupings within this set.

2.2.2 A taxonomy of meanings

The first step toward understanding the variability across a single lexical item's meanings is by identifying major groupings within the set. The first taxon I identify is the widely reported location-possession-existence (LPE) group of meanings (Lyons, 1967), motivated by two linguistic distinctions. At a comparative level, languages across the world encode the notions of

[2]That said, the mere existence of these readings at a specific historical point does not necessarily rule out the possibility of a diachronic trajectory: Fuchs (2020) shows a diachronic pathway based on changes in the relative frequency of usage, rather than the absolute presence or absence of a reading at some point in time. This approach is a possible avenue of future work into the diachronicity of English *have*.

location and possession using a single morphosyntactic form (Clark, 1978; Freeze, 1992; Stassen, 2009, a.o.). This crosslinguistic lexical conflation, manifested as morphological syncretism, is attested in Indo-European, Finno-Ugric, Australian, Dravidian, African, Sino-Tibetan, and indigenous American languages (Aristar, 1996; Heine, 1997; Tham, 2004); such a widespread pattern of syncretism suggests that these LPE meanings could be connected at a deeper, conceptual level, rather than a genetically descended linguistic mechanism (Clark, 1973; Jackendoff, 1990; Clark, 2004; Koch, 2012). At a syntactic level, *have*'s LPE meanings share a core NP-V-NP structure, with an optional PP, whereas *have*'s other uses have two verbs (Causative - *I had my kid walk the dog*, Auxiliary *I have walked the dog*, and Modal *I have to walk the dog*). The Experience/light verb use of *have* does not directly take another verb, but the second NP in the construction represents some sort of event (*I had a party*, *I had a bath*), consistent with the understanding that light verbs take as their complement a deverbal noun, which is a noun with the meaning of a verb (Wittenberg and Piñango, 2011). More generally, the distinction between *have*'s LPE and other meanings is whether its complement is a conceptual entity or event.

Relational uses

I will refer to the so-called location-possession-existence (LPE) meanings as **relational** uses of *have*, as they directly specify the relationship between the two entities in a *have*-sentence. Starting from Lyons (1967), much work has investigated the lexicalization patterns of these meanings in English, which revolve principally around *have* and *be*, with the former expressing locative and possessive relations, and the latter expressing locative and existential relations. While Lyons (1967) notes that the specific contribution of *have* as a lexical item is not clear in English, similar forms in Latin, Russian, Mandarin Chinese, and numerous other languages illustrate the larger idea that the expression of location, possession, and existence are inextricably connected in many of the world's languages. This analytical difficulty has not yet been resolved in subsequent efforts to propose a single syntactic structure for *have* (Myler (2016) describing Freeze, 1992; Kayne, 1993; Harley, 1997; Stassen, 2009, a.o.).

While these relational meanings have often been categorized into subgroups like alienable possession, part-whole, or location, these readings are not always clearly categorizable. I present in (9) a number of these relations between a variety of nominals using the English genitive *'s*, the other canonical possessive device in the language.

(9) a. Sue's chair is broken. (in a waiting room)
b. Sue's chair is broken. (in her office)
c. Sue's school is down the street.
d. The chauffeur's car is in the shop right now. (the car driven by the chauffeur)
e. Sue's car is in the shop right now. (the car owned by Sue)
f. Sue's cat is sick.
g. Sue's haircut is really striking.
h. Sue's hair is turning gray.
i. Sue's unborn baby is kicking a lot these days.
j. Sue's heart is mildly hypertrophic.
k. Sue's liver is taking a beating from all her drinking.
l. Sue's daughter is very independent, she wants nothing to do with Sue.
m. Sue's daughter is her best friend.
n. The car's hood is dented.

These minimally differing sentences illustrate porous boundaries between the categories of, say, control vs. ownership, incidental proximity vs. non-incidental proximity, alienable possession vs. part-whole, etc., illustrating lexical ambiguity within this cluster of meanings. The takeaway from these examples is that there may be a gradient relationship between locative and possessive meanings (where does location end and possession begin?), in contrast to the way that relational *have* seems to differ categorically from auxiliary or light verb *have*.

Notably, *have* has not been described to permit the expression of existential relations. Here, (10a-b) show a direct mismatch between the use of *be* and *have* with expletive subjects for an existential, while the "transformationally related" (Lyons, 1967) *have*-sentence seems to convey a locative relation. The difference between existence and location has been a topic of debate also for philosophers of language (Kahn, 1966).

(10) Existential *have*

a. There is a bear in the meadow. vs. *There has a bear in the meadow. vs. The meadow **has** a bear (in it).

b. There are bears (in North America) vs. North America **has** bears.

However, *have*-type verbs across the world's languages, like Mandarin *you* (11-12), typically do permit a parallel structure for existential and locative relations. (Koch, 2012)

(11) Existential *you*

a. ***you*** *yi* *ben* *shu*
you one CL book

'There is a book.'

(12) Locative *you*

a. *zhuozi-* *shang* ***you*** *yi* *ben* *shu*
table- on *you* one CL book

b. ***you*** *yi* *ben* *shu* *zai* *zhuozi-* *shang*
you one CL book at table- on

'There is a book on the table.'

Accordingly, I take the unavailability of the *be*-like existential *have*-sentence[3] to result from an English language-specific lexical requirement for two non-expletive arguments, rather than a conceptual division between the existential and locative meanings. In contrast, the *have*-type

[3]This distinction is also related to an information structural parameter–the rheme/theme distinction–which I discuss below in Section 2.3.

verb *you* in Mandarin, which does not require the same argument structure, accommodates all three LPE forms.

It is clear that the lexical item *have* shows meaning variability within this group of relational meanings; I take this meaning cluster to be the "core" meanings of *have*, similar to 'the "true verb' *have*" meanings described by Sæbø (2009). Moving forward, I focus on these relational uses of *have* (excluding existentials) here in Chapter 2.

Non-relational uses

I take the non-relational *have*-sentences to be secondary; I briefly describe these meanings here.

Causative *have*-sentences, shown in (13), take the form NP-*have*-NP-VP and convey a situation where the subject compels through some means the object to perform some action (Ritter and Rosen, 1991).

(13) Causative *have*, reproduced from Ritter and Rosen (1991)
  a. Sheila **had** Ralph pick up the kids.
  b. Margaret **had** Dennis wash the car.
  c. Brian **had** George call up the reserves.

These causatives are sometimes separated into adversative (14) and benefactive[4] (15) uses, though the boundaries between these and so-called experiencer *have*-sentences (16) are not well-defined or understood (Tantos, 2009).

(14) Adversative: The breakup **had** me upset for a whole month.

[4]There exists a discussion in the literature regarding the relationship between possession and benefaction (Pinker, 1989; Croft, 1991; Goldberg, 1995; Heine, 1997; Lichtenberk, 2002); while some claim a direct grammaticalization pathway from benefaction to possession, others take the two meanings to be separate, and connected through mechanisms like metaphor. For the purposes here, I retain the separation of causative/benefactive *have*-sentences from core possessive *have*-sentences.

(15) Benefactive: The driver **had** the car washed for me.

(16) Experiencer: The biologist **had** all her mice die on her.

Moreover, well-reported light-verb uses of *have* (17) are not clearly distinguishable, semantically, from experiencer *have*-sentences, though of course their syntactic forms differ. Crucially, light-verb *have* seems to only be able to convey a passive experiencer role, unlike, say, *make* (18) (Wittenberg and Piñango, 2011; Wittenberg et al., 2014).

(17) a. Harry **had** an operation/accident/massage.
 b. *Fanny **had** a kick/stab/punch/kiss at Gerry.

(18) a. Harry made an order. (=gave)
 b. Harry **had** an order. (=received)

The remaining two uses of *have*-sentences both directly take as a complement another verb form: *have* is used to express perfective aspect independent of tense (19), with a past participle of another verb (Falk, 2008), as well as a deontic modal,[5] with an infinitival form of another verb (20).

(19) Auxiliary *have*
 a. I **have** already eaten today.
 b. I **had** already eaten.
 c. I will **have** left by the time you get here.

[5]There also exists a discussion in the literature regarding the relationship between possession and modal necessity (Bjorkman and Cowper, 2016; Cowper and Hall, 2017), arising from parallels in their syntactic and semantic composition algorithms. Again, for the purposes here, I retain the separation of these modal uses from the core relational *have*-sentences, and take up this question in Chapter 4.

(20) Modal *have*

a. I **have** to eat lunch before 1pm today. (=must)

Again, these kinds of *have*-sentences I take to lie outside of the core LPE meaning space, which is shared by *have* and *have*-type verbs crosslinguistically.

2.2.3 Approaches toward lexicalizing meaning variability

Turning back to the "core" relational (locative-possessive) *have*-sentences, we see a clear example of a one lexical structure-to-many meanings mapping. Though it may be difficult–Myler (2016), as the most comprehensive recent analysis of *have*, describes this as a "too many meanings" problem–the puzzle lies in understanding how to account for such a pattern in a principled way. Generally, there are two logical approaches to understanding any one-to-many-mapping problem: underspecification, which involves outsourcing the complexity or plurality in meanings to another system and maintaining a single lexical entry, or overspecification, which involves postulating multiple lexical entries to cover the multiple meanings

Both kinds of approaches have been explored in the literature, though a better characterization of the existing work is perhaps by degree of underspecification. By this, I mean that all approaches recognize the meaning variability of *have*-sentences and the broader location-possession-existence domain, but place the variability "burden" in different areas: either increasing the number of phonologically identical lexical forms, or conversely, the number of external (to the lexical item) sources of these meanings. These proposals range from a single, completely meaningless *have* that acts simply as an identity function for a wide array of predicates to a theoretically unlimited number of different lexical items, sharing the same phonological form *have*, that each express a different meaning. The former proposal family (described in §2.2.3 below) represents the dominant or *status quo* account by virtue of the history, recency, and depth of its constituent proposals.

Directly below, I briefly summarize the two poles of this spectrum, as well as a few proposals that lie in key intermediate positions–this characterization serves a similar purpose as the monosemist-polysemist-homonymist idealization of multifunctionality presented in Haspelmath (2003). I note, however, that these proposals by and large are not necessarily investigating the source of these meaning clusters in English and across languages, and instead, have separate foci, such as identifying a common syntactic structure for English auxiliary verbs or characterizing typological variation within this domain. Accordingly, some of the differences in the proposals are due to questions external to the meaning variability problem. The purpose of this summary is to provide a context for my approach, which is a reframing of the question as addressing the underlying source and motivation for these meaning clusters, rather than addressing the specific algorithmic mechanisms for composing *have*-sentences syntactically or semantically. I take this former question to be the primary focus of this chapter: **why** do locative and possessive relations get encoded by English *have* and *have*-type verbs across the world's languages? What about **the meaning** of *have* enables it to convey this cluster of meanings?

Unlimited meanings, unlimited (related) lexical entries

At one end of the spectrum lies the overspecification approach, which has sought to enumerate the plurality of meanings of *have*-sentences and of the location-possession domain. This approach takes as its fundamental assumption that the process of lexicalization will inherently result in one-to-many meaning mappings, and can capture either cases of related (*smoke*: to cook a fish using smoke vs. to inhale smoke produced by a cigarette) and unrelated (*bank*: the piece of land abutting a river vs. the financial entity) meanings. This overspecification, in fact, is rather a case of one-to-one specification; each meaning associated with a *have*-sentence is assigned a separate, but potentially related, lexical entry (21). While Jackendoff (1983) describes the possibility of an underlying shared infrastructure for relational (location-possession-existence) meanings, later work and conversation has made it clear that his view takes *have* to be a case of simple polysemy, where the actual lexical meanings are stored in separate lexical entries that share a common phonological form (Jackendoff, 1997, Jackendoff, 2019, *personal communication*).

(21) a. Sue has$_{locative}$ a hat on today.
b. Sue has$_{kinship}$ a sister.
c. Sue has$_{ownership}$ a new car.

This analysis derives from attempting to characterize the semantic variability of *have*-sentences, and does not address issues of economy and parsimony in language, as the cost to polysemy and homonymy is increased demands on contextualization during real-time production and comprehension as well as on the long-term memory aspect of the mental lexicon. Crucially, it does not address the question of the underlying conceptual infrastructure that would permit and/or promote such lexical polysemy–it only states that *have* is polysemous: specifically, that there is a proximity *have*, a part-whole *have*, a locative *have*, etc. (Jackendoff, 2019, *p. c.*).

Four meanings, one lexical entry

In a similar way, a number of other approaches have characterized a more intermediate case, whereby *have* in English and *have*-type sentences across languages are able to lexicalize in different ways four discrete categories of meanings: ownership, possession, location, and existence (Clark, 1978; Bickerton, 1981; Koch, 2012). In this case, these four meanings are ontologically separate but connected through metaphor; that is, possession can be thought of as metaphorical location, in the same way that spatial adpositions are often harnessed within a language to describe time. Specifically, the proposal here is that these meanings form a composite semantic space, reproduced from Koch (2012) in Figure 2.2, whereby adjacent meanings can be lexicalized within a language, and that typological variation follows from such an underlying layout (Clark, 1978; Bickerton, 1981).

Figure 2.2: A semantic space for ownership–possession–location–existence (Koch, 2012).

OWNERSHIP	**LOCATION**
POSSESSION	**EXISTENCE**

These proposals are typological investigations of relational meanings and seek to map out the possible crosslinguistic patterns of lexicalization for these meanings. While they do shed insight on the ways in which different languages lexically conflate meanings associated with *have*-type sentences, again, they do not directly address the question of what about the content of the meanings themselves allows such lexical groupings. That is, they take the entire space to represent relational meanings, but rely on metaphor alone to explain how the meanings are related and take the crosslinguistic patterns to result from descent or contact. The takeaway from these approaches is a more constrained conceptual inventory for the meanings of *have*-sentences than the Jackendoffian approach described above.

One meaning, one lexical entry

The next family of proposals is a stronger instantiation of the aforementioned idea: instead of four categories of meanings, these approaches conceptualize all the relational meanings as modified or marked forms of location, represented roughly as *x is at y* (Heine, 1997; DeLancey, 2000; Baron and Herslund, 2001).[6] What differentiates the readings of specific *have*-sentences are the "relative salience" of the two arguments, an evaluation made based on argument-inherent and contextually relevant properties, like animacy (Heine, 1997, 2001). However, each of these proposals breaks down the single meaning into categorical components: Baron and Herslund (2001) proposes three sub-categories of the larger locational meaning while Heine

[6]While Payne (2009) presents data showing complete lexical categoricalization between locative and possessive meanings in Maa (Nilotic) and argues therefore for at least two categories of meanings, I consider her proposal to lie in this family, as complete lexical categoricalization is not necessarily indicative of an underlying conceptual division, as I will discuss further in Sections 2.3 and 2.6.

(1997) proposes eight. In my view, though these proposals claim to have one underlying meaning, they in fact define a categorical number of meanings which, in the case of Baron and Herslund (2001), are not clearly locational. For example, the second of the three sub-meanings for the local relation *have* is characterized as "the object noun denotes part of the subject noun's possessions (e.g. house —Charles), which is typically the case when the subject is animate and the object is a non-relational noun." As a result, they do not address the actual unification of these meanings, and instead, provide another set of precise characterizations of the various meanings of *have*-sentences.

Status quo: no meaning, one lexical entry

At the other end of the spectrum lies a group of proposals that takes a single lexical entry for have, but eliminates the meanings of *have*-sentences entirely. The semantic elimination approach is motivated by the fact that *have*, and *have*-type verbs cross-linguistically, is used as an auxiliary verb alongside the copula *be*. These approaches have sought to identify a unified syntax and semantics for auxiliary verbs in structure-building, rather than trying to account for the meaning variability of *have*-sentences, and represent the dominant theoretical framework for the discussion of *have*-sentences by virtue of representation in the literature.

Noting that auxiliary verbs do not contribute their own semantics to a sentence (and instead, are the carriers of tense, aspect, and modality morphology), Freeze (1992) and Kayne (1993), among others, claim that *have* is a semantically null copula with an extra argument position representing a location–essentially a transitive form of *be*. I hereby name this family of proposals the "transitive copula" account for English *have*. This enriched "transitive copula" refers to a syntax that is derived from the structure of a copula and adds some other information, e.g. another functional projection, that adds only syntactic structure and is radically underspecified with respect to semantics.[7] Hoekstra, in Cinque and Kayne (1994), names *have*

[7] I employ this nomenclature also to underscore the semantic emptiness of this family of accounts.

explicitly as the transitive form of *be*. Similarly, Ritter and Rosen (1997) reduce the lexical item to a copula that permits the insertion of an extra argument as a second functional projection. In this analysis, the auxiliaries *be* and *have* differ minimally in the number of functional projections; *have* consequently permits the expression of transitive predicates.[8]

The basis for a transitive copula analysis of *have* in English stems from *have*'s properties as an auxiliary: Kayne (1993), à la Benveniste (1966), analyzes *have*$_{aux}$ as an evolutionary parallel to *have*$_{poss}$ and concludes that the alternation between the two auxiliaries (*have* and *be*) in English is determined by the properties of its participial clause complement. Though both auxiliaries are semantically underspecified, English *have* is equivalent to the copula *be* with an abstract preposition (expressed through a copular feature, [+LOC]) (Freeze, 1992), as in (22).

(22) *Larkee-kee paas kuttaa hai.* *[Hindi]*
boy.OBL-GEN PROX dog COP.3SG.PRES-[+LOC]
The boy has a dog.

The *have* as *be*+LOC analysis connects to the location-centric approach of the aforementioned proposals, but again does not explain nor account for why possessive meanings can be expressed with a *be*+LOC structure.

Further work in this line of thought has gone further to semantically eliminate the meaning of *have*, by proposing that *have* is completely meaningless ($\lambda x.x$, according to Myler (2016)). Consequently, the various meanings of *have*-sentences derive from a series of silent functional projections in the syntax, specifically in the domain of the second DP in a *have*-sentence (Ritter and Rosen, 1997; Sæbø, 2009; Harley and Jung, 2015; Myler, 2016). Myler (2016) proposes that the underspecified *have* takes the syntactic form of a light verb (little-*v*) that differs minimally from the light verb *be* by the placement of a missing argument of the vP complement in

[8] Crucially, I do not take this transitive copula nomenclature to imply that *have* participates syntactic behaviors, like passivization, that are part of transitivity as a whole, but use the name solely to refer to this "extra syntactic argument relative to *be*" approach advanced by this family of approaches.

the Spec position of VoiceP. This argument is able to "house" a covert functional projection that contributes the specific meaning to a *have*-sentence. For example, ownership-type *have* sentences get their meanings from a silent PossP, locative-type *have*-sentences get their meanings from a silent or overt locative PredP, and control-type *have*-sentences get their meanings from a silent or overt "with x" PredP, to name a few (Myler, 2016).

The three representative proposals presented below in Table 2.1 can be generalized to a *have*$=$*be*$+x$ type, where x represents an additional argument or feature added to the structure of *be*, hence the '*have* = transitive *be*' transitive copula nomenclature.[9]

In a sense, this spectrum has come full circle to match with the first proposal of unlimited lexical entries, in that both posit a theoretically unlimited number of linguistic units to capture the multiplicity of meanings. Myler's framing of the puzzle of *have*, the "too many meanings problem", suggests that, in his view, there is no reason whatsoever to account for this variability in the use of a single lexical item, *have*, and no principled way to do so. He states in 2014, regarding his work and its precedents, "All of these [too many meanings] problems are eliminated if *have* is instead taken to be meaningless. The further an analysis pushes the idea that *have* is meaningless, the more successful it turns out to be." (p. 260).

[9]For my own proposal of a syntactic structure for *have*, see §2.3.2.

Table 2.1: Syntactic structures for *Have*

Syntax of *Be*	Syntax of *Have*	Source
[IP XP [I′ I YP]]	[IP XP [I′ I[+LOC] YP]]	Freeze (1992); Kayne (1993)
[F1P XP [F1′ F1 YP]]	[F1P XP [F1′ F1 [**F2P** YP [F2′ F2 asdf]]]]	Ritter and Rosen (1997)
[VoiceP $Voice_{\{\}}$ [vP v *be* [Comp PP/ApplP]]]	[VoiceP [DP **Arg_i of Comp**] [**voice′** $Voice_{\{D\}}$ [vP v *have* [Comp **One Arg_i missing**]]]]	Myler (2016)

Note: Key differences between the syntactic representations of *be* and *have* are in bold.

2.2.4 The value of meaning

The meaning of location, possession, and existence, expressed through *have*-sentences in English or otherwise crosslinguistically, are universal to the human language system and have, commensurately, been investigated in a variety of ways with a variety of goals. Here, I have provided a brief characterization of a spectrum of proposals based on their consequences for the behavior of lexicalization (which is not the majority's intended goal), and not based on the details of each theoretical framework.

I do not consider any of these proposals to be wrong; instead, I take them to be addressing different questions with different goals, resulting in consequences for other lines of inquiry probing the same linguistic phenomena. In particular, one consequence of the unification of *have* and *be*, and consequently the bleaching of *have*, from Freeze to Myler is a purported erasure of an entire body of detailed accounting of locative, possessive, and existential meanings and the ways in which they are lexically encoded. Because the variability emerges from to an unspecified number of different covert syntactic structures that compose with the identity function *have*, it remains to be understood why these meanings do indeed cluster together in *have*-sentences in English, and in similar sentences cross-linguistically. Specifically, if *have* is a transitive copula with the semantic denotation $\lambda x.x$, why is it the case that it expresses meanings of only existence, location, and possession types? These complete underspecification approaches ignore the systematic meaning patterns that do exist, as a byproduct of the pursuit of a different goal.

Most importantly, none of these accounts provides an explanation for the distribution of *have*'s many meanings, the seemingly gradient relationships between them, or makes predictions about how speakers and comprehenders use these sentences (since these were not part of their respective agendas). My view of the human language faculty is that its principal goal is to communicate meaning–lexical, linguistic, social, and otherwise–to our peers. I take the meanings themselves to have a level of import distinct from the specific structures through which meaning can be conveyed, and accordingly, place the focus back on the meaning of the lexical item *have*.

Instead of attempting to account for the semantic distribution of *have* as a by-product of its syntactic representation (and concluding there is no semantic content), I focus my investigation of the meaning of *have* and *have*-sentences on the meaning of *have* and *have*-sentences themselves. That is, instead of casting the puzzle of English *have* as a "too many meanings" (for one lexical item to convey) situation that does not clearly define the many meanings, I ask: what about these meanings themselves (versus other meanings) allows them to be captured by a single lexical item?

More broadly, I see two larger issues that remain unsolved. The first is the issue of categoricality vs. continuity–how many discrete categories do you need in order to account for a potentially gradient meaning continuum, without overburdening the model? This is a parsimony optimization problem. The second is understanding the cost of storage and implementation of these discrete units: what are the cognitive implications of acquiring and storing a theoretically unlimited number of covert syntactic heads or related lexical entries both to the memorial component of the mental lexicon and to the real-time implementation of expressions of relational meanings? In my proposal, I hope to address both of these issues by providing a conceptually grounded analysis of the variability in the meanings of *have*-sentences and a cognitively grounded account of how they interact with their linguistic contexts.

2.2.5 Approach: Conceptual unification

My analysis for English *have*-sentences represents a new approach toward understanding their observed variability: rather than arguing for a specific set of categorical meanings, my approach seeks to understand *why* and *how* these many readings are connected as a single, unified meaning. Instead of outsourcing the variability in meaning to covert syntactic configurations or accumulating them through polysemy, I will show how these readings are **lexically and**

conceptually structured in a way that explains the semantic variability observed in English *have*-sentences and situates it as a regular language-specific instantiation of a crosslinguistically frequent phenomenon, rather than an anomalous semantic puzzle.

This approach lies generally within the "one meaning, one lexical entry" family of proposals described above, except that instead of proposing a set of sub-meanings within one "location" meaning, my view is that ***have*** **(a) contributes a generalized meaning that is adaptable to a variety of situations but in a systematic way**, rather than being completely vacuous, **and (b) lexicalizes a unified, underlying conceptual infrastructure for relational meanings**. In a nutshell, I propose that *have* has a unified meaning of a causal potential relation between two entities, and that the resulting readings of *have*-sentences are conceptually principled and crosslinguistically consistent. In contrast, the *status quo*, transitive copula account proposes that *have* is completely meaningless and that the readings of *have*-sentences are not systematic or unifiable but, instead, are determined by language-specific covert syntactic mechanisms.

Accordingly, my proposal comprises three main components. The first (§2.3.1) is a unified lexical semantics for *have* which (a) captures in a conceptually unified way the relational meanings of *have*-sentences as a generalized causal potential relation and (b) also accounts for the non-relational meanings of *have*-sentences. The second (§2.3.2) is a lexical item representation, capturing the sound, form, and meaning of *have*, rooted in a processing model that gives rise to predictions about the psychological reality of *have*-sentences. And the third (Ch. 3) is the conceptual infrastructure that underlies the unified relational meanings. Directly below, I present my lexical-semantic analysis of English *have*.

2.3 Proposal: a unified meaning for English *have*

I now present a lexical-semantic analysis of English *have* that reconsiders the "too many meanings puzzle" as a conceptually unified single generalized relation between two entities. This analysis lies within the "one meaning, one lexical entry" family and takes the various labels for different readings of *have*-sentences to be flavors of a single meaning: the relation or degree of causal potential between two entities. This unified meaning can be specified with either explicit linguistic material or contextual information or implicit world knowledge; my account of *have*'s "too many meanings" takes these meanings to be systematically related and conceptually organized and consequently expressible by *have* in an ordinary way. In contrast, the transitive copula account of *have* takes these meanings to be uncharacterizable using a single overt syntax for *have* and therefore uses covert syntactic mechanisms along with an identity function to explain the observed semantic variability. While the target semantic variability is shared across both accounts, fundamentally, the proposals differ in what meaning is associated with the lexical item *have*: my proposal is that *have* has one generalized meaning characterizing the relationship between two entities, while the transitive copula account takes *have* to be a completely meaningless identity function.

The section is organized as follows: first, I present a lexico-semantic conceptual structure (LCS) representation of the word-meaning of English *have*, that shows how *have* lexicalizes the degree of causal potential between two entities, that is, the locative-type and possessive-type meanings associated with *have*. Next, I present a representation of the entire lexical item, consisting of sound, morphosyntax, and meaning information, and the consequences for a real-time and cognitively grounded implementation of *have*, that is, what are comprehenders doing when they encounter a *have*-sentence? The transitive copula account for *have*, in contrast, does not make predictions about how humans compose and comprehend *have*-sentences. Then, I introduce a test case for the two competing accounts, namely locative *have*-sentences without a locative prepositional phrase, which I call "bare" locative *have*-sentences. I conclude with an operationalized setup for an acceptability judgment study that assess the competing claims on these test sentences, which I detail in the next section.

2.3.1 The meaning of *have*: a lexico-conceptual semantic analysis

I present a lexico-conceptual semantic analysis of *have* which shows how the various meanings of *have*-sentences are organized around a generalized relation of the potential for causality between two entities. Crucially, this analysis illustrates the units of meaning that must be *understood* for the use of a *have*-sentence.

Conceptual causality as the basis of *have*

The key component of this analysis of *have* is a causative component. In this section, I highlight a handful of works from a large and incredibly rich literature on the nature of causality, its manifestation through language, and its conceptual and psychological basis.

First off, what is the evidence for causality in *have*-sentences? The first sign is the productive use of causative *have*-sentences (Butters and Stettler, 1986; Ritter and Rosen, 1991; Inoue, 1995), as in (23), reproduced from (13) above, which show semantic equivalency to the corresponding causative *make*-sentences. These sentences can also surface in a structure more similar to that of the relational *have*-sentences, as in (24).[10]

(23) Causative *have*

a. Sheila **had** Ralph pick up the kids.
b. Margaret **had** Dennis wash the car.
c. Brian **had** George call up the reserves.

[10]See Gilquin (2003) for even further description of the wide range of possible causative *have*-sentences.

(24) a. Sheila **had** the kids picked up.
b. Margaret **had** the car washed.
c. Brian **had** the reserves called up.

While I describe these sentences as being outside of the relational domain, there is a long-standing claim that possession is rooted in causality, specifically, that possession is caused or controlled location (Seiler, 1973; Hagège, 1993; Heine, 1997; Baron and Herslund, 2001; Stassen, 2009; Le Bruyn et al., 2016), as stated succinctly in Evans (1995): "X [the possessor] can expect Y [the possessee] to be in the same place as X when X wants, and X can do with Y what X wants." In fact, Belvin (1993) apply this idea directly to English by claiming that causative *have* and possessive *have* are the same, in that *have* denotes a control relation which is dependent on the properties of the entities involved; these properties can give rise to the causative, experiencer, and possessive relations encoded by *have* (see Belvin and Arnaiz, 1994; Belvin, 1996; Belvin and Den Dikken, 1997). The setup in which entities in a *have*-sentence carry information involving causality and control is paralleled in type-shifting accounts of possessive sentences (see Barker, 1991; Vikner and Jensen, 2002; Storto, 2005, a.o.).

How does linguistic causality connect with conceptual causality? The conceptual semantics framework (see below) represents lexical causality as two connected events, "Event_1 is perceived as causing Event_2" (Jackendoff, 2019), which is implicated in a variety of causative constructions and corresponds to the traditional periphrastic causative construction in (25b, 25c, or 25d versus 25a). The surface structure of the last sentence corresponds most clearly with the bi-eventive conceptual representation of causality.

(25) Periphrastic causative *have*, from Levin and Hovav (1994)
a. Antonia broke the vase.
b. Antonia made the vase break.
c. Antonia caused the vase to break.
d. Antonia caused the breaking of the vase.

What is the psychological basis of causality and its bi-event conceptual representation? Causality is the percept that in a sequence of events, the first event causes the second. The key component of causality itself is temporal precedence, which stems most basically from perception of a self-initiated movement followed by a second movement. The self-initiated movement is understood to be emerging from a causal agent. Representing causality and causal perception is a core cognition operation (Spelke and Kinzler, 2007; Carey, 2009), meaning that it is not unique to human cognition, and presumably is the single primary cognitive capacity universal to all organisms with nervous systems. The bi-eventive representation of causality is in fact grounded in most elementary behavior of neurons through the principle of Hebbian learning (spike-timing-dependent plasticity),which is commonly quoted as "Cells that fire together wire together," indicating that neurons that co-activate will develop a connection that facilitates this co-activation over time. However, this maxim is slightly misleading, as even Hebb himself stressed the importance that while one cell needs to "take part in the firing" of another, the basic mechanism is only triggered if the first cell activates slightly before, and crucially not simultaneously, as the second. All this is to say that the psychological perception and conceptual representation of causality emerges from the cellular level and manifests through numerous aspects of the cognitive system beyond language, (see Scholl and Tremoulet, 2000, a.o.).

How does conceptual causality give rise to linguistic causality? The connection between causal motion and linguistic causality could play out as follows: causal motion and the potential for causal motion is interpreted by the cognitive system as agency, agency is lexicalized or grammaticalized through animacy marking or is directly understood to be a property of a subset of entities (namely humans and most animals), and animacy contributes to a possessive readings of ambiguous relational markers (see §3.4), as the alienable/inalienable distinction is often connected to animacy requirements. While this pathway is but one instantiation, the connection between linguistic causality and conceptual causality is clear (see §3.3 for further discussion on the relationship between linguistic structure and conceptual structure).

This brief background on a causal component in *have*-sentences touch upon numerous existing and future avenues of crossdisciplinary research, though the majority of them will not be further discussed. The takeaway is that there is evidence for a conceptual component of causality in the lexical meaning of *have*; the status of this component will resurface at numerous points throughout the dissertation.

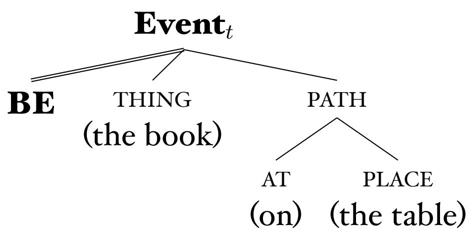
A conceptual semantics framework

Following Jackendoff (2019) (a summary of the framework detailed in Jackendoff, 1983, 1987; Pinker, 1989; Jackendoff, 1990; Pustejovsky, 1995; Jackendoff, 2002, 2007; Pinker, 2007), I propose a unified lexico-semantic conceptual structure (LCS) for English *have*. These formalisms from conceptual semantics are a tool to represent how domain-general conceptual structure is lexicalized into linguistic units, and how the different components of a lexical meaning are rooted in conceptual structure and connected together. Crucially, these LCS diagrams indicate what must be *understood* for a given meaning, not necessarily what must be said. The combinatorial units are few and compositionally simple: SITUATIONS (EVENT or STATE) are headed by conceptual functions (ACT/BE/GO/CAUSE) and take as arguments THING, PATH/PLACE, PROPERTY, MANNER or SITUATION.

The representation of the meaning of *have*

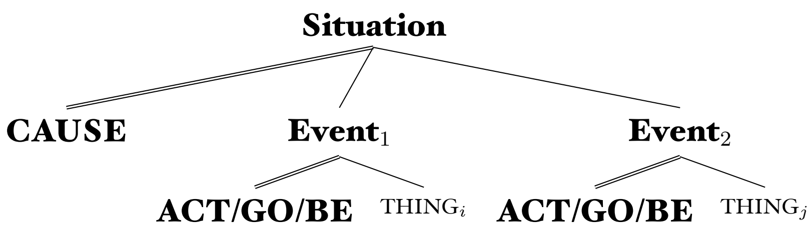
To start, I present the LCS of a prototypical locative relation (incidental proximity), which is represented as an inherently transient situation of an EVENT-type (26). Specifically, this LCS represents the meaning of an incidental proximity sentence as an "event at time *t* of a thing being at a place."

(26) LCS of incidental proximity (e.g. The book is on the table.)



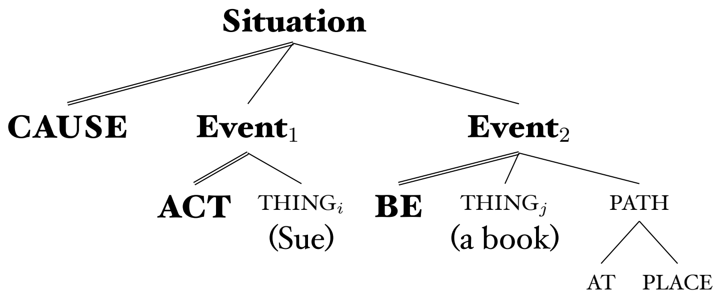
The LCS of *have* can be built simply by nesting the LCS of location in the standard CAUSE frame (27), which represents the meaning of a causal situation as "Event_1 is perceived as causing Event_2." This LCS frame is independently motivated and is the canonical representation for any causal component.

(27) LCS CAUSE frame



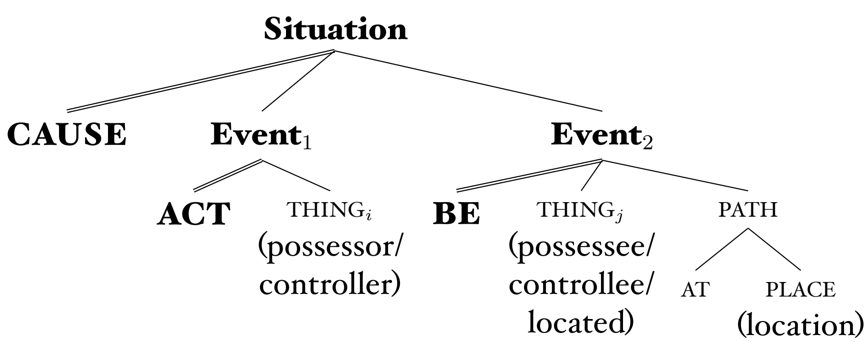
The nesting of the incidental proximity (location) LCS into the CAUSE frame creates a unified LCS for representing all relational meanings, including possessive meanings (28). In this LCS, the possessor is the causal $\mathbf{Event}_1$ actor, and a possessee is the $\mathbf{Event}_2$ actor. Specifically, this LCS represents the meaning of possession (THING_i has THING_j) as "something that THING_i does causes THING_j to be in a specific location."

(28) LCS of possession (e.g. Sue has a book.)



Thus, what a fundamental possession relation means is not only locative at its core, but also the obligatory control of a possessor over a possessee (and its location), coinciding with the "enriched location" account of possession (e.g. Kayne, 1993). Below, I present a generalized LCS for *have* (29), which shows the possible configurations for expressing the range of relational meanings. The crucial component of this structure is the incorporation of both possessor and location roles in the meaning of a *have*-sentence.

(29) LCS for relational meanings in a *have*-sentence.



This is the LCS representation that I propose for English *have*; retrieval of the lexical item *have* retrieves this lexico-semantic conceptual structure representation.[11],[12] If this structure is

[11] I describe the mechanics of the real-time processing of this LCS representation in Section 5.3.

[12] Here, I provide the beginnings of a formal implementation with the broader goal of demonstrating notational equivalency. Semantically, I define *have* as a relational meaning in which there is a core locative component as well as a variable R for an additional relational meaning, as in (30). This machinery is a straightforward manifestation of standard locative and relational semantics (see Storto, 2005; Peters and Westerståhl, 2013, a.o.) and also makes use of an understood and not obligatorily spelled out location ℓ (Francez, 2007; Phillips, 2021, see).

what *have* retrieves, then it logically follows that *have* should be able to express the wide variety of locative and possessive meanings that are well-attested in the literature.

(30) $[\![have]\!] = \lambda y_e \lambda x_e.\text{Loc}(y_e, \ell) \wedge R(y_e, x_e)$

I borrow from Karvovskaya (2018) the notion that the two possible relations (location and possession, in this example) lie in a Horn scale in which $\text{Poss}(x, y)$ is an informationally richer meaning than $\text{Loc}(x, y)$, because it entails the locative relation but also gives additional meaning in the form of a causal backstory (e.g. *The car is on the driveway* vs. *The car is on the driveway because Sue owns it*). This presuppositional asymmetry ($\langle \text{Loc}(x, y), \text{Poss}(x, y)\rangle$ in the $\langle w, s\rangle$ form), which is context-dependent, therefore is subject to Heim's Maximize Presupposition, corroborating the evidence from Study 1a (detailed in §2.4) that for a bare *have*-sentence, locative readings are highly dispreferred by native speakers (#*The maple tree has a car*). Lauer (2016), in fact, argues that MP is in fact not a normative constraint nor a Gricean maxim, and in fact is best understood as a speaker preference, which aligns well with the idea of linguistic context-sensitivity and individual-level variability described in Chapter 4. Karvovskaya operationalizes this context-dependence in the assignment function g, which takes a relational variable and returns a specific relation, though her instantiation arbitrates between so-called "stereotypical" and "non-stereotypical" possession relations, which are determined by contextual factors. In my proposal, the conceptual domain for the set of possible relational meanings ($R\langle x, y\rangle$) is defined by the gradient conceptual infrastructure (GCI) described in Chapter 3, which is a conceptual space organized along two dimensions that, crucially, contribute to the percept of causal potential between the two entities in a relational meaning. The key operation to identify an R is a causal potential evaluation operation, say, **CPE**, between any two entities over which a relational meaning could hold. The evaluation of a causal potential between two entities makes use of each entity's rich conceptual content that is not necessarily linguistically pre-digested (e.g., into relational or non-relational types). It draws upon conceptual features such as animacy that could contribute to a causal potential between the two entities. The output of the CPE operation results in some value that determines the specific relation between the two entities. Schematically, a high degree of causal potential between two entities will result in a possessive (control) relation in which one entity has control over the other. A low degree of causal potential will result in a locative (incidental proximity) relation. Formally, then, this CPE operation takes a pair of entities (with minimal semantic pre-digestion, i.e., of type $\langle e\rangle$) and returns a value, say between 0 and 1, that determines which R holds over the pair. For the purposes of this derivation, I set the threshold at .5, though in reality, the multiplicity of possible relations would not follow from a single threshold. This operator is defined in (31).

(31) a. $\text{CPE} : D_e \times D_e \rightarrow (0, 1)$

b. $\lambda\langle x_e, y_e\rangle.\text{CPE}\langle x_e, y_e\rangle$

c. $\lambda\langle x_e, y_e\rangle.\text{CPE}\langle x_e, y_e\rangle \begin{cases} > .5 \rightarrow \text{Poss}\langle x_e, y_e\rangle \\ < .5 \rightarrow \text{Loc}\langle x_e, y_e\rangle \end{cases}$

Accordingly, I implement an assignment function g_{CPE} as part of the denotation of *have* (also corroborating the context-dependence of *have*-sentences as shown in Study 1a) that takes a relational variable and entity pair over which the CPE operator, returns a value, thereby producing a specific relation (Poss vs. Loc) depending in its evaluation. This updated denotation is shown in (32).

(32) $[\![have]\!]^{g_{\text{CPE}}} = \lambda y_e \lambda x_e.\text{Loc}(y_e, \ell) \wedge g_{\text{CPE}}(y_e, x_e)$

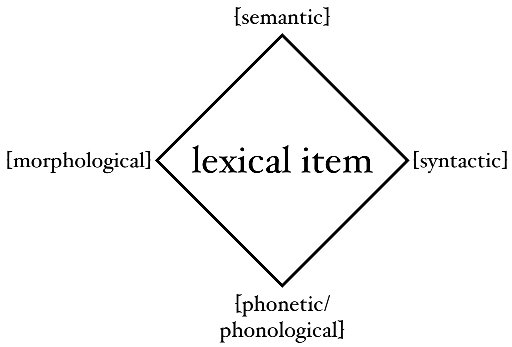
Takeaway: *have* adds causal potential between two entities in a situation

Overall, this conceptual semantics analysis of the meaning of English *have* gives rise to two principal takeaways. The first, is that **the use of the lexical item *have* enables the inclusion of a conceptual potential for causality in the meaning of the *have*-sentence**. The second takeaway is an implication of the first: because the meaning of a *have*-sentence depends on the causality involved, and because causality is a gradient percept (*i.e.* a percept of degree and not category), and because the degree of causality involved is determined based on contextual (i.e., non-linguistic) factors relating to the nature of the participants and their contextual situation, then **the meaning of a *have*-sentence can be context-dependent**. Right off the bat, the incorporation of the gradient causal potential in this LCS representation allows for the intuitively smooth transition to a (causal) possessive relation from a (non- or less-causal) locative relation (as described in the previous section), rather than necessitating a metaphoric jump or categorically different functional projections.

2.3.2 The lexical item *have*: sound, form, and meaning

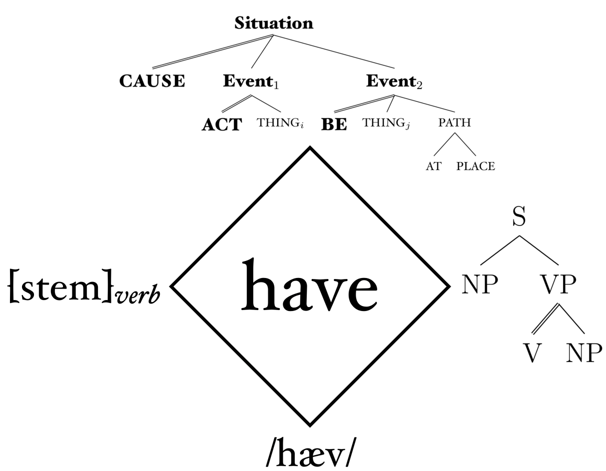
Here, I present a representation of the entire lexical item *have*, which comprises information regarding its phonetic, phonological, and morphosyntactic properties in addition to its meaning. I use the "diamond structure" visualization of a lexical item, as shown in (33) . What this schematic visualization represents is what an individual must know when that individual uses that lexical item.

(33)



In (34), I show the specific lexical item representation for *have*. For all speaker and comprehenders, knowing the lexical item *have* means knowing its phonetic and phonological properties, represented here by the IPA transcription, but also including its articulator/motoric implementation, acoustic properties, and prosodic parameters. Knowing the lexical item *have* also means knowing that *have* participates in morphological processes as a verbal stem, and that *have* subcategorizes for two NPs. Other syntactic adjuncts are possible, but not required. And knowing the meaning of *have* means knowing meaning components of the lexico-semantic conceptual structure described above.

(34)



The lexical item representation predisposes itself for a compositional account for *have*-sentences grounded in the cognitive implementation of language–a concatenation of lexical items in real-time with parallel, interactive processing of these different components of the lexical item. In a nutshell, the comprehension of a *have*-sentence involves the incremental constituent-by-constituent composition of Entity 1, *have*, and Entity 2; crucially, the specific degree of causal potential–and therefore the specific meaning of the *have*-sentence–is determined as soon as Entity 2 is composed into the larger structure. This determination process involves considering the nature of the entities themselves as well as relevant information in the context or relevant explicit linguistic material. Syntactically, the process involves the concatenation of a subject NP, the V, and its NP complement. Again, this visualization emphasizes that the explanatory burden for the meaning variability of *have*-sentences lies in the lexico-semantic conceptual structure (the meaning) of the lexical item, rather than its syntax.

One methodological consequence between the two proposals is that the transitive copula account has not made predictions for real-time comprehension or composition at all, not by a failure in the quality of the analysis, but by a restriction in the domain of inquiry. The transitive copula account mechanics are not intended to be models of real-time human comprehension of *have*-sentences, but rather highly articulated descriptions of linguistic utterances using a specific set of analytical tools. Therefore, the real-time comprehension predictions I will describe are logical extensions into the cognitive domain, rather than first-hand claims of the original accounts. Furthermore, this logical extension is my own extrapolation, based largely on the analysis in Myler (2016), formulated in order to assess the hypotheses for processing that such an analysis would make. Other hypotheses which generate real-time processing predictions could be made from this analysis, which I discuss in §8.4.

So, while my proposal is that *have*-sentences of all kinds share a standard compositional process involving semantic contextualization at the point of the second entity, and are therefore equally standard, the derivational approach of the transitive copula account takes non-possessive *have*-sentences to be marked and secondary, therefore requiring additional syntactic structure to be comprehended. From a processing perspective, there are two immediate limitations: one is that a subclass of these sentences, though well observed, are only possible through post-hoc repair mechanisms, and the second is that these mechanisms require structure that has no physical realization. While both of these situations can be possible, a repair mechanism for otherwise standard sentences and silent structure are possible, they require much higher burdens of justification. From a processing perspective, a unified, ordinary, and What-You-See-Is-What-You-Get account for these sentences is the more conservative approach of the two. Of course, the relationship between the analytical tools implemented in the transitive copula account and real-time comprehension remains to be formalized, so it could also be the case that the real-time comprehension process from the transitive copula account would differ from my extrapolations here. The linking between these analytical tools and real-time comprehension must be established in order to truly compare these accounts. I discuss the details of this process (including the morphosyntactic compositional process) in §5.3, as well as its relationship to the transitive copula account of *have*-sentences, specifically to motivate the real-time processing studies of the comprehension of *have*-sentences.

Takeaway: comprehending a *have*-sentence is an incremental process of disambiguation

The broad linguistic implication of this is that as the nature of the relationship between the two entities in a relational meaning is perceived to be more causally implicated, then the selection of a specific linguistic device may change, depending on the device's semantic restrictions (i.e., *belong* in (58)). The narrow linguistic implication for *have* is that because *have* lexicalizes the entire set of relational meanings, *have*-sentences, which are therefore inherently ambiguous, require additional specification, which can come either through explicit linguistic marking or from contextual support.

Therefore, the overall process of comprehending a *have*-sentence is a natural process of incremental disambiguation using contextual information (Swinney, 1979; Altmann and Steedman, 1988, a.o.), and therefore relies on the ability to "mine" relevant linguistic context–an ability grounded in a number of components in the broader cognitive system.

2.3.3 "Bare" locative *have*-sentences

Moving forward, I take the perspective that since they lexicalize the entire range of causal-potential relations *have*-sentences are inherently ambiguous. So, how do locative *have*-sentences, as in (35), fit into the proposal?

(35) This table has a cup on it.

In my unified meaning account, the locative prepositional phrase (PP) serves as the disambiguating information that narrows down the possible set of readings by explicitly reducing the salience of the causality in the relationship between the two entities. By providing information that the relationship between *table* and *cup* is one of spatial co-location and given the nature of the two entities themselves, there is a low degree of causal potential perceived. Crucially, this operation is predicted to take place with either explicit linguistic material, like a locative PP, or by relevant contextual information.

However, it has been reported that locative *have*-sentences without a locative prepositional phrase violate native speaker intuitions (Freeze, 1992; Ritter and Rosen, 1997; Harley and Jung, 2015; Myler, 2016, a.o.), as in (36a). In contrast, possessive *have*-sentences do not need any sort of additional material for interpretation, as in (36b).

(36) a. The oak tree $_i$ **has** many nests *(in it$_i$).
b. The oak tree **has** many branches.

The transitive copula account takes *have* to be meaningless, and as a mere identity function, syntactically joins the subject DP with the object DP, which contains a locative PP within it. Since the locative PP is the sole source of the locative meaning, without it, there is no interpretable meaning, since it is claimed that a possessive interpretation (which does not require a locative PP but does require a covert PossP) is unavailable to speakers.

Because "bare" locative *have*-sentences are *a priori* predicted to be part of the standard wheelhouse, I take their relative unacceptability to emerge from native speaker dispreference, rather than that ungrammaticality. Corroborating this point, Belvin and Den Dikken (1997) report that a colleague found these sentences entirely acceptable.

This dispreference could emerge for (at least) two reasons. The first is that locative *have*-sentences provide less information about a relational situation than possessive *have*-sentences; that is, possessive *have*-sentences provide more information about the relationship between the two entities, namely both the location situation as well as the cause for such a location situation, as in *There's a car on Sue's driveway* ***because she owns it***. For example, there is a clear progression of acceptability for the "bare" version of (35) with an increasing degree of backstory (37). What is particularly notable is that the backstory (37d) does not make any reference to locative or possessive or otherwise relational information, yet still facilitates the locative relation in the bare *have*-sentence.

(37) a. The table has a cup.
b. The table has a cup on it.
c. The table has a cup because Sue put it there.
d. The table has a cup because Sue had a party last night and is generally good about cleaning up but sometimes gets distracted and doesn't finish the job.

The second is that bare locative *have*-sentences compete with more explicit strategies of communicating a locative relation, like using an existential construction, if focusing on the located item, or by using the locative PP (Payne, 2009). In this case, the purported dispreference could be the result of a canonical lexical blocking effect (see Rainer, 2016, and references therein). Presumably, both of these possibilities could be contributing factors to the lower frequency of "bare" locative *have*-sentences. While frequency is always a consequence, it in turn can have its own effect on the acceptability and processing of linguistic material (see Adli, 2015, and references therein for a discussion on the relationship between frequency and acceptability).

In a context-elicitation task, where native American English speakers were asked to provide contextual situations for bare locative *have*-sentences, we see clear dispreference for the locative interpretation, and a variety of strategies used to "rescue" a variety of possessive interpretations (Sheen, 2019). Specifically, in this task, speakers were asked to provide contextual information, such as the physical or conversational setting, the interlocutors, or the intended meaning, in response to a series of bare *have*-sentences of the form NP-*have*-NP. In (38) I present two examples of successful locative interpretations for these bare stimuli; in (39-42), I present several examples in which the speakers used a variety of semantic operations like nicknaming, anthropomorphizing, or metonymizing to "rescue" a possessive interpretation. In each of these examples, the sentence in italics represents the stimulus item, while the speaker's response is directly below in quotes.

(38) Locative interpretation

a. *The maple tree* ***has*** *a car.*

"It could be like, there's a car under the maple tree. When you say it like that, you're trying to like, point out that car, so you'll say like it's under the maple tree. The maple tree has that red car."

b. *The chair* ***has*** *a box that is cardboard.*

"Um, someone left their cardboard box on top of the chair."

(39) Nicknamed possession

a. *The maple tree* ***has*** *a car.*

"Maybe it's like a super tall dude and his nickname's the Maple Tree. He's a big basketball player, and he's got a car, and they're talking about his car."

(40) Anthropomorphized possession

a. *The signpost **has** a scooter that is pink.*

"So...there's a school where all the signs have to go to learn how to be good signs, and at the end of school, like, they get to pick which sign to become, so like a yield sign or a stop sign. But when they go to school, they don't have a name on them yet, so they're all blank, and so this sign rides his scooter, pink scooter to school."

(41) Metonymized possession

a. *The Picasso **has** a painting by Vincent van Gogh.*

"I guess it's like an art museum that's dedicated to Picasso, or like funded by Picasso, or just, like, really appreciates Picasso, so named it the Picasso, and they bought a painting by that other person."

(42) Named possession

a. *The saucepan **has** a cookie sheet that is rectangular.*

"I guess The Saucepan is, like, a store that sells cookware, and it would have a cookie sheet in it."

b. *The notebook **has** a cup that is white.*

"A cup? *The Notebook*, the movie, has a cup in it that is white."

These examples show the degree to which possessive interpretations for these bare *have*-sentences are preferred; while some speakers are happy to accept a locative reading, others will go to somewhat extreme lengths to support a possessive interpretation. I discuss the observed variability between individual speakers further in Chapter 5.

Linguistically, the setup here for relational *have*-sentences resembles the case of Mandarin Chinese *you* and similar lexical items in other languages; while one lexical device captures the entire range of relational meanings, explicit additional marking is required to specify subsets of this range. In (43, I present the case of Mandarin *you*, typically glossed as *exist/have*, in which a locative adposition (*shang* 'on/up') is required for a locative meaning; without it, the sentence would read as the similarly degraded English *the table has a book*.

(43) Mandarin Chinese

a. ***you*** *yi* *ben* *shu*
exist one CL book

'There is a book.'

b. *wo* ***you*** *yi* *ben* *shu*
1.sg have one CL book

'I have a book.'

c. *zhuozi-shang* ***you*** *yi* *ben* *shu*
table-on have one CL book

'The table has a book on it.'

Spatiotemporal restrictors privilege locative readings

These examples represent a larger pattern in which markers that restrict the spatial or temporal extent of the relational meaning privilege locative readings, specifically by decreasing the degree of causal potential in the relation. For example, (44) shows a spatial restrictor (a locative PP, in fact), that delimits the bounds of the possessive relation: that is (44a) with the spatial restrictor weakens the possessive relation in (44b) by restricting the ownership relation to one of control. In fact, adding another restrictor, this time a temporal one, weakens the possessive relation even further.[13]

(44) a. I **have** the book.
b. I **have** the book on me.
c. I **have** the book on me today.

In another Mandarin construction, we see a similar spatiotemporal restriction phenomenon. Mandarin *zai* "at" is also used to encode both locative and possessive meanings, in the same way as the lexical dative-possessive alternations presented previously. (45a) shows the prototypical

[13]Here, the presumed linguistic operation is the generation of focus-alternatives that restrict the proposition (Rooth, 1985).

expression of a locative meaning using *zai*, while (45b) shows the possessive meaning emerging from the animate possessor (*wo* 'I/me'), which also requires a deictic (*zhe-li* 'here' lit. 'this in') marker, which is doing a similar spatial restriction as above. In (45c), I show that this restrictor is a grammatical construction requiring standard deictic person-proximity agreement. Finally, in (45d), I show how use of the progressive marker can further restrict the possessive relationship in the same way as the temporal restrictor 'today' in the English example above (44c).

(45) Mandarin Chinese

a. *Na ben shu* ***zai*** *tushuguan-li*
that CL book is.at library-in

'The book is in the library.'

b. *Na ben shu* ***zai*** *wo zhe-li*
that CL book is.at 1.SG this-in

'I have the book.' lit. 'The book is at me here.'

c. *Na ben shu* ***zai*** *ni na-li*
that CL book is.at 2.SG that-in

'You have the book.' lit. 'The book is at you there.'

d. *Na ben shu* ***zai*** *wo zhe-li ne*
that CL book is.at 1.SG this-in PROG

'I have the book now.' lit. 'The book is PROG at me here.'

In summary, what these grammatically spatiotemporal restrictors are doing is decreasing the perceived degree of the causal potential or influence that the possessor has over the possessee by delimiting spatial or temporal boundaries of their relationship. Turning back to the case of the English locative PP, it could be the case that it is serving a similar restrictor role, though further work would need to be undertaken to arbitrate between this possibility and the aforementioned generalized ambiguity specification role. If the former were to hold, then the case of English *have* would fall in line with crosslinguistic patterns of expressing relational meanings.[14]

2.3.4 Takeaway: the role of context

The principal takeaway from the conceptual and lexical analyses detailed here is that relational meanings, particularly as encoded by *have*-sentences, are sensitive to contextual information. Specifically, to understand a relational meaning, a determination of the causal potential between the two entities must be made. The perceptual evaluation of this causal potential is heavily influenced by contextual information, be it properties of the entities in the relational meaning or properties of the contextual situation. To illustrate this point further, I present two examples of English markers that can encode both locative (proximity) and possessive (control) meanings (46-47).

(46) Prepositional: *with*
  a. The keys are **with** Sue. (control)
  b. The keys are **with** the car. (proximity)

(47) Verbal: *have*
  a. The garden$_i$ **has** strawberries (in it$_i$). (proximity/containment)
  b. Sue$_j$ **has** strawberries (in/with her$_i$). (control/containment)

The control (possessive) reading involving *with*, a canonically locative marker (46), and the proximity (locative) reading involving *have* (47), are less frequent than the cross-linguistic examples detailed above.

[14]One additional avenue of semantic restriction that can lead to a decreased degree of causal potential is the observed distinction that definiteness makes in the interpretation of *have*-sentences: *Sue has a/the car*, in which the use of the definite determiner leads to a temporary control reading rather than a (more) permanent ownership or alienable possession reading. In line with this distinction, Fraurud (2001) presents evidence from Komi and Urdmurt (Uralic, Russia), Turkish, Yucatec Maya, Turkish, and Amharic that suggests that definite determiners evolve from possessive markers, in addition to the well-reported source of demonstratives. Huehnergard and Pat-El (2012) present similar evidence in Semitic; Gerland (2014) and Janda (2015) in other Uralic languages. While not in the scope of this dissertation, the discourse-domain restriction of a definite article could be a third source of restriction that decreases the perceived degree of connectedness or control asymmetry and thus “demotes” a reading from a permanent ownership reading to a temporary control reading.

While none of the sentences are categorically ungrammatical, the lower frequency–and higher markedness–result in a greater need for contextual support; with appropriate support, the semantic ambiguity seems to be entirely alleviated.

(48) *Context: At a rental car office, Sue is the employee in charge of distributing keys directly to customers. The front desk employee tells a customer ready to walk to the car:*

'The keys are with Sue.'

(49) *Context: At a large family farm where customers pick their own fruit, a customer asks an employee if the strawberry patch is located behind the farmhouse. The employee shakes her head and says:*

'The front garden has strawberries.'

The improvement in acceptability suggests that there is a fundamental role of disambiguating context in the understanding of *have*-sentences. This is preliminary support for the unified relational meaning account over the "copula account", which predicts categorical ungrammaticality for bare locative *have*-sentences regardless of contextual content.

2.3.5 Prediction: interpretation of *have*-sentences are contextually manipulable

In summary, my proposal for the analysis of *have*-sentences and relational meanings centers around a unified, context-dependent lexical semantics for *have*. There are two main consequences to the analysis that I have proposed. First, the proposal analyzes the different readings of *have*-sentences as a single meaning, which is a generalized relation of causal potential involving two entities (the unified LCS). Second, the meaning of a *have*-sentence depends on a variable degree of causality perceived from relevant contextual information, explicit linguistic material (like a locative PP), or implicit world knowledge. Together, this means that linguistic variability in *have*-sentences is a direct result of conceptual variability in *have*'s underlying conceptual structure.

These consequences lead to a series of predictions regarding locative *have*-sentences in English. Specifically, **(a)** locative meanings with English *have*-sentences are possible, **(b)** locative *have*-sentences are dispreferred, and therefore **(c)** locative *have*-sentences need support from explicit marking or context. Returning to the reported unacceptability of (50), it is clear, from the perspective detailed here, that the unacceptability arises out of a dispreference for locative *have*-sentences without explicit locative marking or contextual support.

(50) The oak tree $_i$ **has** many nests *(in it$_i$).

While it is clear that we can use an explicit locative PP to support the locative reading, leading to a perfectly acceptable *have*-sentence, it remains to be proven the degree to which contextual support can facilitate the locative reading of a bare *have*-sentence. That is, neither account predicts the unavailability of locative *have*-sentences, as these are a well-established construction in the English language. The crucial difference is whether the locative reading of a *have*-sentence comes from **(a)** a generalized relational meaning that is then narrowed down by relevant context (LCS of *have* + causal perception), or, **(b)** exclusively from the locative PP ($\lambda x.x$ + locative PP). Is the locative PP, therefore, an explicit, conventionalized way to restrict the ambiguity of a bare locative *have*-sentence or is it the sole grammatical source of the locative meaning?

One way to address this question is to investigate whether context can supply the relevant information or a conducive communicative environment, in the absence of other, more explicit strategies, to facilitate the locative reading of a bare *have*-sentence. In order to do so, a supportive context must remove or reduce the cues to causality by either changing the features of the entities or the properties of the communicative context.

The unified LCS account predicts that contextual support can indeed facilitate the locative reading, while the transitive copula account predicts that these sentences are categorically ungrammatical and not contextually manipulable, at least without the post-hoc repair of silent PP-insertion.

Accordingly, I hypothesize that providing a locative relation in the context will provide a communicative context that facilitates the acceptability of a target bare locative *have*-sentence following that context, due to the unified meaning for English *have*. This hypothesis is the direct motivation for the first experimental study of this dissertation, published in Zhang et al. 2022, and reported below in §2.4.

2.4 Study 1a: Contextually facilitating a locative *have*-sentence

2.4.1 Methods

Linguistic stimuli

Six sets of five sentences each were designed around a simple locative relationship expressed with *have*, as in (51). The *have*-sentence expressed an incidental proximity relation—the least constraining interpretation of location.[15] The entities were selected from equivalent semantic fields such that none were biased towards a possession construal, and all were conceptually non-composite enough to block any plausible containment reading.

(51) *The maple tree has a car.*

Each *have*-sentence was structured as a conjunction with a context in the first conjunct and the critical target in the second (52).

(52) *[The motorcycle is under the pine tree]*$_{context}$ *and [the maple tree has a car]*$_{target}$.

[15] Incidental proximity presupposes no ontological or conventionalized relationship between the two involved entities: they are spatially co-located by pure chance or coincidence (*e.g.* a mirror and a cactus).

In addition to Locative, two other semantic context-types were provided: Possessive and Attributive. The Possessive Context-type presented an inalienable part-whole context. The Attributive presented a non-locative, non-possessive context. Additionally, two control contexts were provided: an Identity, to isolate the the potential effect of identity priming, containing the same syntactic structures as the target sentence but different participants and a Nonsensical, containing a contextually unacceptable conjunction such as *or*, *so*, *because*, or *until*.[16] All context-types are presented in Table (2.2).

Table 2.2: Sample stimuli set

Context-type	Context	Conj.	Target
Locative	The motorcycle is under the pine tree	and	
Possessive	The pine tree has big branches	and	
Attributive	The pine tree is very green	and	the maple tree has a car.
Identity	The pine tree has a motorcycle	and	
Nonsensical	The motorcycle is under the pine tree	or	

Participants

The participants comprised an in-lab sample and an online sample. For the in-lab sample, 66 native[17] speakers of American English were recruited from our university student body. All, by self-report, had no history of psychological illness, neurological disease, brain injury, or learning or reading disability, and had normal or corrected-to-normal vision. The data from 61 participants (35 women & 26 men, ages 18-29, mean 20;10) from the in-lab sample were included in the analysis; data from the five others were excluded due to experimenter error.

Additionally, 247 native speakers of American English were recruited through Amazon

[16] This context-type is intended to show a categorical distinction between the dispreference of a locative reading of a *have*-sentence and the true semantic unacceptability of the nonsensical conjunction. This unacceptability arises from the infelicitous use of these conjunctions, which do not create the parallelism that 'and' does. This lack of parallelism weakens the communicative intent of the entire utterance and therefore dissuades the contextualization operation that could otherwise facilitate the interpretation of the target.

[17] Native here indicates that the language was acquired naturally from birth within a family context. Native acquisition is orthogonal to the number of languages acquired.

Mechanical Turk (MTurk). All, by self-report and validation through language screening questions, were determined to be native speakers of American English. Through MTurk Filters, only participants with an IP address in the United States, a history of >1000 successfully completed tasks, and a task-approval rate of >90% were invited to participate. The data from 210 participants (102 women & 108 men, ages 18-68, mean 31;8) from the online sample were included in the analysis; data from the 37 others were excluded because of missed attention questions, signifying that they were answering randomly, or failed language screening questions. All participants consented to participate in accordance with our university Human Subjects Committee guidelines.

Design

In-lab participants sat in a quiet room and read sentences on a monitor presented using E-Prime 2.0 software (Psychology Software Tools, 2012). Acceptability ratings and response times were collected on a keyboard. Each sentence was presented in two windows: the first showed the first conjunct (context), and the second showed the complete conjoined sentence (context and target). Participants were instructed to rate the acceptability of all the material on the screen; thus, the first rating evaluated only the first conjunct (context) while the second evaluated the entire conjoined sentence (context and target). The windows advanced with each input, but were capped at 10 sec for the first window and 14 sec for the second. The ratings for the context alone served to verify the participants' attention, since these ratings were expected to be ceiling-level. Participants were given a scale of 1 to 7 (7 being the most acceptable) and no specific criteria for determining acceptability to ensure no disproportionate attention or bias towards certain features of the sentences over others. Table (2.3) gives an overview of the paradigm.

Participants were given a practice run to acclimate to the testing environment, the keyboard input, and the text presentation. This practice contained no experimental items, but

Table 2.3: Experimental procedure

Content	Material	Duration & input
Context	The motorcycle is under the pine tree	10 sec or until rating (1-7)
Context + Target	The motorcycle is under the pine tree and the maple tree has a car.	14 sec or until rating (1-7)
Fixation	+	2 sec

10 well-attested syntactically well-formed and ill-formed sentences (*i.e.*, with consistently polarized judgments) to help the participants quickly orient to the scale, and to assess participants' attention, understanding of the rating system, and proficiency in English. Participants repeated the practice run until they scored 100%; no participant completed the practice run more than twice. Each participant saw all 30 items in a unique, pseudo-randomized order mixed with 70 additional sentences of three unrelated types which served as fillers.

Online participants were presented with identical instructions as the in-lab version through the Qualtrics survey platform. The sentences were presented in the same manner as outlined above, except that instead of pressing one of seven keys on the keyboard, the participants used their cursor to select one of seven radio buttons on-screen, which were presented in the same orientation as the in-lab version. Five attention questions were presented randomly within the 30 experimental items. Though no time limits were given, the average completion time for the study was comparable to the duration of in-lab participants. Before each session, participants were presented ten semantically complex English sentences (involving circumstantial metonymy or complement coercion constructions) and asked to explain the sentences' meanings to validate the participants' self-reported English proficiency.

2.4.2 Predictions

The unified lexical meaning hypothesis predicts that context can indeed modulate the salience of different readings of *have*-sentences. Specifically, a facilitatory context should improve the salience of the otherwise dispreferred locative reading of a bare *have*-sentence. If this hypothesis is right, then the acceptability ratings for the target sentence in the Locative Context-type should be significantly greater than all ratings in all other context-types.

2.4.3 Findings

Dispreference vs. unacceptability

As a control measure, I first analyzed the effect of sensicality to ensure participants were paying attention successfully to the acceptability judgment task. A linear mixed-effects model was created using the *lme4* package (Bates et al., 2015) in the *R* statistical computing environment (R Core Team, 2018). The model was built using the fixed-effect of sensicality (2 levels: sensical (the Locative, Possessive, Attributive, and Identity Context-types) vs. nonsensical (the Nonsensical Context-type)), and as random-effects, intercepts for subjects and items in addition to by-subject random slopes for the effect of sensicality. Statistical significance (p-value) was obtained by a likelihood ratio test of the full model with the effect in question against the null model without the effect in question. Instead of *a priori* trimming using a three standard deviation threshold, outlying data points to the model fit were removed, following Baayen and Milin (2010).

Acceptability ratings, shown in Figure (2.3), revealed a significant main effect of sensicality ($\chi^2(1)=42.2$, $n=271$, $p<.001$), suggesting that participants attended and responded to the relation of the context to the target. They also indicate that the dispreference of the locative interpretation of a *have*-sentence is categorically distinct from the semantic unacceptability of the Nonsensical Context-type.

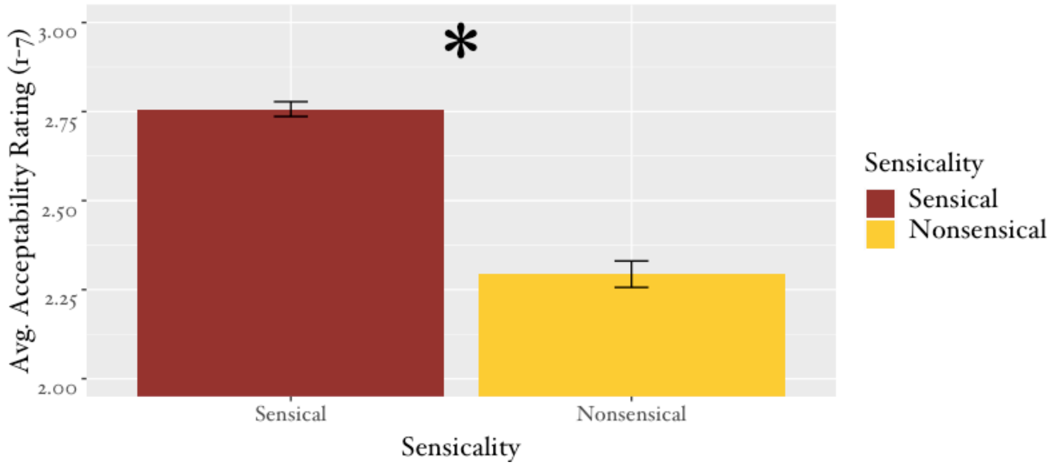


Figure 2.3: Mean acceptability ratings by sensicality.
Note: Error bars indicate the standard error of the mean.

Contextual facilitation of locative *have*-sentences

For the main analysis, I analyzed the data from the four sensical context-types for all subjects. A linear mixed-effects model was built using fixed-effects of context-type (4 levels: Locative, Possessive, Attributive, vs. Identity). As random effects, random intercepts were included for subjects and items in addition to by-subject random slopes for the effect of context-type. Statistical significance was obtained in the same manner, through likelihood ratio tests; outliers were removed in the same way as well.

Acceptability ratings of the sentences with only the sensical contexts showed a significant main effect of context-type ($\chi^2(3)$=101.2, n=271, $p<.001$). Pairwise t-tests show that the ratings, presented in Figure (2.4), for the target sentence after the Locative Context-type were significantly higher than the ratings for the target sentence after all other contexts (all p's$<.001$).

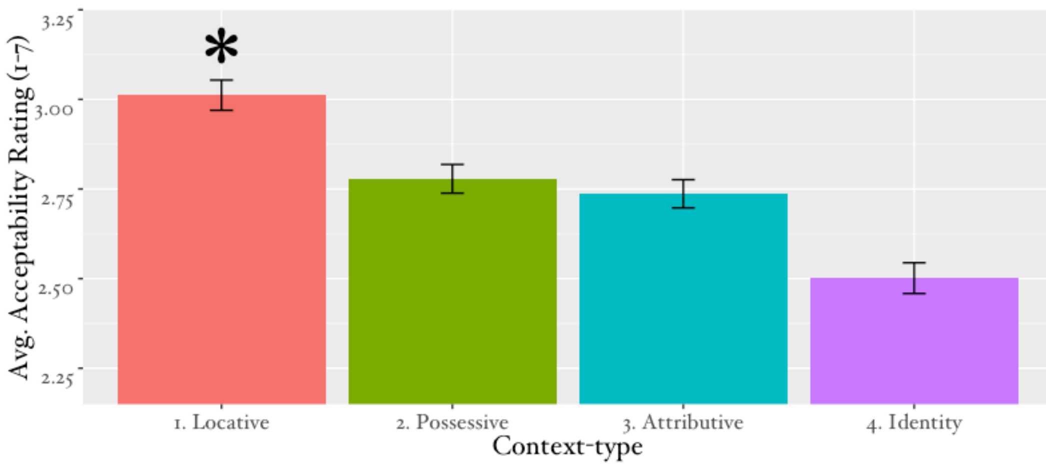


Figure 2.4: Mean acceptability ratings by context-type.
Error bars indicate the standard error of the mean.

This finding is consistent with the predictions about the unified relational meaning: context successfully facilitated the locative reading of the target sentence, resulting in higher ratings for the target sentence and only after the Locative Context-type.

2.4.4 Discussion: Contextual modulation of English *have*-sentences

A unified analysis of the LCS associated with English *have*-sentences underlies the prediction that comprehenders' sensitivity to the unified conceptual foundation for relational meanings would be experimentally visible in the form of higher ratings to the target sentence only after the locative context as compared to the non-locative contexts. I assume here that this unified meaning is what permits the prototypically possessive verb *have* to express a locative relation at all, and additionally, one that is facilitated with relevant context.

The unified LCS account for *have* predicted that the right context can facilitate the locative reading of a "bare" *have*-sentence, by decreasing the degree of causality perceived, and therefore the salience of the conceptual causal adjunct in *have*'s meaning. These results are consistent with this prediction, which was borne out in the the main effect of context-type, whereby ratings of the target sentence increased only after the Locative Context-type, supporting the unified LCS account as well as the ability of local linguistic context to make a dispreferred meaning salient.

The effect of the Locative Context-type was categorically distinct from the effect of the other semantic contexts; the Possessive and Attributive Context-type ratings were not significantly different from each other. Furthermore, participants were sensitive to only the relevant *relational* features of the context, as the Identity Context-type, with an identical syntactic structure, did not improve the rating for the target *have*-sentence.

In this experimental setup, the true semantic baseline was the Attributive Context-type, because it provided no content relevant to a relational meaning at all, yet was still a perfectly acceptable sentence of English (e.g. The pine tree is very green). In contrast, the Identity Context-type presented an already marginal sentence that did not facilitate the otherwise marginal target sentence. It is therefore striking that the Possessive Context-type, which provided a non-facilitatory but still relevant context, was equally non-facilitatory as the irrelevant Attributive Context-type.

These patterns also shed light on the role of context in language processing by leveraging the LCS for *have* in which the salience of the causal Event_1 depends on the perceived causality in the situation. Because this LCS is inherently unified, it follows that *have* should naturally express both the locative and possessive meanings it has been observed to express. This pattern is not predicted by the transitive copula account, which analyzes the locative reading of a *have*-sentence to emerge entirely from the presence of an overt locative PP. Instead, the relatively higher informativity of the possessive reading–captured with the additional causal frame–leads to an asymmetry in preference relative to the locative reading, which requires backgrounding of the causal frame to become available. What comprehenders must do to enable the dispreferred locative reading is reduce the salience of the causal frame, a process that is facilitated by relevant contextual information.

The fact that comprehenders are able to do this contextualization nuances the understanding of what "acceptability" means. In this case, locative readings of bare *have*-sentences are taken to be dispreferred due to lower frequency. This lower frequency could have emerged over time due to an increased demand for contextualization, which is effortful. Alternatively, the dispreference could be due directly to the increased demand for contextualization: comprehenders will not exert this contextualization effort unless otherwise necessary, though individual degrees of context-sensitivity would modulate this tendency. Overall, this linguistic setup is consistent with the view that there is more than one reason for why a linguistic structure could be found less acceptable, even in relative terms.

2.4.5 Linguistic consequences of contextually facilitated locative *have*-sentences

Support for a unified LCS account of the meaning of *have*

These results constitute the first support for both the unified lexical semantic-analysis of *have* as well as the role of context in the comprehension of *have*-sentences; specifically, despite being dispreferred, the locative reading of a bare *have*-sentence can be made salient through linguistic context.

This finding has direct implications for the assumptions regarding the lexical representation of English *have*. Specifically, this finding is not predicted by the transitive copula account of English *have*, which forbids locative interpretations without overt locative PPs (Ritter and Rosen, 1997, p. 308). The results here suggest that the process of comprehending a *have*-sentence is a process of disambiguating a generalized meaning using available means, such as a locative PP or, as in the present setup, relevant contextual information which decreases the causality perceived in the relation, thus leading to a locative reading for the target. Consequently, while the transitive copula account is not incorrect about the locative PP contributing to the meaning of a *have*-sentence, it is not the case that the locative PP is shouldering the entirety of the semantic burden, suggesting that *have* does indeed have semantic content.

The demonstrated contextual facilitation effect motivates further inquiry into the psychological reality of these sentences: what are human comprehenders actually doing when they encounter *have*-sentences? The unified LCS predictions about the comprehension process lends itself to a real-time processing investigation because it predicts that there should be a measurable effect of contextualization in the comprehension of *have*-sentences specifically at the point when the second entity is comprehended and incrementally composed into the meaning of the sentence. While the transitive copula account does not make predictions about the psychological reality of comprehension, the real-time processing predictions that would come from putting the semantic burden on the locative PP are indeed testable. Specifically, real-time methods like self-paced reading and event-related potentials could assess whether there is extra effort required to comprehend "bare" locative *have*-sentences, and whether this effort has a semantic nature (as predicted by the contextualization process of the unified LCS account) or a syntactic nature (as would be predicted by the syntactic source of the locative meaning of the transitive copula account). While the observed pattern was predicted by and more directly supports the unified LCS account, the evidence does not completely rule out the possibility of some sort of repair operation, and therefore the transitive copula account entirely. For example, it could be the case that participants are able to implement a post-hoc syntactic repair, such as the insertion of a locative PP. Such a possibility adds additional motivation for further work investigating what is actually happening during the real-time comprehension of these locative *have*-sentences. Are comprehenders contextually determining the degree of causal potential to arrive a specific reading for the target, or are they inserting a locative PP to rescue an otherwise ungrammatical sentence? Real-time comprehension methods can arbitrate between these two possibilities–I describe the specific predictions for the real-time processing of locative *have*-sentences in Chapter 5.

Syntactic consequences of contextual facilitation

If the contextual facilitation effect is indeed indicating that a locative PP is not grammatically obligatory for a locative reading of a *have*-sentence, then both accounts face syntactic consequences, of different sorts.

Following the unified LCS account, the non-obligatory locative PP falls in line with the syntactic analysis, which is that *have* as a verb head subcategorizes for a single NP, with no further specification for other obligatory constituents. In this case, a locative PP can be analyzed as a VP adjunct, which is a standard analysis for spatial or temporal PPs (53a), in contrast to (53b) where it serves as a VP complement.

(53) a. I met Sue in London.
b. Sue lives in London.

Given the contextual facilitation effect, then "bare" locative *have*-sentences would not receive an ungrammaticality mark, suggesting that locative PPs do behave as syntactic adjuncts, in line with omission and locality tests for argumenthood (54).

(54) a. [Context] The table has a cup.
b. #The table has on it a cup.

However, it is important to note that the unified LCS account does not make a firm prediction on whether this locative PP is serving as a VP adjunct or an NP adjunct; the account merely predicts that the locative PP is a syntactic adjunct that can help disambiguate the generalized causal potential meaning of a *have*-sentence. The more conservative approach is to analyze it as a VP adjunct, given that it is contributing disambiguating information to the relation encoded by the verb, supported by substitution, coordination, and movement tests for constituency (55)

(55) The table has a cup on it.

a. The table has one on it. > #The table has one.

b. The table has a cup and a plate on it. > #The table has a cup on it and a plate.

c. It is a cup that the table has on it. > *It is a cup on it that the table has.

In contrast, the transitive copula account for the syntax of *have* is that there is always a functional projection in the second NP of a *have*-sentence that is the sole source of the meaning of the *have*-sentence (Myler, 2016); this XP is then connected to the subject NP with the identity function that is *have* to give rise to the final interpretation of the sentence, as in (56).

(56) a. Locative: The table [has [a cup [on it]$_{PP}$]$_{NP}$]$_{VP}$.

b. Possessive: The table [has [[four legs]$_{PossP}$]$_{NP}$]$_{VP}$.

The contextual facilitation effect as well as the argument and constituency tests above do not align straightforwardly with the transitive copula account for *have*. Put more directly, this account relies on the claim that "bare" locative *have*-sentences are categorically ungrammatical, though this claim is not supported with robust evidence (Ritter and Rosen, 1997; Harley and Jung, 2015; Myler, 2016). The findings in this study show that this claim does not match actual acceptability judgments from a large sample of English speakers. Consequently, the meaninglessness of *have* is therefore cast into question.

While this account does not make predictions about the psychological reality of *have*-sentences, there would be additional compositional mechanisms required (such as a LocPP insertion syntactic repair operation), which requires a higher bar of evidence to justify. Is it not impossible to account for unvoiced syntactic structures, though, again, justifying their existence requires additional evidence in the face of a more conservative and parsimonious analysis. I return to this question in Chapter 5 in discussing the predictions for the real-time processing of *have*-sentences.

2.5 Conclusion

The study presented here is the first to show that English *have*-sentences can be modulated by context. Specifically, relevant contextual content can facilitate otherwise dispreferred locative readings of bare *have*-sentences, which had previously been analyzed as being categorically ungrammatical, due to the lack of an overt locative prepositional phrase. These findings are consistent with the unified LCS account of English *have*, which takes *have* to bear a generalized relational meaning that captures the degree of causal potential between the two entities in a *have*-sentence. These findings challenge the *status quo*, transitive copula account of English *have*, which takes *have* to be a semantically null identity function, in which an overt or covert functional projection within the domain of the second DP in the *have*-sentence is the sole source of the meaning of a given *have*-sentence.

The crucial takeaway is that contextual information can disambiguate the generalized meaning of a *have*-sentence into a specific reading. In line with the unified LCS account, the generalized meaning can be disambiguated by both contextual information as well as explicit linguistic material, such as a locative PP. These two strategies for individuating specific readings for *have*-sentences both work by affecting the fundamental causal perception operation, which helps determine the relationship between two entities; operationally, this is carried out by modulating the salience of the conceptual causal adjunct. Moreover, these strategies in communicative *have*-sentences are also part of a set of communicative strategies or preferences that individual speakers and comprehenders can employ to help deliver their communicative intent, that is, a speaker could choose to use context or a spatiotemporal restrictor (like a locative PP) or a causal backstory to deliver a precisely specified *have*-sentence. Contextual modulation is therefore part and parcel of an overall communicative strategy. I take up the question of systematicity or tendencies in how different individuals choose to rely on contextual support, specifically, in Chapter 4. The findings here give preliminary support to the idea that these three kinds of variability, linguistic, conceptual, and cognitive, are intrinsically connected–a specific framework which I further discuss in Chapter 5.

Moving forward, while the results of Study 1a (discussion above notwithstanding) show that context can facilitate an otherwise dispreferred locative reading for a bare *have*-sentence, it remains to be understood the semantic breadth of the contextual facilitation capability. What are the boundaries or limits for readings of *have*-sentences? How are these meanings semantically organized in a conceptually principled way? While the unified LCS analysis posits a subset relation between locative and possessive meanings (LOCATIVE $\subset$ POSSESSIVE), the LCS does not further explain the unified conceptual basis for the set of relational meanings.

Moreover, one major consequence of the unified LCS account is that *have*'s variability is a crosslinguistically regular variability phenomenon, rather than being a crosslinguistically idiosyncratic puzzle. How does the meaning of *have* relate to other *have*-like lexical items and locative, possessive, and relational meanings in other languages? These are the questions I address in the following chapter, which details my proposal for a conceptual infrastructure that organizes the entire set of relational meanings in a cognitively grounded way.

Chapter 3

Conceptual gradience: a multidimensional conceptual space for relational meanings

Contents

3.1 Introduction

In this chapter, I introduce the second component of the model of meaning variation, which is a multidimensional conceptual space that serves as the infrastructure for the entire set of possible relational meanings that a *have*-sentence can convey. In §3.2, I describe the design features, cognitive grounding, and the mechanics of the conceptual infrastructure. Crucially, this infrastructure, organized by two dimensions of causal perception, serves as the possible set of conceptual relations that can be lexicalized by lexical items such as English *have*; I describe the consequences for this LCS-conceptual infrastructure connection in §3.3. The gradient infrastructure also makes predictions for the behavior of *have* and *have*-type lexical items across languages, over time, and through development; I outline the predictions for and evidence from typology, diachrony, and acquisition in §3.4. I conclude the chapter with a discussion of English *have*-sentences as a crosslinguistically regular instantiation of the interaction of lexical and conceptual variability, in contrast to the anomalous "too many meanings" puzzle perspective of the transitive copula account, and motivate the final ingredient of the model: inter-comprehender cognitive variability.

3.2 Modeling the set of relational meanings in a gradient conceptual infrastructure

In light of unified LCS analysis of the meaning of English *have*, I move forward with a working model for the organization of such a unified and gradient conceptual structure for relational meanings. This conceptual structure model forms the infrastructure over which linguistic markers can lexicalize locative and possessive meanings; that is, it delineates and organizes the meanings that *have*-sentences and crosslinguistic corresponding markers can encode. While previous accounts have sought to sort the many readings of *have*-sentences (as well as location-possession meanings crosslinguistically) into a range of categorical, conceptually linked bins, there has yet to be a convergence on an optimal resolution for the set of relational meanings.

This optimal resolution problem is especially evidenced in cases where single relations seem to elude categorization, as in (57), from the OED entry for *have*, or the continuum presented in (9).

(57) Let me *have* men about me that are fat. (1616)

Often, these categories depend on the focus of the investigation, which may not rely on a precise characterization of the different relational meanings: for example, Sæbø (2009) defines one set of meanings for *have* as "the true verb *have*" while Karvovskaya (2018) defines "stereotypical" and "non-stereotypical" possessive meanings. One major consequence of the transitive copula approach is that there are no constraints (specifically postulated) for the meanings of *have*: relational meanings are derived independently from the entity-pair of a *have*-sentence and manifest through a theoretically unlimited set of functional heads. This view takes the situation of *have*-sentences as being completely separate from the constraints on and organization of relational meanings, since *have* itself does not impose selectional restrictions as an identity function.

The key idea is that there are two layers: the operationalization of the lexical item *have* itself as well as the operationalization of the possible meanings or flavors of meaning that are encodable by *have*. I take the perspective that characterizing the relational meaning space is a vital part of understanding the behavior of *have*-sentences by defining the possible parameter space over which it can lexicalize. The lexicalization behavior of other relational markers crosslinguistically can also further inform our characterization of the underlying conceptual space. With respect to the larger goal of this project, characterizing the lexical or linguistic structure as well as the underlying conceptual structure is necessary to spell out the overarching model of meaning variation.

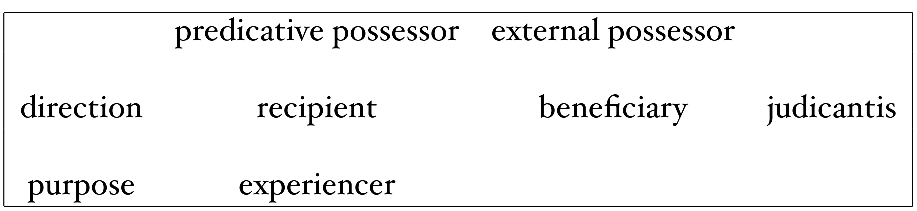
In this section, I lay out a model for a gradient conceptual infrastructure for the family of relational meanings that seeks to address the parsimony optimization problem described earlier as well as the intuition for examples like (57) where the understood meaning of a sentence is relatively clear, but the precise categorization remains ambiguous–would it be locative, control/alienable possession, kinship, existence, or something else? Below, I introduce the semantic map approach, which is the primary extant approach for capturing crosslinguistic patterns of shared meaning, as motivation for the two principal design features of my proposed gradient conceptual infrastructure.

3.2.1 Design features

No discussion of a spatially organized system of describing a set of related meanings would be complete without discussion of semantic maps (Haspelmath, 2003), which are a way of describing the patterns of linguistic markers across languages. While Haspelmath was the one to popularize the notion of semantic maps, its intellectual origins lie in Anderson (1974, 1982) and Croft et al. (1987), and it was also developed in Kemmer (1993), Stassen (1997), and Van Der Auwera and Plungian (1998). Croft (2001) uses the term 'conceptual space' roughly to describe a similar idea, and differs from the use of the term in this work. The idea of semantic maps resembles the polysemy networks of Lakoff (1987), Langacker (1988), and Sandra and Rice (1995), among others, though these structures are language-specific and do not necessarily seek to describe presumably universal conceptual structure.

The principal goal of semantic map visualizations is to reveal a universal configuration of functions and the patterns in which language-specific markers lexicalize these functions. For example, Figure 3.1 shows the proposed semantic map for typical functions of dative markers. Lexical markers from different languages are represented with enclosed shapes that delineate which functions are permitted; for example, English *to* encapsulates the 'direction', 'recipient', 'experiencer', and 'purpose' functions, while French *à* is used for the 'direction', 'recipient', 'experiencer', and 'predicative possessor' functions.

Figure 3.1: A semantic map of typical dative functions from Haspelmath (2003)



The primary benefits, as described in Haspelmath (2003), are to allow crosslinguistic comparability, to identify universal semantic relationships, and to make predictions regarding diachronic trajectories within each map. These goals are aligned with the goals of this project as well and inform the below design features. However, two main limitations exist with this approach. First, this type of semantic map still relies on categorical distinctions and therefore faces the same type of categoricality vs. continuity problem for modeling an apparent continuum. Second, Haspelmath makes a clear statement regarding the arbitrariness of the functions in the space: he states that "their spatial orientation are not significant and is purely a matter of representational convenience," further clarifying that deriving the functions' relative position on the map is "of course totally utopian," suggesting that the categorical functions, though groupable, do not form a larger organizational structure. This claim implies that the pursuit of such larger organizational structure may be fruitless.

Zwarts (2010) points out that inherent in Haspelmathian maps are actually two components: a lexical matrix and a conceptual structure or space. Lexical matrices are simply charts depicting which of the component meanings each language's lexical marker is able to encode, whereas conceptual spaces are geometrically ordered sets of meanings. Haspelmath's maps are based primarily on the lexical matrices, which, by the aforementioned representational convenience, are implicitly hypothesized to reveal systematicity in the underlying conceptual structure. Conversely, it is possible to define conceptual structures and then map lexical matrices on them from language-external measures: one clear successful example is the definition of color terms, where lexical items are mapped onto a conceptual space defined by physical properties of color, like hue, saturation, and brightness (Berlin and Kay, 1991). In fact, Regier et al. (2007) report that crosslinguistic lexical matrices represent optimal partitions of this physically irregular space. For other situations, in contrast, externally derived measures for organizing the conceptual space do not provide insight on the organization of lexical items within or across languages: the human body itself provides a language-external physical structure over which body-part markers can be interpreted. Anatomical distances in this physical structure alone, however, cannot satisfactorily explain lexical clustering patterns, for example, why some languages use the same words for fingers and toes, suggesting that our conceptual space for the human form incorporates structure beyond its purely anatomical physicality.

The two principal limitations of Haspelmathian semantic maps in addressing the issues I have laid out for this present work are as follows:[1] lack of true gradience and lack of externally sourced structure. These gaps therefore represent the two principal design features I hope to incorporate in my proposal for a gradient conceptual infrastructure for relational meanings.

Continuity/gradience

The principal design feature of this conceptual space is its conceptual continuity or gradience. Such gradience is required to capture the incremental ambiguities as well as the intuitive labeling difficulty for a variety of relational meetings. A gradient space can also help address the parsimony optimization problem of defining an appropriate number of categorical bins in a continuum. For example, I present in (58) a series of relationships using the English genitive marker, which can also encode a broad range of relational meanings: the relevant question is where to draw the boundaries between alienable possession, control, part-whole, etc., and all the categorical bins that have been proposed. Specifically, for (58a-b), both could be classed as locative or control relationships, though there is no explicit linguistic cue for either. This set of examples illustrates how the set of relational meanings might be better understood as a spectrum that depends on the degree of causal potential. Presumably, Sue has more control over the chair in her office than the chair in a waiting room–she could easily have the former chair removed, sold, or repaired, while her influence over the latter is less direct.

(58) A spectrum of relational meanings
  a. Sue's chair is broken. (in a waiting room)
  b. Sue's chair is broken. (in her office)

[1]These limitations are not necessarily limitations for his research goals; they are problems that limit the applicability of standard semantic mapping approaches to the current question.

c. The chauffeur's car is in the shop right now. (the car driven by the chauffeur)
d. Sue's car is in the shop right now. (the car owned by Sue)
e. Sue's cat is sick.
f. Sue's haircut is really striking.
g. Sue's hair is turning gray.
h. Sue's unborn baby is kicking a lot these days.
i. Sue's heart is mildly hypertrophic.
j. Sue's liver is taking a beating from all her drinking.
k. Sue's daughter is very independent, she wants nothing to do with Sue.
l. Sue's daughter is her best friend.

Crucially, while some changes in degree of causal potential could cause a "jump" between categories, like (58c-d), and some do not, like (58k-l). This suggests there are non-lexical requirements for justifying the subcategories of this relational meaning spectrum. Myler (2016), as the most recent representative of the transitive copula account, posits a theoretically unlimited number of individual nominal-internal functions to account for the different readings, for example, *sibling-of*, *part-of*, or *body-part-of* (p. 367), to name a few. The critical question, then, is what are the constraints on positing these theoretically unlimited number of categories? Without explicit lexical distinctions, the cognitive burden of learning and memorizing a vast number of these categorical semantic relations is quite great, suggesting this is not the most parsimonious or psychologically plausible way to account for the semantic variability in *have*-sentences. In contrast, the unified relational meaning allows for a single conceptual device to account for this variability and places the burden on lexicalization on each language, rather than on the underlying cognitive system.

Cognitively principled structure

While Haspelmath discounts the possibility of identifying structural dimensions for such a conceptual space that emerge independently from the lexical clustering patterns themselves–

perhaps due to the target fields for mapping–I propose that the behavior of relational-meaning markers crosslinguistically reveal two possible domain-general conceptual dimensions that can structure this space that emerge from the central causal component for relational meanings, as described in the unified LCS analysis. These dimensions are independently motivated components of causal perception, which is one of the most fundamental operations of the human (and nonhuman, to some degree) cognitive system. Using these dimensions will ground a language-driven lexical matrix into the structure of the mind in a more direct way.

3.2.2 Organizing conceptual dimensions

Here, I describe the two conceptual dimensions that will structure the gradient conceptual infrastructure proposed to underlie the meanings of location and possession. Given the spectrum of externally derived structural relevance described by Zwarts (2010) (color vs. body-part examples), I identify organizing conceptual dimensions that are both inherently connected to the relational meanings themselves and grounded in the core of the domain-general cognitive system.

First and foremost, relational meanings are inherently about the connection or relationship between the two entities involved. Part-whole relations, typically categorized as inalienable possession, describe the strong, sometimes permanent, usually physical connection between two entities, while a correspondingly strong, semipermanent, *social* connection between two entities forms a kinship relation, which is also typically categorized as inalienable possession. Locative relations, on the other hand, also describe the spatial configuration or relationship between two entities, contiguous or not. Accordingly, one potentially useful conceptual dimension is therefore **connectedness**.

Second, the role of animacy has been described in-depth as being a crucial parameter for synchronic and diachronic patterns in relational markers (Kuryłowicz, 1964; Aristar, 1996; Myler, 2016, a.o.). Specifically, animacy asymmetries between the first and second entities in a relational meaning give rise to readings of control or asymmetric influence (Falmier and Young, 2008), especially in the case of ownership or control relations (i.e., the stepwise ambiguities in the early-stage Marathi trajectory or the lexical ambiguities as in the case of French dative or possessive *à*). Therefore, the second conceptual dimension I propose is **control asymmetry**.

As it happens, two of the most fundamental, domain-general operations in the human cognitive system align perfectly with these two principal components of relational meanings I have just described: perception of "oneness" and perception of animacy/agency, respectively (Carey, 2009). The former is the core cognition operation that individuates continuous sensory input into discontinuous objects or units (**object individuation**), while the latter is the core cognition operation that ascribes causality and thus agency from sequential events (**causal perception**). Both of these operations have been shown to be developmentally primary (learned first/innate, Bowerman, 1974; Richardson and Kirkham, 2004) and perceptually automatic throughout the lifespan (happens obligatorily, Gopnik et al., 2004).[2]

The mechanism that unites the relational meanings and the cognitive system is therefore that of causal perception, which is not only a fundamental cognitive operation, but the key component of the unified LCS account for the meaning of *have*. Directly below, I describe in detail the way that these dimensions are (a) inherent to relational meanings, (b) grounded in the domain-general cognitive system, and (c) useful for organizing the range of relational meanings.

Connectedness

The grounding of the conceptual dimension of connectedness lies in the cognitive operation of object individuation. Object individuation is an innate and automatic cognitive operation

[2]While not in the scope of this dissertation, understanding how perceptual, conceptual, and statistical processes feature into perception of "oneness" and causality throughout the lifetime, and how these percepts guide and are guided by language use and development is a rich domain for future research.

that allows us to parse into chunks (objects/entities/units) a continuous sensory input, and has been primarily investigated in the visual modality (Strawson, 1964; Spelke et al., 1995; Xu and Carey, 1996; Krøjgaard, 2004). The output of this operation is a percept of connectedness–the degree to which various components of a scene can be understood to form a unit. What this means is that the fundamental cognitive operation returns an output value ranging from low-connectedness to high-connectedness. Entities perceived as separate or less connected are then thought less of as a unit, while entities perceived as together or more connected can be conceptually grouped into a unit. One important property of such unithood is inextricability, the degree to which components of a unit can be separated while remaining "themselves" still.

Connectedness and inextricability are useful conceptual dimensions to evaluate relational meanings because they capture the spectrum of connectedness from incidental proximity to part-whole relations. Specifically, incidental proximity relations like *The red car is next to the blue truck* have a low degree of connectedness, while part-whole relations like *Sue's liver* have a high degree of connectedness. From the inextricability lens, separating the red car from the blue truck would not result in a change of unithood, while separating Sue's liver from Sue would constitute a major change resulting in *most of Sue* and *a disembodied liver*. To highlight the gradience, a parallel situation involving Sue and her hair would represent a less dramatic change, indicating a slightly lower degree of connectedness or inextricability. In between, an ownership (alienable possession) relation like *I own a three-bedroom house* would have an intermediate degree of connectedness–the house and its owner are not as inextricable as a human being and their liver, but constitute more of a unit than two vehicles incidentally co-located.

Control asymmetry

The other conceptual dimension for the gradient infrastructure is grounded in the cognitive operation of causal perception. Causal perception is the fast, automatic, stimulus-driven inferencing process that leads to the perception, feeling, or interpretation of causality (Heider and

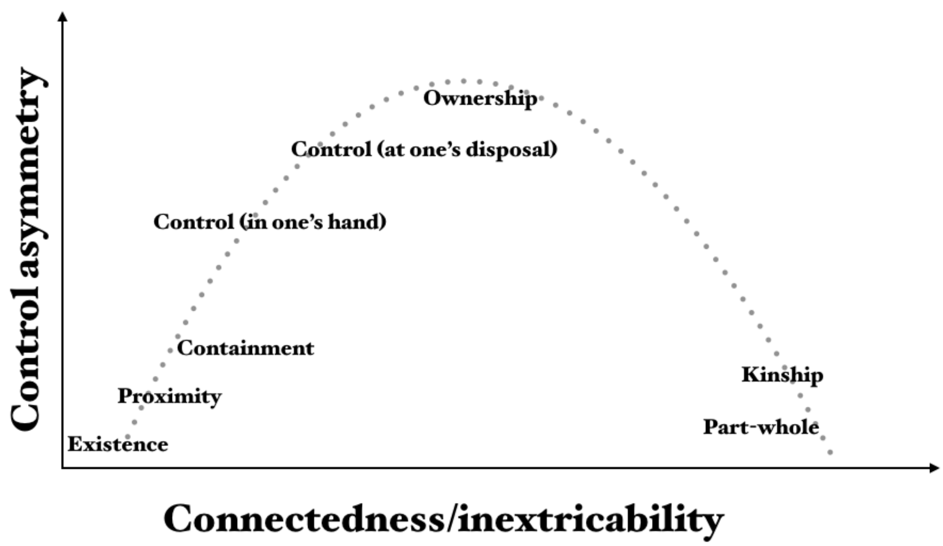
Simmel, 1944; Michotte, 1946; Scholl and Tremoulet, 2000). One key component of the causal perception process is the detecting of features associated with animacy, like self-generated movement or eyes, among others. Animacy is a cognitive evaluation that is known to be gradient (degree of animacy rather than ±animate) and shows variability across individuals (Scholl and Tremoulet, 2000; Prasada, 2003; Falmier and Young, 2008). A high degree of perceived or understood animacy will result in a high degree of agency and therefore causal potential in an event or scene. That is, entities that are perceived as animate are ascribed as having more causal potential to affect other entities or participants in a scene, while entities that are perceived as less animate or inanimate are associated with less ability to affect other participants in a scene. Therefore, what this means is that the fundamental cognitive operation will return an output value ranging from high potential to control or affect others (more animate) to less potential for control (less animate). Crucially, for this conceptual dimension, the *asymmetry* in degree of perceived control/causal potential is the important measure for relational meanings. That is, the difference in control potential–or the relative control–is the key distinction. For example, the degree of control asymmetry between two adult twins may resemble the same degree of control asymmetry between the two adjacent mugs on a table (both having no control asymmetry), even though the absolute degree of animacy or control potential may differ between the entity pairs.

Control asymmetry is a useful conceptual dimension to evaluate relational meanings because it captures the degree of affectedness that is inherently understood in situations of control, ownership, or generalized possession. Specifically, incidental proximity relations like *The red car is next to the blue truck* have a low degree of control asymmetry. Part-whole relations like *Sue's liver* are also characterizable as having a low degree of control asymmetry since, for this example, it is unclear whether Sue has more control over her liver than her liver has over her. In contrast, ownership or control relations show the greatest degree of control asymmetry, especially in cases where the animacy difference is maximized, as in the case of an adult human with an inanimate object, like *Sue has a porcelain vase.* Intermediate degrees of control asymmetry can be achieved by pairing two animate entities with differing degrees of animacy such as *Sue has an orange cat* or *The mother cat has a newborn kitten*.

3.2.3 A gradient conceptual infrastructure for relational meanings

Using these two conceptual dimensions, I construct a Cartesian space that represents the gradient conceptual infrastructure (GCI), as presented in Figure 3.2. Here, I present it with several relational meanings placed in their respective regions of this space; the dotted line indicates roughly where the conceptually salient–or even possible–relational meanings are located within this space.

Figure 3.2: The gradient conceptual infrastructure underlying relational meanings.



This model distinguishes different forms of relational meanings by relative values of perceived connectedness and control asymmetry; it does not create discrete categories for different degrees of connectedness relations. For example, locative-type relations tend to have low connectedness and low control asymmetry, and are therefore represented by the lower-left region in the space; inalienable possessive-type relations tend to have high connectedness and low control asymmetry values, and are therefore represented by the lower-left region in the space. Alienable possessive-type relations are characterized by greater degrees of control asymmetry, and are therefore represented by the upper region in the space. The possible relations communicable by a *have*-sentence lie in this gradient conceptual infrastructure. The categories of meaning are therefore epiphenomenal: they are perceived to be categorical due to varying lexicalization patterns in English and other languages. For example, *belong* and *own* would lexicalize the chunk of this conceptual space characterized by high degrees of control asymmetry and medium degrees of connectedness. Crucially, these categories serve only as heuristics for more easily describing certain types of relations; the underlying conceptual representations are not categorical.

Gradient manipulation of the conceptual properties in a relation

To illustrate the gradience of this space, I will present two examples in which manipulating conceptual properties in a gradient way can change the relationship between the two entities in a relational meaning and consequently change, within a language, the lexical marking strategy used to communicate it.

Property of the situation: Conventionalized structure Take, for example, the lower-left region of low connectedness and low control asymmetry, which is typically understood as locative-type relations. This region includes relations like the incidental proximity of two leaves on the ground during autumn, a car and a truck parked near each other in a field, or a car parked next to a tree. By subtly manipulating the properties of the contextual situation, differences in the perceived relational meaning can emerge: for example, a car and a truck parked near each other, in a parallel orientation, in a parking lot, or a car parked next to a tree because of the shade it provides on a hot summer day. In these examples, the *incidentality* of the entities' co-location is reduced, which in turn strengthens the perception of connectedness (i.e., participation in a larger unit). Situational enrichment with information about conventionalized or known relational structures and motivations can thus change the perceived relational meaning.

Property of the entities: Animacy Manipulating the properties of the entities involved can also give rise to changes in an interpreted relational meaning: as described in previous examples, the difference between a proximity (locative) and a control (possessive) relation is often determined by the animacy of the possessor/location. For example, as shown in (65), reproduced below as (59), the use of an animate possessor (the first person pronoun) in (59a) gives rise to a control/possession relation using the same locative adposition *kade* as the inanimate location in (59b).

(59) Marathi (Deo, 2014, *p. c.*)

a. *Mazh-ya-**kade*** *pustak* *ahe.*
1.SG.OBL-**near** book.NOM be.3.SG.PRES
'I have the book.'

b. *Granthalaya-**kade*** *pustak* *ahe.*
library.OBL-**near** book.NOM be.3.SG.PRES
'The book is near the library.'

However, upon closer scrutiny, categoricality vs. contiguity problem resurfaces in the domain of animacy.[3] What counts as animate and what counts as inanimate? While animacy accepted to be a domain-general concept evolutionarily privileged in cognitive systems (Caramazza and Shelton, 1998; Castelli et al., 2002), a categorical boundary between animate and inanimate remains elusive (Thorat et al., 2019; Balas and Auen, 2019). Though a thorough investigation of the conceptual foundations of the perception of animacy lies outside the scope of this project, two parameters seem to be of particular import in determining animacy from

[3]For discussion the Animacy Hierarchy in linguistics, see Sorlin and Gardelle (2018).

a human perspective: internally generated motion and conceptual proximity or relatability to the human mind and body.[4] Take these examples of entities on a cline of internally generated motion (60) as well as relatability to humans (61). Applying the lexically ambiguous *kade* or French *à* frames of "X-*kade* is a stone" or "the stone is *à* X," it is not obviously clear where to draw a boundary for the resulting locative vs. possessive readings.[5] Moreover, a distinction can even be drawn within human beings between babies and adults, in which the relationship between an entity, say, a book, and a baby might be understood to be more locative than the relationship between the same entity and an adult.

(60) Internally generated motion

a. Rock
b. Moss
c. Tree
d. Vine
e. Jellyfish
f. Butterfly
g. Slug
h. Sloth
i. Cat

(61) Relatability to humans

a. Slug
b. Mosquito
c. Trout
d. Snake
e. Chicken
f. Cow
g. Cat
h. Dolphin

Ultimately, this gradience is the crux of the issue with relational meanings. Where is the boundary between a proximity-type relation and a control-type relation? A gradient conceptual infrastructure allows us to characterize these relations without needing to make specific determinations for category membership; consequently, we can understand the existing proposed categories as a natural cline of relations, rather than a puzzling set of lexically coincident

[4]Another important factor is relative size. Cognitive scientists of all disciplines have long observed that relative size between objects can influence the perception of their relation: this is known as the figure-ground organization or distinction (Thiering, 2011; Wagemans et al., 2012).

[5]The test frame also has its own influence on the final reading of the sentence, since a critical component of evaluation is relating the entities together. Accordingly, choosing "a pebble" as the locatum/possessee, compared to "a book" or "a mobile phone" changes the evaluated break between animate vs. inanimate.

patterns. Crucially, it is also clear that the resulting relation depends on a variety of conceptual features associated with the entities and context of a relational meaning.

3.3 The LCS-CS connection

3.3.1 Lexicalization of conceptual structure

One way to model the conceptual connection between location and possession (and all relational) meanings is by using a gradient space constructed from conceptually relevant but language-external cognitive dimensions. By understanding relational meanings as a unified but gradient space, this account addresses the issue of parsimony optimization: accounting for an underlyingly continuous representation using categorical bins.[6]

The key connection for this model of meaning variation is that between the unified lexico-conceptual semantic structure presented in Chapter 2 and this gradient conceptual infrastructure (GCI), as a specific model for the conceptual strucutre underlying relational meanings. What the LCS represents is the linguistic packaging of a chunk of conceptual structure with a physical signal (auditory or visual) by linguistic conventionalization. This linking may include morphosyntactic combinatorial information, but the vital unit is the sound/sign-meaning pairing, as represented by the lexical item structure shown in §2.3.2. This packaging process is referred to as lexicalization (Jackendoff, 1983, 1997, 2019): the expression of systematic con-

[6]One methodological point that has theoretical consequences is that these categories within the body of relational meanings serve as analytic tools for linguists; they help us describe in specific and systematic ways the meanings that lexical markers like *have* can encode. While useful for the precise description of linguistic patterns, these categories cannot be understood to be the ontological substance of meaning; they remain interpretation-driven externally imposed structures onto the less-easily tractable stuff of thought. If each set of category divisions, which are created for study-specific purposes, is taken to be the actual substance of meaning, then it is easy to see such a situation as a "too many meanings" problem to be addressed by eliminating the entire space. To avoid such a bathwater-baby situation, it is important to remain cognizant of the purposes, limitations, and the scope of any given analytic tool.

nections between semantic and conceptual constituents through lexical items.[7,8,9]

3.3.2 English *have* lexicalizes the entire gradient conceptual infrastructure

I take English *have* to be simply a case of lexicalization over this conceptual infrastructure. That is, English *have* can refer to the whole range of relational meanings represented by the GCI: location, possession, and every relation in between. From this perspective, *have* does not seem to encode "too many" meanings, but precisely the meanings expected, especially locative-type meanings.

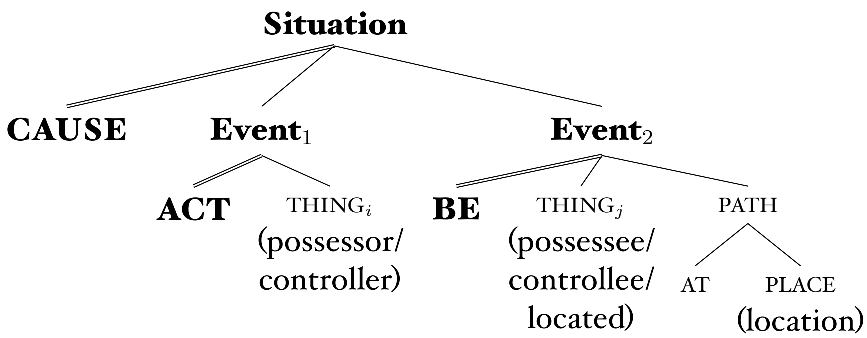
The LCS of *have*, reproduced below in (62), lexicalizes the gradient conceptual infrastructure by packaging the causal dimensions of a relational meaning between two entities into the causal adjunct and locative core.

[7]The term *lexicalization* has many theoretical and operational instantiations; Thomas (2013) characterizes at least two types: synchronic and diachronic, with the Jackendovian type belonging to the former. This lexicalization idea refers to the way that conceptually related meanings are expressed through linguistically related lexical items and broadly concerns the mapping between these levels of representation. Diachronic lexicalization, on the other hand, is understood to be the process of word-formation over time through the "atomization" of composed structure into a single, non-decomposable unit; for a survey of topics within this field of study, see ten Hacken and Thomas (2013).

[8]While it is an important component of the lexicalization process, I do not further discuss the content of this chunking process, i.e., specifically the status and role of syntactic structure in theses lexicalizations. The main reason is one of operation rather than interest–specifically, because the syntactic structures of the *have*-sentences in question are identical. It remains an interesting question the extent to which the idea of constructionalization could be applied to *have*-sentences, particularly in the case of locative PPs; for a comprehensive synthesis on the spectrum of proposals regarding constructionalization vs. lexicalization, see Lepic (2019).

[9]Importantly, however, lexicalization in the latter sense can be understood to be a property of linguistic structures that varies continuously between the poles of complete, invariable memorization (as in the case of, say, the name of a specific chemical compound) and complete, variable context-dependence (as in the case of, say, a deictic eye, lip, or hand movement). This spectrum allows for varying degrees of pan-situational reliability, as discussed in Piñango et al. (2017), for the case of systematic versus circumstantial metonymy. In Chapter 9, I further discuss this aspect of context-dependence, as motivated by the neuroimaging results from Chapter 8, as an avenue for diachronic change emerging from this otherwise "synchronic" (see Thomas 2013) view of lexicalization.

(62) LCS for relational meanings in a *have*-sentence.



This means that the conceptual representations of the entities and their relation are harnessed by linguistic structure into linguistically salient roles such as actor/subject, patient/object, etc. This packaging, and perhaps translation of sorts, allows for conceptual representations, as the "stuff of thought" (à la Pinker 2007), to enter into the domain of and be manipulated by linguistic structures.[10]

The relationship between the LCS of *have* and the GCI is a unidirectional one. That is, the GCI's conceptual ontology has linguistic consequence: both dimensions of the GCI are properties or assessments of properties over two entities. This conceptual two-entity requirement is borne out linguistically through the two-argument structure of *have*. Additionally, the requirement of a high degree of control asymmetry, indicating a high degree of control by one entity over another, is borne out linguistically through the designation of an actor (and its consequent language-specific structure). While the LCS of a lexical item does not influence the GCI directly, it mediates a speaker/comprehender's interaction with the GCI, as its structure can make salient a subspace of relational meanings from the entire GCI. Linguistically, this

[10]Another body of thought and work highly relevant to the lexicalization of conceptual structure discussion is the Two-level Semantics framework (Bierwisch, 2007; Lang and Maienborn, 2019), which broadly seeks to bridge compositionality, context-dependence, and conceptuality as the major aims of the predominant analytical approaches for studying linguistic meaning. The fundamental idea is two levels of semantic representation, Semantic Form (SF) and Conceptual Structure (CS), whereby SF is a subset of CS, that can be characterized together formally; the mathematical sanctioning of contextual factors and conceptual content allows the Two-level Semantics framework to account for a variety of semantic phenomena typically restricted to the individual wheelhouses of model-theoretic semantics, conceptual semantics, etc. I invoke some of its key components in the formal analysis of *have*-sentences following from the unified LCS account, in Chapter 5.

designation of a subspace is the demarcation of a lexical boundary. However, lexical items such as *have* that lexicalize maximally over the entire GCI space bear no influence on the GCI itself.

This conceptual space is directly motivated by the gradience between prototypical locative- and possessive-type meanings, as exemplified by the sentences in (63, reproduced from 58), which show how different degrees of connectedness (a/b, c/d, d/e) or control asymmetry (f/g, h/i, i/j, k/l) can change the type of relationship between the two entities involved, giving rise to **a spectrum of readings in one meaning space**. Here, I present the relationships using the English genitive marker, which can also encode a broad range of meanings from the conceptual space; the relevant test for assessing a change in relationship is by using other lexical devices that do not permit encoding of such a broad range from the space. For example, between examples (63a-b), the former would not permit *The chair belongs to Sue* while the latter would, as *belong* requires a higher degree of connectedness through the social relationship of ownership.

(63) Conceptual parameter manipulations

a. Sue's chair is broken. (in a waiting room)
b. Sue's chair is broken. (in her office)
c. The chauffeur's car is in the shop right now. (the car driven by the chauffeur)
d. Sue's car is in the shop right now. (the car owned by Sue)
e. Sue's cat is sick.
f. Sue's haircut is really striking.
g. Sue's hair is turning gray.
h. Sue's unborn baby is kicking a lot these days.
i. Sue's heart is mildly hypertrophic.
j. Sue's liver is taking a beating from all her drinking.
k. Sue's daughter is very independent, she wants nothing to do with Sue.
l. Sue's daughter is her best friend.

This gradient space inherently addresses the limitations in the extant approaches by explaining why *have* shows constrained variability in this domain (because these are the meanings that are captured by these conceptual parameters) and how the meanings conveyed by *have*-sentences seem to show ambiguities in their types (because these are ambiguous, and therefore contextually specified readings of a single generalized relational meaning). Crucially, this analysis is an answer to the one-to-many meaning mapping "problem" described by Myler (2014, a.o.), by showing that the many so-called "different meanings" are simply conceptually principled readings of a single, generalized meaning.

The takeaway for the unified LCS account for English *have*-sentences is that this gradient conceptual infrastructure serves as the set of conceptually possible relational meanings which language-specific linguistic structures can potentially identify and encode.[11]

3.3.3 Predictions for typology and diachrony

The setup of lexicalizing over this gradient conceptual infrastructure makes predictions crosslinguistically for how relational markers behave over space and time. This notion of variable lexicalization across languages follows from the framework described in Levin and Hovav (2019), who investigate "the encoding of conceptual components into a lexical unit" and "the regularities in the way such components are encoded in lexical items and hence distributed across [linguistic] constituents in particular languages."

I propose that the gradient conceptual infrastructure setup makes three types of predictions regarding the regularities in how lexical items can encode portions of the space: synchronic, diachronic, and acquisitional. **Synchronically**, we should observe rampant lexical

[11]Technically, the GCI for relational meanings is agnostic to the lexical semantic analysis of the two competing accounts; it could very much be the case that this relational meaning space is indeed what underlies the theoretically unlimited set of functional heads required to enumerate the semantic variability of *have*-sentences in the transitive copula account. However, I take the GCI to be part of the unified LCS account because it is specifically connected through the conceptual dimensions contributing to the causal potential evaluation of the LCS representation. The transitive copula account does not make any explicit connection to the possible infrastructural principles or constraints for the spectrum of relational meanings.

conflation across languages given a shared relational meaning infrastructure, though additional lexical devices for identifying specific sub-spaces within the infrastructure should also be available in any given language. The setup for English *have* could give rise to an implicational hierarchy in which possessive markers must also encode locative meanings, though this effect could be, as in the case of English, mediated by lexical blocking strength and contextual support. **Diachronically**, relational markers that lexicalize a GCI subspace (such as *kade*) should show smooth diachronic trajectories through the space, given the underlying gradience of the relations, in contrast to markers that lexicalize the entire GCI (such as *à*). Furthermore, these trajectories should proceed unidirectionally, from the origin of the Cartesian space outward, due to the higher informativity of greater degrees of connectedness and control asymmetry. **Developmentally**, children acquiring language should show a sequentiality of relational meanings starting from location, as the most conceptually basic of relations, and progressing to control and possession. Furthermore, instantiating the diachronic pattern during acquisition, children could also show overextension of informationally weaker relational markers (such as markers of proximity) into the domains of control or possession.

3.4 Crosslinguistic consequences of the gradient conceptual infrastructure

In this section, I present evidence from a diverse set of languages that bear out these predicted patterns of variation and change made by the gradient conceptual infrastructure for relational meanings. First, I show synchronic lexicalization patterns in which languages lexicalize over this entire space, then, I illustrate the smooth, incremental, and unidirectional diachronic trajectories of locational markers through the space, and conclude with acquisitional stages corresponding to the conceptual primacy of location and the growth of other relational meanings from it.

3.4.1 Synchronic conflation

Typologists have long observed that possessive meanings are often conveyed with the use of prototypically locative linguistic material; this conflation phenomenon has been described as syncretism taking place at the morphological level and the lexical item level.[12] Directly below, I briefly present these two patterns as crosslinguistic evidence that result from a gradient conceptual infrastructure for relational meanings.

Morphological conflation: possessives as datives and datives from locative adpositions

The examples in (64-66) illustrate a small sample of clear cases of how the same marker, a locative adposition, is used to express both incidental proximity (location) and ownership or control (possession) meanings across a variety of languages.

(64) French

a.

Le	*livre,*	*c'*	*est*	***à***	*moi.*
the.M.SG	book.M.SG	it	be.3.SG.PRES	**at**	1.SG

'I have the book.'

b.

Le	*livre,*	*c'*	*est*	***à***	*la*	*bibliothèque.*
the.the.M.SG	book.the.M.SG	it	be.3.SG.PRES	**at**	the.F.SG	library

'The book is at the library.'

(65) Marathi (Deo, 2014, *p. c.*)

a.

*Mazh-ya-**kade***	*pustak*	*ahe.*
1.SG.OBL-**near**	book.NOM	be.3.SG.PRES

'I have the book.'

b.

*Granthalaya-**kade***	*pustak*	*ahe.*
library.OBL-**near**	book.NOM	be.3.SG.PRES

'The book is near the library.'

[12] See Matushansky (2021) for a comprehensive crosslinguistic comparison of prepositional phrase distributions within this semantic domain.

(66) Mandarin Chinese

a. *Zhe ben shu* ***zai*** *wo zhe-li*
this CL book [is].**at** 1.SG here

'I have the book.'

b. *Zhe ben shu* ***zai*** *tushuguan (na-li)*
this CL book [is].**at** library (there)

'The book is at the library.'

The use of locative terms in the expression of predicative possession is a well-studied instance of morphological syncretism (Lyons, 1967; Clark, 1978; Freeze, 1992) in which languages encode the notions of spatial proximity or coincidence and alienable possession using a single morphosyntactic form. This conflation is attested, at least, in Indo-European, Finno-Ugric, Australian, Dravidian, African, and American indigenous languages (Aristar, 1996; Heine, 1997; Tham, 2004).

Specifically, such markers are understood to be the final stage of a grammaticalization pathway that begins with purely locative adpositions and ends at dative markers (Deo, 2015a). Dative markers, in turn, have been extensively documented as participating in possessive constructions; this kind of possessive construction is typically referred to as 'external possession' which itself has been a topic of much discussion (see Payne and Barshi, 1999, a.o.).[13] While these possessive datives have typically been associated with European languages (Haspelmath, 1999) (see German (67)), more recent work has shown that such possessive dative constructions are well-represented crosslinguistically. Lambert (2010) details the parallel constructions in Estonian, Korean, as well as Eastern African (Cushitic), Central African (Chadic), Papuan (Sepik-Ramu), and Southeastern Native American (Muskogean) languages, showing the global breadth of the use of dative markers for the expression of possessive relations.

[13]While much of the focus of external possession has been in relation to syntactic theory, it is noteworthy that descriptions of the meanings associated with external possession constructions have converged on meanings associated with English *have* in the location/possession domain as well as causatives, adversatives, and benefactives.

(67) ***dem*** ***Jungen*** *seine* *Hände*
the.M.SG.**DAT** boy.**DAT** POSS.PRN.PL hands
'the boy's hands'

Crucially, Kuryłowicz (1964) proposes that the dative is "genetically nothing else than an offshoot of the locative used with personal nouns." This claim is later substantiated with typological evidence by Aristar (1996) that shows a complementary distribution of datives and locatives depending on an animacy parameter, that is, datives are used with animate nominals while locatives are used with inanimate nominals.

An even more compelling example of this morphological syncretism is the case of Finnish, which has one of the most explicitly enumerated nominal case systems that has been studied extensively (Toivonen, 2000). In the traditional analysis of Finnish, there are six locative case markers which mark "internal location" (inessive 'inside', elative 'out of', illative 'into') and "external location" (adessive 'on, at', ablative 'off', allative ''onto') (Setälä, 1898), among others. Finnish also has a dedicated genitive marker in addition to a comitative marker, though recent work has cast into question the nature of this genitive, which in addition to expressing possession in the conventional way, shows parallels with other possessive markers like datives as well as *have*-type possessive verbs (Mahieu, 2013). Specifically, even with such a conventionalized way to express possession, Finnish also makes use of the explicitly locative adessive marker for possession meanings as well. Notably, this adessive possessive is a commonly used possessive construction (68).

(68) Finnish (Mahieu, 2013)

a. *Pekka-**n*** *auto.*
Pekka-**GEN** car-NOM
'Pekka's car'

b. *Auto* *on* *Pekka-**n**.*
Car-NOM be.3.SG Pekka-**GEN**
'The car is Pekka's.'

c. *Pekka-**lla*** *on* *auto.*
Pekka-**ADE** be.3.SG car-NOM
'Pekka has a car' lit.: 'at Pekka is a car.'

The case of Finnish possession shows that even with explicit and dedicated linguistic resources to mark possessive relations, locatives are still used widely to mark possession as well.[14] Overall, the takeaway here is that such widespread crosslinguistic conflation of locative and possessive morphology lends support to the idea that these locative and possessive meanings are connected at a conceptual level; I take the crosslinguistic ubiquity of this overt linguistic syncretism to be rooted in an underlying "conceptual syncretism" for these relational meanings.

Lexical conflation: possessive verbs for location and possession

The other form of lexical conflation within the relational meaning domain is a common verb used for both locative and possessive (and to some degree, existential) meanings. Such verbs are the most direct correlates to English *have*, but typically show more circumscribed sets of uses. One such example is the Mandarin verb *you*, typically glossed as 'have/exist,' which is the canonical device in the language used to express all relational meanings. The three examples in (69) show how the three meanings are distinguished by the first argument of the verb: existential predication requires no first argument (69a), possession requires any NP/THING as the first argument (69b),1 and location requires an inanimate NP/THING plus a locative particle as the first argument (69c). The second argument for all meanings with *you* is any NP/THING. Notably, the same dependence on the conceptual feature of animacy is involved in the interpretation of these sentences, as observed by Kuryłowicz (1964).

[14] Why is this the case? One possible explanation is that communicative systems tend to have bidirectional constructions that allow for focusing of different entities in the construction. This information structural parameter is the theme-rheme split and will be discussed later in Section **??**.

(69) Mandarin Chinese

a. ***you*** *yi* *ben* *shu*
exist one CL book

'There is a book.'

b. *wo* ***you*** *yi* *ben* *shu*
1.SG have one CL book

'I have a book.'

c. *zhuozi-shang* ***you*** *yi* *ben* *shu*
table-on have one CL book

'The table has a book on it.'

Another example is American Sign Language, which uses the verb HAVE[15] to express possessive relations as well as locative relations in a similar way to Mandarin Chinese, that is, in requiring the additional specification of a possessive relation to give a locative meaning. ASL is typically understood to have freer word order than Mandarin, consequently the placement of the locational specifier is less restricted than in Mandarin, where it must follow the location entity directly.

(70) American Sign Language[16]

a. *I HAVE ONE BOOK*

'I have one book.'

b. *TABLE HAVE BOOK* $CL{:}A_{IX}$
table have book CL:LOC

'The table has a book on it.'

c. *TABLE HAVE WHAT BOOK* $CL{:}A_{IX}$
table have what book CL:LOC

'The table has a book on it.'

[15] Following linguistic convention, I will use capital letters to indicate signs (linguistic material in the visuo-gestural modality) in ASL–this convention is parallel to the use of italics to designate words (linguistic material in the aural-oral modality).

[16] Example (70c) uses one of the most prototypical sentence constructions of ASL, the Clausal Question-Answer Pair (Davidson et al., 2008), as opposed to the more English-influenced (70b).

Such lexical conflation is widespread in Tibeto-Burman languages in particular; the Tani languages of Northeastern India and Southeastern Tibet show conflation of these relational meanings in a slightly different way (Post, 2008): in Mising, a generalized form *dung* is used for existence, location, and possession meanings, with possessives requiring a genitive-like marker (71). This pattern contrasts the Mandarin and ASL data, which require additional specification of the generalized marker for locative meanings.

(71) Mising (Post, 2008)

a. *sə* *asi* ***dung***
PRX water exist

'There's water in this one.'

b. *guhatisə* *gasumko* *tani* ***dung***
guhati=sə gasum=ko tani dung
Guwahati=PRX multiplicity=IND person exist

'There are many people here in Guwahati.'

c. *Ngokkə* *eegə* ***dung***
No-kə=əə eek=əə dung
1.sg-GEN=TOP pig=TOP exist

'I have pigs.'

Interestingly, *dung* is also the verb for 'sit', which places this lexical nexus into a crosslinguistically well-attested pattern of locative expressions emerging from positional verbs for 'sit', 'stand', and 'lie down', among others. In Apatani, a closely related Tani language, all three of these positional verbs (*dùu*, *dà'*, and *dóo*, respectively), are used for locative, possessive, and existential meanings.

Takeaway: various strategies (degrees of syncretism) for referring to these meanings

Again, the takeaway here is that this widespread crosslinguistic conflation of locative and possessive linguistic material, this time at the lexical rather than morphological level, further bolsters a conceptual connection between the meanings of location and possession–the "conceptual syncretism" described previously, particularly as predicted by the setup of the gradient conceptual infrastructure. The breadth of these conflation phenomena globally show a systematic lexicalization of these meanings. Though the individual patterns also show variation, presumably due to language-internal factors, there is no question that the connection between location and possession expressions lies beyond areal or contact phenomena, and indicates a deeper motivation for why linguistic structures across the world converge systematically on expressing location and possessive meanings using overlapping lexical devices.

3.4.2 Diachronic trajectories

I now turn to diachronic patterns of locative and possessive expressions for additional insight on the conceptual connection between the meanings of location and possession. In this section, I will show a diachronic trajectory, consistent with the setup of the gradient conceptual infrastructure, that illustrates how these meanings are ontologically connected, and that they extend unidirectionally in a systematic fashion.

Marathi *kade*

The morphological conflation of locative and possessive meanings is also attested across languages diachronically. The best documented example of this phenomenon is observed in Marathi, an Indo-Aryan language with over 70 million speakers. Table (3.1) shows how a single adposition *kade* moves incrementally through this meaning space over the course of approximately 200 years (Deo, 2008; Deo, 2020, *p. c.*). The change is actuated by animacy differences in the subject position, and through alternating expansion and categorization processes, illustrated in (72-74).

Table 3.1: The diachronic trajectory of the location-to-possession shift in Marathi

Meaning	Subject	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Loc	Inanim.	***kade***	***kade***	*dzəval*/ ***kade***	*dzəval*	*dzəval*	Z/*dzəval*
Loc	Anim.	***kade***	***kade***	*dzəval*	*dzəval*	*dzəval*	Z
Poss_{alien}	Anim.	*la*	***kade***/*la*	***kade***	*dzəval*/***kade***	*dzəval*/ ***kade***	*dzəval*
$\text{Poss}_{inalien}$	Anim.	*la*	*la*	*la*	***kade***/ *la*	***kade***/*la*	***kade***
$\text{Poss}_{inalien}$	Inanim.	*la*	*la*	*la*	*la*	***kade***/*la*	***kade***

In Stage 0, locative readings (72) are exhaustively conveyed through the use of *kade*, regardless of the animacy of the subject. All possessive readings are communicated through *la*. Gradually, *kade* encroaches upon the meanings of *la*, such that in Stage 1, there is an ambiguity with only animate agents (73), where both locative (proximity) and possessive (control) readings are possible. Eventually, the language reaches Stage 2, where locative readings with animate arguments are no longer possible with *kade*–it has become the only way to convey alienable possession, and a new marker, *dzəval*–meaning 'underarm'–is recruited to convey locative readings with animate subjects (74). Stage 3 shows an ongoing extension of *kade* into inalienable possession (specifically part-whole and kinship relations) with animate arguments (75).

(72) Stage 0

a. *ghara-**kade*** *ek* *vihir* *ase.*
house.OBL-**near** one well.NOM be.3.SG.PRES

Near the house is a well.

b. *gosaviya-**kade*** *mahadaisa* *ase.*
sage.OBL-**near** Mahadaisa be.3.SG.PRES

Mahadaisa is near the sage.

(73) Stage 1 (ambiguity with animate agents)

a. *ghara-**kade*** *ek* *vihir* *ahe.*
house.OBL-**near** one well.NOM be.3.SG.PRES

Near the house is a well.

b. *manusa-**kade*** *ek* *kharata* *ahe.*
man.OBL-**near** one broom.NOM be.3.SG.PRES

(a) Near the man is a broom.
(b) The man has a broom. (under his control)

(74) Stage 2 (categorical distinction with animate agents)

a. *ghara-**kade*** *ek* *vihir* *ahe.*
house.OBL-**near** one well.NOM be.3.SG.PRES

Near the house is a well.

b. *manusa-**kade*** *ek* *kharata* *ahe.*
man.OBL-**near** one broom.NOM be.3.SG.PRES

(a) *Near the man is a broom.
(b) The man has a broom. (under his control)

c. *manusa-**dzəval*** *ek* *kharata* *ahe.*
man.OBL-**near** one broom.NOM be.3.SG.PRES

Near the man is a broom.

(75) Stage 3 (inalienable with animate agents)

a. *majhya-**kade*** *phakta* *nau* *bota* *ahet.*
1.sg.OBL-**near** only nine fingers.NOM be.3.PL.PRES

I have only nine fingers.

b. *Ram-kade* *tin* *bahini* *ani* *don* *bhau* *ahet.*
Ram-**near** three sisters.NOM and two brothers.nom be.3.SG.PRES

Ram has three sisters and two brothers.

Crucially, the gradual, incrementally ambiguous trajectory of *kade* is evidence for a *gradient* underlying conceptual connection for the meanings of location and possession, since the factors that drive each change are a conceptual feature, namely animacy, in the first argument, rather than a domain change as would be the case for a metaphorical extension. Further evidence for a gradient conceptual connection is that the location-to-possession trajectory presented here is cyclical: Stage 2 shows the introduction of *dzəval* into the trajectory, after which it follows the same pattern in Stages 3-5 as *kade* in Stages 0-2. Such cyclicality highlights the stability of the meanings as conceptual infrastructure for the dynamic lexical markers themselves, which shift due to communicative and social pressures. That is to say, these patterns reveal diachronic change at the level of the actual linguistic resources used to convey a set of stable meanings. The meanings of locative and possessive relations are constant as concepts that humans think and talk about–it is the linguistic devices that they used to indicate the specific relations that shift over time.

Takeaway: these meanings are connected in an ordered way

Overall, the Marathi diachronicity follows from the gradient conceptual infrastructure, such that lexical markers move unidirectionally from expressing locative meanings to possessive meanings.[17] These meanings are locally ambiguous, in that each 'adjacent' meaning pair shows ambiguity, principally due to the conceptual feature of animacy. Deo (2015a) describes a set of questions regarding any characterization of semantic change, one of which is "What is the logical relation between the meanings of these expressions such that a "path" may exist between them?" Here, the Marathi data illustrate a subset relation between location and possession, consistent with the LCS analysis for English *have*.

Such a gradient representation sheds light on *why* language after language shows systematic synchronic overlap and diachronic shifts in the lexical markers used to express these meanings. The lexical markers, as categorical bins that "chunk" this meaning space, live in states of flux and stability. On the one hand, minor changes in any of these conceptual features, for this example–animacy, can push the lexical boundaries of a so-called "proximity" marker into a marker that expresses a control or alienable possession relation. These lexical boundaries face

[17]Regarding English *have*, though the breadth of relational meanings are well-attested before the beginning of Modern English and therefore no diachronic patterns have been ascribed to it, the mere attestation of these readings throughout its history does not necessarily rule out the possibility of a diachronic trajectory, as change within a class of meanings is often visible only through a more nuanced investigation, such as relative frequencies of forms (see Fuchs, 2020). This type of analysis is a possible avenue of future research.

a challenge of maintaining traction in a semantic slippery slope. On the other hand, communicative pressures such as the optimization of economy vs. expressivity (vagueness vs. ambiguity in Haspelmath 2003) combined with cognitive blocking help maintain multiple markers to cover this space.

3.4.3 Acquisition patterns

Another body of evidence bearing out the predictions from the gradient conceptual infrastructure of relational meanings are patterns of language acquisition and conceptual development. These patterns again show the unidirectional gradience of the conceptual infrastructure at a lifespan-internal timescale.

Conceptual development of location-possession meanings

The developmental literature has studied the acquisition of spatial language extensively; Clark (1973) exhaustively outlines the conceptual dimensions of spatial language acquisition and its relations to temporal language and the consequent challenges children face when acquiring these linguistic devices. One particular challenge is the initially exhaustive mapping of linguistic space ("L-space") onto perceptual space ("P-space") and the subsequent pruning of distinctions based on the categoricality of the language eventually acquired. Clark (2004) presents experimental data illustrating this exhaustivity allowing an important conclusion regarding a shared conceptual basis for location and possession to be drawn.

Through preferential looking time studies, Clark outlines a sequence of acquisition for different spatial relations, which I take to be evidence illustrating the unary nature of relational meanings. She finds that as a group, children are earliest in attending to containment relations (6-7 months of age), and build on this understanding to attend to support relations later (9-14 months of age), though the individual learning trajectories are variable between individuals. Moreover, children further build on these gradient notions of spatial configurations to locative "goal" trajectories by 15-18 months of age. While prototypical possessive relations, such as ownership relations, are not acquired until an understanding of its societal implications is gained, the locative relations here reflect the differential values of agentive control (as in (73)) that define location and possession. The incrementality of this spatial language process highlights the continuity of the conceptual space; different languages' lexical categorization of these relations only subsequently refine the specific relations. Clark's key conclusion is that the acquisition of spatial language is perceptually driven and connected to a conceptual space, and only later binned into language-specific categories, in the same way acquisition of vowels in formant space is understood. Grounding the perceptual experiences of children into a conceptual space prior to a linguistic space enables children to continue perceiving a wide array of spatial configurations, even after the linguistic categories are acquired.

Semantic extensions in acquisition

Children (and adolescents) have been widely reported to play a crucial role in language change, especially along known dimensions of conceptual change, like the space-to-time dimensions (Slobin, 1977; Kerswill, 1996; Eckert, 1989); that is, innovations and extensions made during language acquisition and development can follow known trajectories of meaning change. This general phenomenon has been called into question (Sankoff, 1980; Baker and Syea, 1996), specifically whether such "innovations" are true innovations or are taken from existing forms that adults use and are readily available in the child's linguistic milieu. This so-called counter-evidence, however, takes the concepts to which children are innovating new mappings of linguistic form to be the basis of adult language, and consequently, children are not innovating new meanings, the argument goes. I take the perspective that meanings, particularly relational meanings for the purposes here, are not necessarily adult forms uniquely, but grounded in the innate conceptual system. The question relevant to the present discussion, however, is how the re-mapping of linguistic material to so-called "adult" forms (*i.e.,* the maturing of "adult"-like lexical boundaries) can reveal the structure of the conceptual system.

One example of this situation lies again in the case of Marathi *kade*. Anecdotal evidence suggests that children over-extend the use of *kade* along the predicted trajectory, using it even for inalienable possession by inanimate first arguments (possessors), which is otherwise unacceptable by adult speakers (Deo, 2014, 2020, *p. c.*). In (76), we see *kade* used with inanimate "agents" to describe part-whole and kinship relations; these uses represent Stage 4 of the trajectory above. Within these inanimate entities, use with both inanimate but "animized" (facialized) entities, like vehicles, as well as entirely inanimate entities is observed.

(76) Unauthorized extensions of *kade* by children

a. *bus-**kade** muh nahi ahe, dat nahi ahe, mag ti ma-la kasa kha-un tak-nar?*
bus-**'near'** mouth NEG be.3.SG.PRES teeth NEG be.3.SG.PRES then 3.SG.F 1.SG.ACC how eat.GER drop.PROSP

The bus doesn't have a mouth, doesn't have teeth, then how will she (it) eat me up?

b. *hya ghara-**kade** lal dar ahe.*
this house-**'near'** red door be.3.PL.PRES

This house has a red door.

This pattern of over-extension by children provides corroborating evidence that the lexical devices in the language used to express relational meanings are identifying portions of this underlying, unified conceptual space in two ways. Following (Clark, 2004), children begin with a maximally generalized form-to-concept mapping and later develop language-specific lexical boundaries for more specific relations within the generalized mapping; the use of *kade* over the entire relational space by young children suggests an inherent unity in these meanings such that they are taken to be one at the start–specifically, that the more causal (and therefore informationally stronger) reading is part of the more general meaning. Additionally, following the idea that only children can simplify grammars (Halle, 1964; Lightfoot, 1979; Kiparsky, 1982) this so-called 'extension' suggests a generalizability of these relational meanings, such that children would systematically refer to this generalized concept more economically, that is, with fewer linguistic markers.

Takeaway: children understand these meanings to be conceptually unified

Overall, the unidirectional acquisitional incrementality parallels the unidirectional diachronic incrementality as reflexes of the incrementality of the gradient conceptual infrastructure. The conceptual primary of location as well as its manifestation in pre-linguistic beings is further support for the import of the conceptual structure setup for the linguistic patterns we can directly observe.

3.5 Conclusion

In sum, I take the synchronic, diachronic, and developmental patterns described here to be reflexes of the underlying gradient conceptual infrastructure for relational meanings. In particular, the cyclicality of the Marathi trajectory supports the framework of a stable conceptual infrastructure over which linguistic markers lexicalize while the movement of the mappings of the lexical markers over the concepts is actuated by ambiguities from related conceptual features like animacy.

The gradient conceptual infrastructure serves as the conceptual foundation and source for the possible relational meanings encodable by linguistic devices in the process of lexicalization. These crosslinguistic patterns tie together the first two ingredients of the model of meaning variation: a flexible linguistic structure that allows access to and encoding of an entire conceptual space (the unified LCS structure in Chapter 2). The interaction of such lexical structure with such conceptual structure is the source of how different meaning variants can emerge.

But, how are the possible meaning variants actuated? Individual speakers and comprehenders are the key ingredient for creating these variants from the flexible lexical structure as constrained by the conceptual infrastructure. In the next section, I describe one operationalization of how individual users of a language can actuate meaning variation out of this model, and how these individual-level traits, emerging from independently arising cognitive predispositions, interact with the flexible lexical structure to produce conceptually constrained meaning variation.

Chapter 4

Cognitive variability: using linguistic context-sensitivity

Contents

4.1 Introduction

In this chapter, I motivate the final component of the model of meaning variation, which is the construct of linguistic context-sensitivity, defined as the capacity of a neurocognitive linguistic system to identify and integrate the information in the communicative context prompted by the meaning requirements of a given linguistic expression in that context (§4.2). Then, I describe two possible sources of individual-level variability in linguistic context-sensitivity, seeking to ground this construct in domain-general cognitive capacities (§4.3). Then, I take up the findings in Study 1a, which showed that the locative reading of a "bare" *have*-sentence can be facilitated using relevant contextual information, and show that this contextual-facilitation effect, in fact, is limited to individual comprehenders who show a greater degree of linguistic context-sensitivity (§4.4). Finally, I describe limitations with my principal index of linguistic context-sensitivity, the Autism Quotient measure, and propose a new tool constructed from it as an improved measure for further investigation (§4.5), and conclude the chapter with a discussion on the implications of including individual-level variability in theoretical accounts of language and further motivate investigation into the psychological reality of all three components of the model of meaning variation.

4.2 Linguistic context-sensitivity

The way in which individuals within the same speech community use language is systematic yet variable. Where does this variability come from? Boland et al. (2016) define two sources for between-individual variability in language: internal, that is, features of an individual's cognitive system, such as cognitive style, that undergird linguistic choices and processing, and external, that is, features of the communicative context, such as social dynamics.

The notion of cognitive style is used to describe the generalized ways in which different individuals acquire and process information, which presumably emerge from variability in their underlying cognitive makeup (Kozhevnikov, 2007; Kozhevnikov et al., 2014). One well-studied cognitive style phenomenon relevant and operationalizable to language use is **context-sensitivity**. In its domain-general instantiation, context-sensitivity refers to the capacity of an individual for recognizing and making use of relevant information from the context. This construct has been used in cross-cultural psychology to distinguish individuals from 'Eastern' versus 'Western' cultures (Masuda and Nisbett, 2001; Imada et al., 2013; Martin et al., 2019), in cognitive psychology to distinguish women from men (Bonanno and Burton, 2013; Goubet and Chrysikou, 2019), and in clinical psychology to distinguish individuals diagnosed with autistic spectrum condition (ASC) from matched individuals without ASC (Mottron et al., 2000; Zilbovicius et al., 2006; Chawarska et al., 2012; Baez and Ibanez, 2014; Palmer et al., 2015). In this latter domain, individuals with ASC are systematically less context-sensitive than their matched neurotypical peers. This characterization falls in line with the well-established difficulties that individuals with ASC have with language use (American Psychiatric Association, 2013), particularly in the case of pragmatic, or context-dependent, language (Pijnacker et al., 2009, 2010).

By extension, systematic variability in linguistic behavior has also been found in individuals exhibiting so-called "autistic" traits, relative to individuals who do not display autistic traits (Stewart and Ota, 2008; Nieuwland et al., 2010; Yu, 2010; Xiang et al., 2013; Antoniou et al., 2016; Yoshimoto et al., 2017; Yang et al., 2018; Derrick et al., 2019; Lai et al., 2019). These two sets of findings directly relate to the larger motive because they show that individuals with ASC or autistic traits have difficulty with generalized context-sensitivity as well as with certain aspects of context-dependent language.

Consequently, I propose that the construct of **linguistic context-sensitivity** is a key contributor to variability in linguistic behavior. Hereafter, I define linguistic context-sensitivity as the capacity of a neurocognitive linguistic system to identify and integrate the information in the communicative context prompted by the meaning requirements of a given linguistic expression in that context. Specifically, the meaning requirements are those imposed by the lexico-semantic conceptual structure of a given lexical item. Accordingly, the primary research question is whether variability in the domain-general cognitive capacities identified as "autistic" traits contribute to variability in linguistic context-sensitivity.

Secondarily, I question the role of gender in linguistic context-sensitivity, as gender-group has been found to correlate with differences in autism diagnoses and manifestations (American Psychiatric Association, 2013; Parish-Morris et al., 2017), in context-sensitivity (Goubet and Chrysikou, 2019), and in "autistic" traits in language (Yu, 2010). Moreover, foundational work in the sociolinguistic variationist tradition has shown that gender-group correlates with a variety of linguistic behaviors (Lakoff, 1973; Labov, 1990; Romaine, 2003), though the mechanisms by which socially constructed gender directly contributes to linguistic differences or, instead, reflects other social factors that generate linguistic differences is still an area of active research (Eckert and McConnell-Ginet, 2013; Talbot, 2019). These patterns beg the question: do the multiplicity of social factors implicated in gender identity and performance also contribute variability in linguistic behavior through differences in linguistic context-sensitivity? That is, do differences in gender-group or differences in behavior that are associated with gender-group but originate from differences in other social factors, like position in a asymmetric social power structure, contribute to variability in linguistic context-sensitivity? These questions are the focus of the present section.

4.3 Possible sources of variability in linguistic context-sensitivity

4.3.1 Cognitive factors

One possible source for variability in linguistic context-sensitivity lies in the view that context-sensitivity is a function of cognitive style, in other words, that differences in domain-general cognitive dispositions lead to certain individuals being more context-sensitive than others. (Kozhevnikov et al., 2014), who, in an interdisciplinary analysis of different cognitive styles, identify psychological dimensions as parameters for variability in cognitive style. I take three of them to be particularly relevant for context-sensitivity, and list them with the context-sensitive pole of the dimension preceding the context-insensitive pole of the same dimension: **(a)** integration versus compartmentalization: the ability to see atomic units composing into larger structures versus seeing units as individual entities; **(b)** innovation versus adaptation: the tendency to question convention and propose novel approaches versus accepting established procedures for a task; and **(c)** intuitive versus rule-based processing: the preference for flexible/pragmatic versus rigid/conventionalized information processing.

The psychological construct of context-sensitivity has also been explored in the autistic spectrum condition (ASC) literature, as individuals diagnosed with ASC are widely reported to show lower sensitivity to context in experimental tasks when compared to matched neurotypical peers, involving not only language processing (Brock et al., 2008; Pijnacker et al., 2009, 2010) and language learning (Dörnyei, 2005; Dörnyei and Ryan, 2015), but also social attention (Zilbovicius et al., 2006; Chawarska et al., 2012; Baez and Ibanez, 2014), and visual and music perception (Palmer et al., 2015; Mottron et al., 2000).

The predominant framework for accounting for these low context-sensitivity effects is the weak central coherence (WCC) account of ASC (Frith, 1989; Frith and Happé, 1994). The

WCC account proposes that the source of the behavioral differences associated with ASC is not an inherent disability *per se*, but a cognitive style focused on local, rather than global, processing. A local processing style is understood as attending to and focusing on details/atoms first and foremost, while a global processing style is understood as attending to and focusing on overall configurations/gestalts first and foremost (Navon, 1977; Kimchi, 1992), aligning with dimension (a) from Kozhevnikov et al. (2014), above. Such a perspective can account not only for the socio-communicative difficulties but also the heightened perceptual and "savant" abilities associated with ASC (Happé, 1997; Happé and Frith, 2006). The Enhanced Perceptual Functioning (EPF) account, an alternative to the WCC, also focuses on the idea of a local bias, though it attributes the bias not to a cognitive style, but disproportionately enhanced abilities at the local, perceptual level (Mottron et al., 2006). Yet another view, detailed in Plaisted (2001), proposes that the inability to perform more global processes arises from an inability to generalize (*i.e.*, recognize similarities across stimuli and structure pieces of information together), rather than an asymmetric ability in or predisposition towards local processing.

While arbitrating between theoretical accounts of ASC is not in the scope of this work, these findings provide possible explanations for largely overlapping bodies of evidence. In particular, the WCC and EPF accounts converge on the prediction that individuals with ASC will show greater impairment in their performance of linguistic tasks that demand an integration of linguistic input with the larger linguistic context, in contrast to linguistic tasks that do not demand such contextual integration. Reported evidence bears this prediction out. Nuske and Bavin (2011) tested narrative comprehension in children ages 4-7 and found a performance asymmetry: whereas children with ASC and their age-matched typically developing controls score similarly on local-processing questions probing details and fact-based recall, the typically developing children show improved global-processing questions probing main ideas and inferential processing. While the similar local processing scores, in terms of group means, would seem to support only the WCC, the ASC group showed much higher variability in their scores, which is not inconsistent with an EPF approach. This observation, in line with the well-known heterogeneity of ASC trait presentation, underscores the importance of characterizing *individual-level* variability in language behavior.

Crucially, the reconceptualization of ASC as the degree of "local bias" in processing, as a gradient cognitive style rather than a categorical dysfunction, suggests the existence of a similar bias in non-autistic individuals in the population at large, following the broader autism phenotype framework (Piven et al., 1997; Constantino and Todd, 2003; Sucksmith et al., 2011; Bralten et al., 2018, a.o.), which takes characteristics of ASC to be subclinical manifestations of personality traits in the neurotypical population.[1] Indeed, recent work has characterized this difference in local versus global processing bias for neurotypical populations in the domains of face perception (Stevenson et al., 2018), object decision/classification (English et al., 2017; Gerlach and Poirel, 2018), susceptibility to optical illusions (Chouinard et al., 2016), motor control planning (Job et al., 2017), and predisposition to post-traumatic stress disorder symptoms (Hagenaars et al., 2016). Notably for the present effort, a tool that has been developed to carry out this cognitive style discrimination is the Autism-Spectrum Quotient (AQ) questionnaire , which measures the degree of "autistic" traits, as emerging from general cognitive dimensions of variability, in the general population (Baron-Cohen et al., 2001). The AQ comprises 50 items in which participants self-report agreement with "I-statements" capturing the five principal categories of traits associated with ASC: attention to detail, attention switching, communication, imagination, and social skills (Baron-Cohen et al., 2001). I further detail the mechanics of this psychometric instrument in Section 4.4.1, but assert here that the utility of such a gradient tool allows for operationalizing a gradient characterization of "autistic" traits in the general population.

[1]This perspective underlies the recent efforts toward promoting the idea and consequent social movement of "neurodiversity," which reframes traits associated with ASC as natural brain variability to be valued, mirroring the well-established positivity of *bio*diversity, rather than merely disorders or deficits to be cured or treated (Baron-Cohen, 2017; den Houting, 2019, a.o).

This setup for a context-sensitive cognitive style is supported by evidence from linguistic behavior. Specifically, the AQ has been used as a tool in language studies in neurotypical populations to index a context-sensitive cognitive style at all levels of linguistic use: phonetic, syntactic, and semantic/pragmatic. Because context-sensitivity decreases with a higher degree of "autistic" traits, low AQ scores are taken to indicate high context-sensitivity, while high AQ scores indicate low context-sensitivity. However, the AQ does not necessarily manifest linguistic context-sensitivity in a uniform way, especially in light of the three possible cognitive dimensions of linguistic context-sensitivity from Kozhevnikov et al. (2014). To my knowledge, Stewart and Ota (2008) were the first to use AQ in a linguistic task; they showed that high-AQ (less context-sensitive) participants were less able to use lexical information in discriminating between ambiguous phonetic strings and attributed this to a bias toward compartmentalization of acoustic and lexical information, in line with dimension (a) above. No differences were found between high-AQ and low-AQ individuals in their baseline acoustic acuity or lexical access abilities, suggesting a dispreference toward integrating these types of linguistic information (dimension (a)), or, in my view, possibly an inflexibility or unwillingness to use lexical information in an auditory discrimination task (dimension (c)). Subsequently, Nieuwland et al. (2010) report a correlation between high AQ scores (lower context-sensitivity) and non-attenuated comprehension of pragmatically underinformative statements, suggesting that less context-sensitive participants were less affected by contextually infelicitous stimuli. Xiang et al. (2013) report an acceptability judgment pattern whereby high-AQ (less context-sensitive) participants exhibit less pragmatic interference than low-AQ participants in NPI licensing constructions—a computation involving syntactic long-distance dependency; this effect, however, was not borne out in real-time processing measures. In both studies, the differences between AQ groups were attributed to an diminished ability to integrate world knowledge with lexical knowledge (connecting to dimension (a)) and a greater focus on incremental word-by-word relations rather than more global, phrase-by-phrase relations (connecting to dimensions

(b) and (c)).

These reports are cohesive in ascribing differences in using or being affected by contextual information between high-AQ (less context-sensitive) and low-AQ (more context-sensitive) individuals and are consistent with the aforementioned accounts of ASC traits. These findings also advance the view that differences associated with "autistic" traits are not necessarily deficits, in line with the broader autism phenotype and neurodiversity ideas: high-AQ (less context-sensitive) participants in Xiang et al. (2013), for example, actually showed less "deficit" in terms of the NPI interference effect.

In an examination at the phonetic level, Derrick et al. (2019) report that high-AQ participants show poorer multisensory integration abilities, that is, they used the "right" contextual phonetic information at the "wrong" time. Previously, Derrick et al. (2009) showed, for a general population, that a puff of air on the skin helps disambiguate /pa/, a syllable beginning with an aspirated voiceless bilabial stop, from a silent video of a person pronouncing /pa/ or /ba/, but only when the puff of air occurs between 50 and 100 milliseconds after the visible lip-opening. High-AQ participants, however, used the air puff information to disambiguate the target well beyond that time window, which suggests not necessarily a problem with multisensory integration itself, but rather, not having acquired the typically narrow perceptual windows of integration in development (Derrick et al., 2019). This finding nuances the general claim that individuals with "autistic" traits are less able or unable to use contextual information by showing that these individuals have difficulty using the right information at the right time. Pijnacker et al. (2010) present corroborating ERP findings that high-functioning adults with ASC show a delayed or less-automatic—but not categorically absent—contextualization effect during real-time sentence comprehension. This *asynchrony* in contextualization ability, not the contextualization ability itself, could, in fact, be the source of the differences described in the first three studies.

From these reports, at least three possible specific traits or mechanisms that could underlie linguistic context-sensitivity emerge, though I note that the AQ does not *a priori* distinguish between them: **(a)** the detection of variation (baseline perceptual acuity), **(b)** the actual ability to make use of the variants, or **(c)** the willingness to allow for non-canonical variants to guide downstream processing; these last two align with dimensions (b) and (c) from Kozhevnikov et al. (2014), above.

Closer to the focus here, Yu (2010) was the first to use both gender-group and AQ to index context-sensitivity, finding an interaction between the two factors in a phonetic contextualization task. Yu reports that men and high-AQ women overcompensate and normalize coarticulation effects, while low-AQ women undercompensate for these effects, thereby allowing context-induced phonetic variants to persist and percolate through a speech community. Here, context-sensitivity is operationalized as an ability to tolerate variation, rather than the ability to use contextual information. These results nuance possibility (b) above—the making use of variants—into two sub-mechanisms: the assignment of significance and therefore utility to variants, and the actual ability to use those variants for later processing. I interpret the undercompensation to indicate an assignment of potential significance to these otherwise predictable coarticulatory effects, in that certain individuals leave open the possibility that these variants could hold meaning, socioindexical or not, and thus do not neutralize them.

In these findings and in the broader literature, however, the connection between gender-group and AQ is unclear. The AQ has been shown to correlate with gender-group (Hurst et al., 2007; Pisula et al., 2013; Lai et al., 2015; Ruzich et al., 2015; Grove et al., 2016), in line with the clinical correlation whereby men are diagnosed with ASC at a much greater rate than women (*e.g.* Baron-Cohen et al., 2011). While it could be the case here that gender-group and AQ simply are capturing similar variability at different resolutions, the underlying causes for the ASC-gender incidence asymmetry remain an actively studied question. One possible explanation, which casts the gender-group-asymmetry as a methodological artifact, is the idea of linguistic camouflage, a phenomenon whereby some individuals, generally women, mask the specific social or communicative behaviors associated with ASC that diagnostic tools are targeting (Parish-Morris et al., 2017). To sum this up, while the documented relationship between gender-group and ASC and expression of autistic traits is well-reported, the actual mechanisms that underlie these correlations remain unspecified—in the following section, I describe further some possibilities to explain the association between gender-group effects and linguistic behavior.

Overall, the main takeaway from this body of work is that the AQ questionnaire is an effective tool for organizing individual-level variability in "autistic" traits and therefore represents a viable instrument to assess a potentially composite cognitive component of context-sensitivity in linguistic behavior. This support notwithstanding, those studies do not identify the underlying cognitive dimensions of linguistic context-sensitivity nor do they indicate how contextual information features in language use. So, the question remains: on the assumption that it has a non-linguistic, cognitive basis, how should linguistic context-sensitivity be understood such that it can be measured during language use? An answer to this question will shed light on understanding the cognitive capacities involved in the language contextualization process and how individual-level variability in these capacities gives rise to variability in language behavior.

4.3.2 Social factors

I include an exploration of gender in this investigation of linguistic context-sensitivity because of the reported gender-based effects in three of the relevant literatures: ASC and autistic traits (*e.g.* Yu, 2010; Baron-Cohen et al., 2011; Parish-Morris et al., 2017), context-sensitivity (Bonanno and Burton, 2013; Goubet and Chrysikou, 2019), and language behavior (see Talbot, 2019). While the implementation of gender as an experimental factor differs across these bodies of work, my position here is that the underlying human capacity for language is common to all individuals, regardless of their gender identity or expression. And consequently, though the outward (and inward) manifestations of gender reflect a multitude of sociopsychobiological factors (Helgeson, 2015; Polderman et al., 2018; Hyde et al., 2019), I take the existing findings involving gender-group differences to principally reflect social factors, in contrast to the cognitive factors described in the previous section.

What are some of these social factors, and how do they connect to the relationship between gender and linguistic behavior? It has been proposed an individual's use of language is grounded, in part, in the social and cultural conditioning provided by the community into which an individual is born and where the individual develops. Specifically, gender category has been invoked as an organizing factor in an individual's linguistic development (see Eckert and McConnell-Ginet, 2013; Talbot, 2019), due to the observation that the way that children are socialized as speakers/producers and hearers/comprehenders in a speech community can vary in accordance with their gender identity. In cultures across the world, for example, there exist prescriptive divides in lexical items, grammatical constructions, and discourse practices for women and men based on sociocultural or religious norms: one notable case is Japanese *joseigo* (women's language) and *danseigo* (men's language), which comprise phonological, lexical, morphosyntactic, and conversational differences and are learned as early as age 3-6 (Nakamura, 2001).

Early work seeking to categorize the linguistic behaviors of women versus men attributed linguistic differences as a direct result of gender identity (*e.g.* Lakoff, 1972, 1973); this operationalization of gender often targets the gender-normative behaviors that women and men are exposed to during childhood and are reinforced through their lifetimes (the 'difference' approach, see Eckert and McConnell-Ginet, 2013). Over time, the centrality of gender in linguistic organization has been further nuanced with the idea that an individual's gender is not the only sociocultural source of variability in language. That is, to have a linguistic impact, gender must be contextualized within other factors like race and sexuality, two dimensions along which social power manifests asymmetrically across a speech community (Eckert and McConnell-Ginet, 1999).

Later research on nonverbal expressions of gender has found that the performance of gender must be understood in the context of additional communicative factors like age, group size, task, power asymmetry, communicative (facial versus vocal) channel, and gender composition, which themselves modulate the expression of gender-normative behaviors (see LaFrance and Vial, 2016). In fact, in the 'dominance' approach, so-called "gendered" behaviors are taken to arise not from socialized (or psychobiological) differences at all, but from the fact that gender-groups typically occupy different positions within social structures, which inherently fall along power asymmetries (Eckert and McConnell-Ginet, 2013). In this view, behavioral differences that surface as aligning with gender-groups are actually determined by the different goals and resources available at each position or level within an asymmetric power structure. For the purposes of this study, I remain agnostic to the difference versus dominance perspectives of gendered language, and I take gender-group, as an underspecified metric, to reflect the amalgam of social factors associated with gender identity construction and expression.

The question here is whether those factors are connected to the variability in linguistic behavior that is associated with linguistic context-sensitivity. Given this setup, there are three logical possibilities: **(a)** the social factors manifested as a gender-group difference connect with variability in linguistic behavior through variability in linguistic context-sensitivity; **(b)** these same social factors connect with variability in linguistic behavior, but not through linguistic context-sensitivity; or **(c)**, these social factors do not connect with variability in linguistic behavior. Altogether, this approach supports the perspective that human beings' underlying capacity to produce and comprehend language may be mediated by social factors, resulting in behaviors that appear different when measured across any given social variable, such as gender, race, or sexuality. These behaviors are the substrate for the social variables; it is not necessarily the case that any behavioral differences identified result from differences in capacity.

While the problematic nature of any categorization for gender that does not take into account the gradience of any given individual's gender identity and performance, particularly their participation in gender-normative or otherwise gendered linguistic behaviors is clear, the absence of a continuous measure to organize this gradient construct of gender renders the binary grouping still a relevant tool in attempting to understand the role of social factors in linguistic context-sensitivity, by connecting this study with the documented patterns associated with gender-group, particularly that of Yu (2010). With these limitations in mind, I adopt the binary grouping of gender as the index for the potential social bases of linguistic context-sensitivity.

4.4 Study 1b: Individual-level variability in contextual facilitation

I present here the experimental investigation of the two potential sources of differences in linguistic context-sensitivity using the contextual facilitation effect obtained from Study 1a and Zhang et al. (2022), with the expectation that variability in an individual's cognitive style is an important factor that contributes to the core linguistic operation of interpreting an ambiguous *have*-sentence in context. The two hypotheses regarding the cognitive and social factors in variability in linguistic context-sensitivity make distinct predictions. If the cognitive capacities underlying "autistic" traits are a contributing factor to linguistic context-sensitivity, then AQ scores should significantly correlate with inter-comprehender variability in acceptability ratings of the target sentence in the Locative Context-type. Alternatively, if the social factors that underlie or manifest as gender expression contribute to linguistic context-sensitivity, then the two gender-groups should show a difference in ratings for the target sentence in the Locative Context-type. Finally, if both factors contribute to linguistic context-sensitivity, AQ and gender-group should show respective significant interaction effects with context-type.

4.4.1 Indices of variability

Autism Quotient

I use the Autism-Spectrum Quotient (AQ) questionnaire as an index of the cognitive factors potentially underlying linguistic context-sensitivity. The AQ questionnaire is a self-administered scale used to determine the degree to which an adult of normal intelligence possesses traits typically associated with ASC (Baron-Cohen et al., 2001). Although not intended as a diagnostic measure, it is used clinically and shows consistency in three important psychometric properties: test-retest reliability (Baron-Cohen et al., 2001), cross-cultural stability (Wakabayashi et al., 2006), and heritability (Hoekstra et al., 2007).

The 50-item questionnaire has five component subscales, each drawn from a unique subset of 10 questions: Attention Switching (AS), Attention to Detail (AD), Communication (CM), Imagination (IM), and Social Skills (SS). The scales are oriented such that higher scores signify more "autistic" traits (difficulty in attention switching, higher attention to detail, lower communicative ability, less imagination, and lower social skills). Among the linguistic studies using the AQ measure, the way the total AQ measure and its component subscales have been used is variable: Yu (2010) analyzed the total AQ along with four of the five subscales (AD, AS, CM, and IM), while Nieuwland et al. (2010) and Xiang et al. (2013) analyzed the CM subscale but found the same effect with different sets of subscales.

Such variability in application of the AQ measure aligns with a body of factor analysis research that has shown that the AQ subscales are not independent factors, *i.e.*, they do not measure distinct dimensions of variability. Austin (2005) was the first to investigate its internal consistency and found that for a non-clinical sample of 337 individuals, a factor analysis supported a three-factor solution, comprising "social skills," "details/patterns," and "communication/mindreading"; Hurst et al. (2007) replicated the three-factor solution in a separate non-clinical sample of 1005 individuals. Of particular interest in both studies is the fact that although the three-factor solution generally supports three of the five original subscales, the loadings are crossed: individual items from all five subscales contributed to each of the three factors. Hoekstra et al. (2008) conducted a similar factor analysis on both general and clinical populations in Dutch, comprising 1416 individuals, and found support for a two-factor analysis: "attention to detail" (comprising only the original AD subscale) and "social interaction" (comprising the other four subscales, SS, AS, CM, and IM). Subsequent factor analyses (Stewart and Austin, 2009; Russell-Smith et al., 2011; Kloosterman et al., 2011; Lau et al., 2013a,b; Grove et al., 2016), summarized recently in English et al. (2020) further corroborate these patterns.

Even within the study population, the non-independence of the five subscales is clear. Figure (4.1), below, shows the correlations between each of the AQ subscales for the study sample.

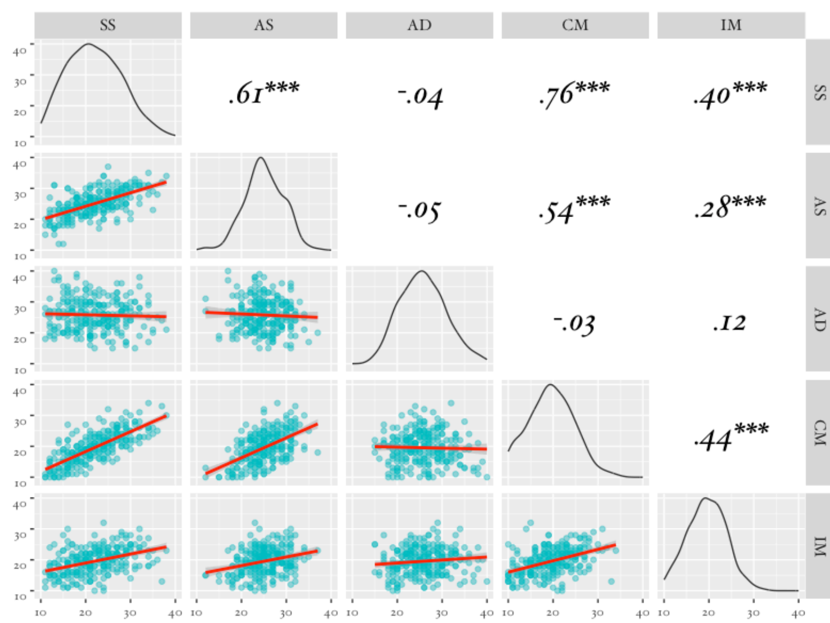


Figure 4.1: Correlations between the five component subscales of the AQ.
Note: Density plots are shown for each subscale along the diagonal. SS = Social Skill, AS = Attention Switching, AD = Attention to Detail, CM = Communication, IM = Imagination. Correlation coefficients are shown above the diagonal; asterisks indicate a significant correlation at the $p<.001$(***) level.

While the individual correlations between SS versus CM and SS versus AS seem to be the strongest, these data are generally supportive of the two-factor analysis reported by Hoekstra et al. (2008), which isolated AD as "attention to detail" and groups SS, AS, CM, and IM as "social interaction." Among linguistic studies, Yu (2010) analyzed, in addition to the aggregate AQ measure, four of the five subscales (AD, AS, CM, and IM), but residualized AS and CM by SS in order to eliminate collinearity, Nieuwland et al. (2010) used the CM subscale but found identical correlations with the total AQ and the SS and AS subscales, and Xiang et al. (2013) used only the CM subscale, but found an identical effect with the SS subscale. These treatments add further weight to the non-independence of these subscales, particularly between SS and CM. Indeed, numerous items from these two scales seem to be intrinsically intertwined: items such as "Other people frequently tell me that what I've said is impolite, even though I think it is polite," "I enjoy social chit-chat," or "I'm often the last to understand the point of a joke," which are categorized as CM, could easily be classified as SS, and vice versa for "I enjoy meeting new people" or "I am a good diplomat." Given the statistical collinearity among subscales as well as the intuitive conceptual overlap between them, I followed the more conservative approach of Stewart and Ota (2008), Yoshimoto et al. (2017), Yang et al. (2018), Derrick et al. (2019), and Lai et al. (2019), and used only the aggregate, total AQ in the analysis.

Each item is phrased as a sentence in the first person (an "I-statement"); the participant chooses one answer among "Strongly Disagree," "Slightly Disagree," "Slightly Agree," and "Strongly Disagree." Here, responses were coded on a 4-point Likert scale (1-4), following Stewart and Ota (2008); Nieuwland et al. (2010); Yu (2010), as both the degree and polarity of agreement bear meaning, and thus should not be collapsed, as in the scoring system of Baron-Cohen et al. (2001). Thus, total AQ scores range from 50-200.

Participants tested in-lab completed the questionnaire on paper; participants recruited online responded to the same questions through Qualtrics, an online survey platform. Both versions gave all questions and answer choices in the same order and orientation. For the online version, five "attention" questions were spaced randomly throughout asking participants to select a specific answer.

Gender

To connect to existing reports on the role of gender in language variability, namely (Yu, 2010), and in the absence of a widespread, gradient measure of the dimensions underlying gender identity, gender-group was used as a binary category to index the social factors sources potentially underlying linguistic context-sensitivity. This variable was collected as a free-response question, "What is your gender identity?" and coded binarily.

4.4.2 Predictions

The two hypotheses regarding the cognitive and social factors in variability in linguistic context-sensitivity make distinct predictions. If the cognitive capacities underlying "autistic" traits are a contributing factor to linguistic context-sensitivity, then AQ scores should significantly correlate with inter-comprehender variability in acceptability ratings of the target sentence in the Locative Context-type. Alternatively, if the social factors that underlie or manifest as gender expression contribute to linguistic context-sensitivity, then the two gender-groups should show a difference in ratings for the target sentence in the Locative Context-type. Finally, if both factors contribute to linguistic context-sensitivity, AQ and gender-group should show respective significant interaction effects with context-type.

4.4.3 Sample comparison

In order to evaluate the role of individual differences in context-sensitivity, I first compared the participant samples along the two variables of gender-group and AQ. Both samples had roughly evenly divided gender groups. In terms of AQ, both groups showed similar profiles overall[2] and within their gender groups; their descriptive statistics are presented in Table (4.1).

Table 4.1: AQ descriptive statistics

		In-lab population (*n*=61)			Online population (*n*=210)		
Scale	Gender	Mean	Range	SD	Mean	Range	SD
Autism Quotient (AQ)		**106.8**	**85-137**	**13.1**	**113.0**	**67-146**	**17.99**
	w	103.2	87-137	11.8	114.2	67-146	20.11
	m	111.4	85-134	13.4	111.8	85-145	15.79
Social Skills (SS)		**19.84**	**12-31**	**5.02**	**21.91**	**11-38**	**6.64**
	w	18.86	12-29	4.51	23.69	11-38	7.27
	m	21.09	15-31	5.36	20.33	14-33	5.58
Attention Switching (AS)		**24.64**	**18-32**	**3.24**	**25.21**	**15-34**	**4.63**
	w	24.86	21-30	2.51	26.44	15-34	5.38
	m	24.36	18-32	3.97	24.11	18-31	3.50
Attention to Detail (AD)		**25.04**	**15-33**	**4.50**	**26.29**	**18-39**	**5.27**
	w	23.79	17-29	3.56	26.06	18-37	5.22
	m	26.62	15-33	5.04	26.50	18-39	5.31
Communication (CM)		**19.44**	**10-28**	**4.49**	**19.82**	**10-30**	**5.48**
	w	18.93	13-28	4.14	19.94	10-30	5.61
	m	20.09	10-28	4.75	19.72	12-28	5.37
Imagination (IM)		**17.84**	**12-27**	**4.06**	**19.74**	**12-27**	**4.12**
	w	16.79	12-27	3.99	18.12	12-24	4.17
	m	19.18	15-26	3.75	21.17	15-27	3.50

Note: Means across gender groups for each sample are bolded.

While the in-lab women group mean appeared to be slightly lower than the others', pairwise t-tests corrected using Holm's method showed no differences between groups in their mean AQ (p's$>.7$). Absence of significant differences in gender-group proportion or AQ profile for in-lab group allowed for analyzing the two samples together as one.

4.4.4 Variable contextual modulation of English *have*-sentences

This analysis follows from the analysis described in Study 1a in §2.4. I describe the model again, with the interaction terms included: A linear mixed-effects model was built using

[2] The 61-member population from the study sample showed the same group means with the 60-member population from the University of Chicago student body reported in Yu (2010).

fixed-effects of context-type (4 levels: Locative, Possessive, Attributive, vs. Identity), gender (2 levels: women vs. men), AQ (continuous factor), and the two-way interaction terms of context-type and gender as well as context-type and AQ. As random effects, random intercepts were included for subjects and items in addition to by-subject random slopes for the effect of context-type. Statistical significance was obtained in the same manner, through likelihood ratio tests; outliers were removed in the same way as well. To investigate the interaction effects, I used pairwise t-tests and linear regressions corrected for multiple comparisons using Holm's method.

Crucially, significant interaction effects from the mixed-effects model indicated the presence of individual-level variability along the dimension of context-sensitivity. The same mixed-effects model revealed a significant two-way interaction of context-type and AQ ($\chi^2(4)=10.7$, $n=271$, $p=.030$), while the two-way interaction of context-type and gender-group was not significant ($\chi^2(4)=2.72$, $n=271$, $p=.61$). While a significant three-way interaction was observed, this interaction was driven by a gender-group difference in the Identity Context-type, one of the control conditions, rather than by the experimental context-types. Accordingly, I take this interaction to be indicating gender-group variability outside of the scope of the intended context-type manipulation, and do not consider it further in the analysis.

In order to understand the individual-level variability in the ratings, I started by unpacking the context-type and AQ interaction. Linear regression models showed significant correlations between AQ and the ratings for the Locative Context-type ($\beta=-.007$, $t=-2.7$, $p=.007$) and the Possessive Context-type ($\beta=-.006$, $t=-2.5$, $p=.011$), indicating that higher AQ scores (which index *lower* context-sensitivity) correlate with lower ratings in the relevant context-types, in line with the predictions. That is, the less context-sensitive an individual is, the less they are able to use relevant context to facilitate the otherwise dispreferred locative interpretation of the ambiguous target *have*-sentence; conversely, individuals with lower AQ scores (which index *higher* context-sensitivity) appear better able to use the relevant context to help interpret the ambiguous target. Average acceptability ratings for the Locative Context-type as a function of AQ score are shown in Figure (4.2).

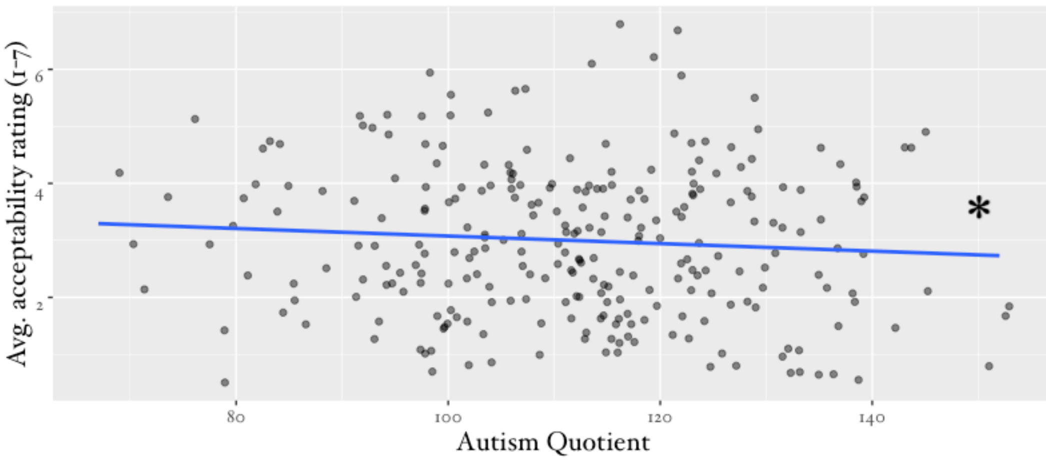


Figure 4.2: Average ratings for the Locative Context-type as a function of AQ.

In order to more clearly visualize the interaction effect of context-type and AQ, and in light of the small effect size of the continuous AQ factor, the ratings were binarized using the median AQ score of the full sample (Mdn_{AQ}=112) resulting in a high-AQ group (*n*=137, M_{AQ}=124.8) and a low-AQ group (*n*=134, M_{AQ}=99.0). The model with the categorical AQ factor instead of the continuous AQ factor revealed an even greater significant interaction between context-type and AQ ($\chi^2(5)$=31.9, *n*=271, $p<.001$). The resulting interaction plot is presented in Figure (4.3). Pairwise *t*-tests revealed a significant effect of AQ group (low versus high) for the Locative (p=.0098) and Possessive Context-types (p=.016) but not for Attributive (p=.63) or Identity (p=.65).

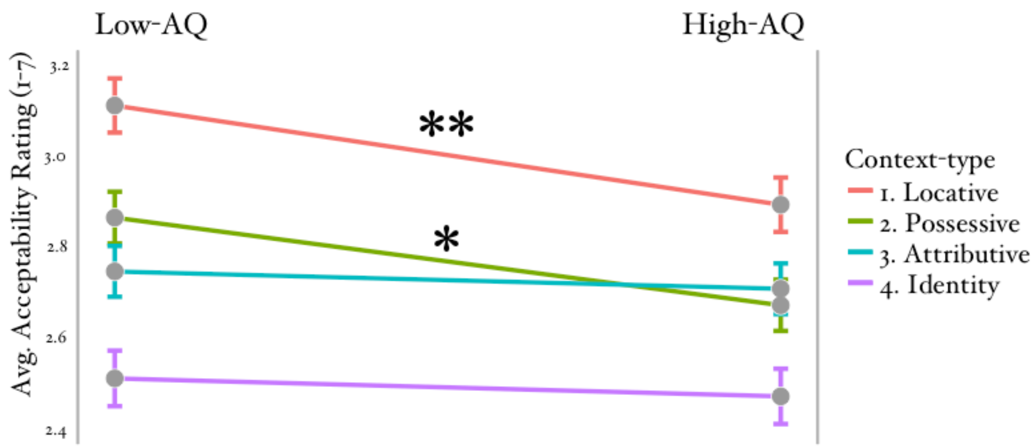


Figure 4.3: Interaction plot between context-type and AQ group.
Note: Error bars indicate the standard error of the mean. Asterisks indicate a significant effect of AQ group within each context-type at the $p<.05$ (*) or $p<.01$ (**) level.

Within the Possessive Context-type, a significant difference was observed between the low- and high-AQ groups (p=.016) while no such difference is found within the Attributive Context-type (p=.63), even though the ratings for both context-types are similarly low. The contrast between the Possessive and Attributive Context-types suggests that only low-AQ comprehenders are sensitive to the relevance of the context to the semantic domain in question, since the locative and possessive contexts describe the relationship between two entities, while the attributive context provides detail about one entity alone.

The contrast between the Locative and Possessive Context-types suggests that within the two relevant contexts, only the Locative Context-type facilitates the intended reading of the bare *have*-sentence; crucially, this facilitatory effect is only observed for the low-AQ (more context-sensitive) group, as the high-AQ group's Locative ratings were not statistically distinct from the low-AQ group's Possessive ratings (p=.72).

This finding bears out the prediction regarding the cognitive factors of linguistic context-sensitivity: AQ, but not gender-group, correlates with the degree to which comprehenders are able to use contextual information. This asymmetry suggests that, at least in the present linguistic task, context-sensitivity connects to cognitive predisposition(s); social factors, as manifested through gender-group, by contrast, do not appear to capture any inter-comprehender variability in the task.

4.4.5 Quantifying individual-level variability in linguistic context-sensitivity

Together with the results described in §2.4, these results support the hypotheses that comprehenders' linguistic context-sensitivity plays an integral role in lexico-conceptual composition; **(a)** the findings are consistent with a conceptual connection between location and possession which *have* lexicalizes, **(b)** despite being dispreferred, the locative interpretation of a bare *have*-sentence can be made salient through linguistic context, and **(c)** within a given speech community, the ability to extract relevant content from context is variable across individuals and correlated with their Autism-Spectrum Quotient (AQ) scores.

Linguistic context-sensitivity as measured by the AQ questionnaire

The principal finding from the present study is that the AQ measure, as an index of a cognitive source of variability in linguistic context-sensitivity, correlates with the degree to which comprehenders show a contextual-modulation effect in the linguistic contextualization task. That is, individual-level variability in "autistic" traits correlates with variability in the degree to which individual comprehenders are able to identify and use relevant contextual information to facilitate the locative reading of the target *have*-sentence, which requires attenuating the salience of the causal segment in the unified location-possession lexico-semantic conceptual structure.

This result adds not only to the existing body of work that AQ is indeed targeting some dimension of the cognitive system, but bolsters the findings that the cognitive capacities implicated in "autistic" traits likely contribute to linguistic context-sensitivity, as the critical task in this study involved direct, intentional contextualization on the part of the comprehender.

I note here, however, that the AQ measure, while significantly correlated with acceptability ratings, accounts for only a small portion of inter-comprehender variability. The three components for evaluating a correlation, effect size, effect significance, and effect meaningfulness can vary independently from another (Hemphill, 2003)—one well-cited example is the correlation of r=.03 between taking aspirin and preventing heart attack, which bears outsized meaning for society at large—that is to say, effects must be evaluated in context. To do so, I offer two points of discussion.

The first is that I recognize the inherent limitations set by the experimental tools. Though it seems clear that AQ is targeting one or more aspects of the cognitive system, it has yet to be shown conclusively what domain of the cognitive system these dimensions lie in. One possibility is that linguistic context-sensitivity, as indexed by the AQ, is rooted in working memory, as working memory has been shown to correlate positively with selective attention and inhibition of distracting information (Engle, 2002; Lavie et al., 2004). Yu et al. (2011) tested both working memory and AQ in a parallel task to that reported in Yu (2010) and found that higher working memory correlated with lower AQ. This finding suggests that a component of context-sensitivity is the ability to store more contextual information for processing at a given time. Another possibility is that the AQ indexes a multitude of cognitive factors, some of which are more related to context-sensitivity than others. Mathematical evidence for this lies in the AQ's well-reported subscale collinearity and factor cross-loading (Austin, 2005; Hurst et al., 2007; Hoekstra et al., 2008; Stewart and Austin, 2009; Russell-Smith et al., 2011; Kloosterman et al., 2011; Lau et al., 2013b; Grove et al., 2016). Additional evidence for this lies in the fact that a number of items in the AQ, such as "I enjoy meeting new people" seem related to context-sensitivity in a less direct way than items such as "I find it easy to 'read between the lines' when someone is talking to me" or "I often notice small sounds when others do not'; this observation is supported by English et al. (2020), who describe over 20 different AQ-trait constellations that result in the same total AQ score, since different configurations of subscale scores can add up to the same total. By using the aggregate AQ measure exclusively, the characterizing of the subset of AQ-trait constellations that more directly connects with context-sensitivity is inherently limited, resulting in a restricted ability to explain variability in a given dataset. Future use of the AQ and linguistic behavior must consider statistically supported subsets of the AQ items that are linguistically principled, rather than the total measure.

The second is that the larger goal for this work is to identify possible sources of the variability that has been observed in linguistic behavior in order to nuance the understanding of the language faculty in context. Incorporating factors that can explain systematic differences in linguistic behavior between individuals strengthens existing work on the systematic commonalities in linguistic behavior. This work is but one instance of the broader effort to incorporate variability as an intrinsic part of the system, rather than exclude it conceptually or mathematically as "noise." Accordingly, I do not expect any single measure to capture all the variability in such a complex system, which is known to be rooted in a multitude of cognitive, social, and other factors. Moreover, correlation effects interpreted as meaningful can be variable across paradigms, questions, and domains (Bosco et al., 2015), in contrast with the widely used benchmarks from Cohen (1988). I take this finding to be indicative of a direct connection between factors already hypothesized to be related, that contribute to an individual's cognitive style and their linguistic behavior—specifically, the way they identify information in the communicative context to satisfy the requirements of a linguistic expression in that context. Future work must continue refining both the methodological instruments and conceptual models in order to precisify the understanding of the relationship between variability in domain-general cognitive factors and variability in how individuals use language.

Social bases of linguistic context-sensitivity

Binary gender-group—the index of the potential social factors contributing to linguistic context-sensitivity—did not play a role in capturing variability in this task. While I certainly expect sociocultural factors to be implicated in linguistic context-sensitivity, there are at least three possible explanations for the lack of effect in the current study: one of manifestation, one of resolution, and one of relevance.

As previously discussed, gender appears to be a much broader construct with numerous contributing factors; operationally, gender-based effects can be modulated by many features of a communicative context: gender composition, racial composition, number of participants, among others (LaFrance and Vial, 2016). These factors of the social context are known to interact with gender performance, and crucially, can magnify or attenuate the expression of gender-normative behaviors; for example, Bailey and LaFrance (2017) show that different types of gendered and gender-neutral wording of questions can modulate gender-based effects like androcentrism. It could be the case that the lack of cues in this paradigm that elicit so-called gendered linguistic behaviors could have attenuated any manifestation of gender-associated social factors potentially present.

It could also be the case that gender-group and AQ in this study indexed overlapping variability between individuals; however, due to the binary nature of the tool, it had less explanatory power than the continuous AQ factor, especially given that the AQ scores across gender-groups were statistically indistinguishable. Thus, it remains an open question the extent to which the gender-group and AQ indices overlap as contributing factors to context-sensitivity. The observation here is that when gender is construed as a binary variable, they do not.

The relationship between binary gender-group and a social basis of linguistic context-sensitivity is not one-to-one; while identifying a gender-group effect would have directly supported the idea that social factors play a role in linguistically context-sensitive behavior, failing to find an effect does not rule it out for at least two reasons. First, binary gender-group is an inherently limited way to represent the gradient and dynamic expression of gendered identity and behavior; a lack of gender-group effect could result from using this categorical predictor for a gradient phenomenon. Second, gender-group represents only one set of social factors that could give rise to linguistic behavior. This leaves open the possibility that a lack of gender-group effect does not mean that social factors are not at play in linguistic context-sensitivity, but rather, that other social factors that connect with variability but are not addressed here may be impacting context-sensitive linguistic behaviors.

Future research must utilize high-resolution and psychosocially grounded metrics for quantifying gender identity as the gradient and dynamic social construct it is; such measures would better identify the degree to which the social factors associated with gender identity contribute to individual-level variability in linguistic context-sensitivity. These tools would be particularly relevant to the field of psycholinguistics, which probes the unconscious, automatic processes that underlie real-time language use. Better measures of gender identity in tandem with psycholinguistic tools could elucidate the extent to which social factors permeate and are intertwined with the presumedly universal processing mechanisms in the mind and brain.

Linguistic context-sensitivity revisited

In light of the findings altogether implicating context-sensitivity as a dimension of variability in linguistic behavior, it is important to better understand the cognitive capacities or traits that underlie linguistic context-sensitivity, again defined as the overall capacity of a neurocognitive linguistic system to identify and integrate the information in the communicative context prompted by the meaning requirements of a given linguistic expression in that context. Here, I revisit the possible components of linguistic context-sensitivity described in Section 4.3.1. The first is perceptual acuity, which could lead to enhanced detection of variation in an ambiguous stimuli. Another is an increased recognition of useful or informative information in the context. Here, assigning meaning, or even simply meaningfulness, to variants is the key switch between recognizing differences and using those differences to tailor their use for different situations. A third possibility is that context-sensitive individuals are more tolerant of or flexible in adopting variants and their consequent differences in sound or meaning; that is, context-sensitivity could highlight the willingness to allow for contextual-modulation, in conjunction or independent from the ability to detect or ascribe meaning to variants.

This study does not arbitrate between these possibilities; it could be the case that one or more of them give rise to the observed context-sensitivity effects. However, since the task involved an active contextualization effort, it seems to suggest that AQ operationalizes at least the latter possibilities, rather than the first, more passive, baseline sensitivity. Additionally, in the same way that gender is understood to be either a contributor to variability or a manifestation of other underlying factors associated with that variability, a distinction can also be drawn between what the "autistic" trait correlation is highlighting: purported cognitive capacities that give rise to context-sensitive behaviors, or alternatively, context-sensitive behaviors that emerge from other possible cognitive capacities. Future work that better accounts for the precise task involved as well as these and other potential component capacities or behaviors that contribute to context-sensitivity must be undertaken to situate the broad cognitive notion of context-sensitivity as a capacity or behavior, linguistic or domain-general, in the mechanics of the cognitive system.

Importantly, the findings from this work suggest that a new parameter is necessary for future linguistic comprehension studies involving context. A misleading result is seen at the group-level analysis: while the main effect shows a clear and significant distinction in the ratings between the Locative Context-type and the other Context-types, this distinction was shown, through the AQ measure, to be the case for only a subset of the study sample, specifically the more context-sensitive (lower-AQ) comprehenders. Had individual differences in context-sensitivity not been accounted for in this study, the conclusion from this finding would have generated different consequences for the understanding of contextualization ability, and its potential role in variation. Therefore, it is crucial for future work involving any sort of contextual modulation to account for this parameter of individual differences, not only to better understand the role of cognitively rooted and socially rooted variability in linguistic behavior, but also for more precise models of linguistic structure and processing.

4.5 Awareness of Communicative Dynamics as an improved measure of variability

While the body of literature characterizing linguistic variability using the AQ measure is schematically coherent, in that low scores on the AQ measure seem to identify a high degree of linguistic context-sensitivity, there are methodological concerns that potentially limit the ability to which the tool can identify variability between comprehenders. The two primary concerns are one of conceptual independence and one of mathematical independence.

The latter non-independence has been well-characterized through a body of psychometric assessment studies (see aforementioned discussion of this literature). English et al. (2020) synthesizes this body of work by showing a collective lack of statistical support for the five-factor solution in the original AQ measure, which means that the five component subscales cannot be used to identify underlying constructs connected to linguistic context-sensitivity. This limitation converges with the conceptual non-independence of the subscales. For example, numerous items from the CM and SS subscales seem ontologically connected: items such as "Other people frequently tell me that what I've said is impolite, even though I think it is polite," "I enjoy social chit-chat," or "I'm often the last to understand the point of a joke," are part of the CM subscale, though it is unclear what motivates them to be distinguished from items like "I enjoy meeting new people" or "I am a good diplomat," which are part of the SS subscale.

To address this problem, Piñango et al. (in prep) use factor analytic techniques to identify a conceptually principled and mathematically validated component structure couched within a larger theoretical framework of linguistic communication. With the largest sample population in the linguistic AQ literature to date, they identify a four-factor solution ("Conversational Facility") that better captures variability along the dimension of linguistic context-sensitivity as well as indicates specific cognitive components connected to each component of the metric. The Conversational Facility measure results in a ten-fold increase in variability explained, along the dimension of linguistic context-sensitivity, over the original AQ measure. In particular, the Conversational Facility measure identifies relevant subcomponents that carry the bulk of this variability, specifically the "Awareness of Communicative Dynamics" (ACD) subcomponent, shown in Table 4.2, which connects to an individual's understanding of the communicative situation, their interlocutor's communicative intent, and meaningful elements of the communicative context that connect to them.

Table 4.2: Awareness of Communicative Dynamics scale from Piñango et al. (in prep)

AQ item	Subscale	Item
AQ-7	CM	Other people frequently tell me that what I've said is impolite, even though I think it is polite.
AQ-18	CM	When I talk, it isn't always easy for others to get a word in edgeways.
AQ-20	IM	When I'm reading a story, I find it difficult to work out the character's intentions.
AQ-33	CM	When I talk on the phone, I'm not sure when it's my turn to speak.
AQ-35	CM	I am often the last to understand the point of a joke.
AQ-39	CM	People often tell me that I keep going on and on about the same thing.
AQ-45	SS	I find it difficult to work out people's intentions.

Note: CM = Communication, IM = Imagination, SS = Social Skills.

The measure, scored in the same way as the AQ measure, allows for scores of 4 - 28: an individual with a low score participates in communicative situations fluently and can recognize and make use of both verbal and non-verbal meaning, while an individual with a high score shows difficulty in participating in such communicative dynamics. What this measure highlights is cognitive capacities implicated in linguistic behavior that connect directly to linguistic context-sensitivity, such that a low score better identifies a high degree of linguistic context-sensitivity.

In sum, I take this ACD measure to identify variability in the cognitive capacities that underlie linguistic context-sensitivity, the capacity of a neurocognitive linguistic system to identify and integrate the information in the communicative context prompted by the meaning requirements of a given linguistic expression in that context. Linguistic context-sensitivity, in turn, serves as the key construct of communicative style that contributes to the proliferation of variability in linguistic meaning when interacting with the linguistic and conceptual variability from Chapters 2 and 3.

4.6 Conclusion

The findings presented here nuance the Study 1a contextual facilitation effect by showing that the effect is only borne out by a subset of the participants in the sample, namely those who exhibit a higher degree of linguistic context-sensitivity, and is quantified using the AQ-based Awareness of Communicative Dynamics measure from Piñango et al. (in prep). Specifically, more context-sensitive comprehenders are better able to make use of relevant information in the context to decrease the salience of the causal adjunct in the LCS of *have*, thereby supporting the otherwise dispreferred locative reading of the bare *have*-sentence in question.

The use of the ACD, as a conceptually principled and mathematically validated measure of variability, supports the idea that the cognitive capacities associated with "autistic" traits contribute to linguistic context-sensitivity, suggesting that inter-comprehender variability is not entirely random. Instead, it results at least partially from the varying cognitive capacities of the comprehender to recognize a communicative intention in conjunction with the lexical meanings present and search effectively for relevant disambiguating information in the context.

Moreover, these findings cement the vital role of individual-level variability in a broader model of meaning variation, in that differences in individuals' communicative styles contribute to their choosing of different lexical strategies in the cases of ambiguous or generalized lexical meanings, such as for *have*-sentences. In this view, contextual modulation is an emergent phenomenon arising from these individual differences in context-sensitivity interacting with the flexibility within a lexical meaning, as in the case of the unified LCS account of *have*-sentences.

In the next part of the dissertation, I unite the three ingredients for the model of meaning variation through the investigative lens of the comprehension of these locative *have*-sentences and show how these components' interaction manifested during real-time processing synthesizes systematic variability in meaning.

Part II

The model in action

Chapter 5

Real-time comprehension: the convergence of linguistic, conceptual, and cognitive variability

Contents

5.1 Introduction

In this chapter, I tie together the three ingredients for a cognitively grounded model of meaning variation. In §5.2, I describe how these three components are needed to capture and understand the phenomenon of meaning variability. In §5.3, I apply this implementation to the real-time composition of English *have*-sentences, compare it to the extrapolated processing predictions of the alternative account, and then motivate the real-time comprehension studies by outlining the step-by-step predictions for how English *have*-sentences are comprehended. I conclude the chapter by describing the methodologies for the subsequent studies in §5.4; for each, I describe the general purpose of the methodology, the scope of its contributions and limitations, and the specific predictions for each regarding the comprehension of locative *have*-sentences, as well as predictions for how the findings are nuanced by the measure of individual-level variability in linguistic context-sensitivity.

5.2 The model of meaning variation

I take meaning variation to be a complex cognitive phenomenon that requires a multifaceted investigative approach. At the end of the day, human language is a cognitive behavior that requires modeling and description using tools from the study of cognition. Language data, as the output of the human language system, does not necessarily require such an approach: that is, characterizing, describing, modeling, and computationally generating such output can be undertaken with a so-called "black-box" approach. The goal of these approaches is to match the input-output of the human language system, but without needing to match its internal processing, thus freeing these approaches to employ a wide variety of tools that are not beholden to the workings of the cognitive system. Understanding the implementation of language as human neurocognitive behavior, however, requires approaches that are beholden to the workings of the cognitive system.

In this view, it is important to reframe the "problem" perspective into a "property" perspective. Rather than treating an observed cognitive phenomenon as a problem for an analytical tradition (i.e., a "too many meanings" situation), I take the phenomenon as a property of the system that must be understood and explained. One example of this "problem" to "property" reframing is the case of so-called 'coercion' phenomena. Traditionally, complement and aspectual coercion were understood as type-mismatch operations, in which a lexical item is used in a construction where its semantic type does not match that of its place in the construction. The classic example is the case of *Sue began the book*, where *begin* is taken to select for an 'event', which is not correctly satisfied by *book*, which is an 'object'. This type-mismatch results in some sort of error, which is resolved by a type-shifting repair mechanism, which fixes the error by changing the type of the lexical item, namely the object *book* into an event of *reading/writing/etc. the book*. This term and treatment comes from "type-coercion" in computer programming languages Moens and Steedman (1988), which was applied to the linguistic phenomenon. Taking a step back, it is noteworthy that the borrowing of a superficially similar concept from an ontologically unrelated system results in a framework that cases a highly frequent and highly productive linguistic construction as an error + repair mechanism. My point here is that the "problematic" status of a phenomenon can be imported from outside of the system, resulting in actual consequences for the way the phenomenon is understood from within the system, which may not have been "problematic" to begin with. One solution to the "problem" of complement coercion is the structured individual hypothesis Piñango and Deo (2012); Piñango et al. (2015), which proposes that verbs like *begin* select not for events but for individuals with internal ordered structure along a number of dimensions, like space, time, or informational content. In this view, *a book* is an entity with internal structure along the dimension of informational content, and is naturally a possible and productive complement to a verb like *begin*. Such a reanalysis of coercion is a more elegant and parsimonious explanation of the imported "problem" of coercion and its resulting plethora of type-mismatch repair mechanisms. The takeaway from this example is that treating linguistic phenomena, particularly in the semantic domain, as the naturally occurring behavior to be explained, rather than problems that must be repaired, lends itself to simpler solutions. Moreover, rooting such explanations in the actual cognitive system that generates the phenomena to begin with is an important priority for a cognitively substantiated account of human behavior.

My proposal for a model of meaning variation takes this perspective: meaning variation is a natural property of the human cognitive system that must be explained in a cognitively grounded way, in contrast to, say, statistically driven models of variation (Eger and Mehler, 2016; Kulkarni, 2017). I take meaning variation to be an emergent cognitive phenomenon that arises from, at minimum, these three components: linguistic, conceptual, and cognitive variability. I now briefly recapitulate each (from Chapters 2, 3, and 4, respectively) in turn.

The first phenomenon that contributes to the larger, emergent phenomenon of meaning variation is variability at the lexical level. The lexical item is the basic unit of human language, and is the conventionalization of a form-meaning mapping. The methodological challenge in modeling a lexical item is finding the right degree of specificity for the structure. Models of language vary in the degree to which they posit lexical meanings, from co-locational frequency accounts to highly specified polysemy accounts; this is yet another case of parsimony optimization. While this range results somewhat from different investigative goals, I maintain that questions about the structure of human language and knowledge require evidence and tools rooted in human behavior. Accordingly, I appeal to the conceptual semantics framework as a balance between cognitively grounded, psychologically real, and linguistically informed units of structure, in conjunction with experimentally validated behaviors.

I believe that this approach has two main advantages in contrast to the model implemented in the transitive copula account. The first is that regarding the units of the model. A principal issue in the linguistic enterprise is understanding the scope of an analysis: is a given analysis a property of the human language system or a property of the tool or framework being used to characterize or describe the outputs of that system? I apply this distinction directly to the competing accounts of the meaning of *have*: without evidence for the psychological reality of the theoretically unlimited functional projections required in the transitive copula account to derive the meanings of *have*-sentences, these devices remain a part of the algorithm, and do not necessarily have a constrained grounding in the human cognitive system and the left-to-right language processing system. The units of conceptual semantics, however, are grounded by rigorous experimentation in the human cognitive system and therefore are able to be claimed as psychologically real objects that participate in cognitive machinery (i.e., are subject to working memory constraints, maturational trajectories), especially when implemented in a testable psycholinguistic and neurolinguistic processing profile. The second is the observational validity. Embodying the fundamental spirit of linguistics in trying to account for the parameters in the underlying system that generate systematic differences across speech communities (quantized as languages, dialects, idiolects, etc), I make use of a study sample that is appropriate for investigating the semantic variability of English *have*-sentences, as highlighted by Belvin and Den Dikken (1997) and Zhang et al. (2022). This is to say, **by enumerating dimensions of both the context** (what parameters and information in the context contribute to observed variability in the interpretation of *have*-sentences?) **and the individual** (what cognitive properties or predispositions of a comprehender contribute to observed variability in the interpretation of *have*-sentences?), **my analysis is able to capture insights on this variability that the transitive copula account, which does not address properties of the context or the individual, is not able to investigate**.

The lexico-semantic conceptual structure I propose unifies the set of meanings expressed by the English lexical item *have* in a conceptually principled way, in contrast to accounts which simply list labeled meanings without organizing structure. The unified LCS solves the "too many meanings" problem, which is, as above, a prescriptive framing that emerges from the limited scope of the analytic tool, and not necessarily a description of the linguistic behavior of speakers in a communicative context. In the unified LCS view, variability is a built-in property and feature of the system; it allows words to be adaptable in principled ways (not randomly) from the start, and not just through post-hoc additions, extensions, or repairs.

Overall, I propose that word-meaning variability emerges from variability in the underlying conceptual structure, since lexical items are merely the conventionalization and package of form-meaning pairings, which allow motoric or otherwise physical signals that can be transmitted inter-personally to identify units of knowledge and thought.

The second component of this model of meaning variation is exactly that: variability in the structure of "thought" as the cognitive substance packaged into lexical meanings by the lexical item. The gradient conceptual infrastructure (GCI) I propose in Chapter 3 is specifically a model of that stuff of "thought" that treats this substance as continuous but organized, in contrast to a view which treats it as discrete atoms. The LCS-GCI connection is the rooting of the causal component of the lexical meaning as a packaging of the psychologically real operation of causal perception, which is a measurable behavior of the human cognitive system. In fact, this behavior is so core to the human cognitive system, and also a feature of non-human cognitive systems, that it could even be thought to be the very essence of what cognition is: perceiving, evaluating, and determining causality (*x* caused *y*).

The two dimensions of causal perception (connectedness and control asymmetry) that organize the GCI are motivated in part by the behavior of lexicalization, which can serve as an insight into the structure of the mind. The fundamental assumption of this logic is that a single lexical item can only identify and "chunk out" an organized piece of conceptual structure, that is, meanings/concepts that are related. So, the fact that connectedness and control asymmetry can be linguistically privileged independently of each other, but also lexicalized together, is the key evidence for modeling the GCI in this way. The implications of this infrastructure for meaning variation and change are that this is the underlying framework of pathways for lexicalization and change: languages can lexicalize adjacent but not discontinuous regions of the space and these lexicalizations can change over time in smooth trajectories through incremental encroaching, but not discontinuous jumping.

These implications for variation and change lead to the third component of the model: individual-level cognitive variability, which is the observation that individual cognitive systems can make use of incoming information in different ways. The established role of individuals as the generators of linguistic behavior and thus variation and change tie the conceptual and cognitive variability components of the model together in a natural way. In any cognitive science, the investigative quest for universality requires the externalizing of some degree of variability or noise to a source outside of the target domain; while the threshold for meaningful variability can certainly vary, I take the position that often, systematic variability between individuals is relegated to social factors exclusively, and therefore excluded from a 'purely' cognitive investigation, hence the disciplinary division created between linguistics "proper" and sociolinguistics, as well as between between cognitive and social psychology, and all the intellectual and bureaucratic consequences thereof. The crucial task therefore is determining what variability is required by the question to be accounted for, and how that variability must be structured. I take linguistic and psychological universality to be distributions around a central property, rather than an invariant operation, such that variability is hard-coded as a property of universality. Because I take the human language system in its cognitive embedding, I consider known dimensions of cognitive variability to be vital to an understanding of the system. Specifically, tools that were built from observations of human behavior and "dysfunction"[1] are

[1] I stress that the designation of "dysfunction," "disorder," and "disability," are merely societally imposed cat-

system-internal and are therefore psychologically real parameters that can structure variability in the way that individuals, as speakers and comprehenders, make use of linguistic information and tools. The contribution in this area is the novel Awareness of Communicative Dynamics, as a conceptually principled and mathematically validated tool, for characterizing variability in a cognitive dimension relevant to the comprehension of *have*-sentences: linguistic context-sensitivity.

In sum, combining these three components for a model of meaning variation enables a deeper investigation of not only the patterns of variation, but the mechanisms that generate those patterns. Specifically, this model can address the questions: what are the variants and how are they structured? Why do they pattern in the way they do? How do they emerge in a speech community? This framing of the "problem" of *have*-sentences suggests that *have*-sentence variability is not an anomaly, but a naturally predicted logical consequence of the system itself. By using mutually supporting and mutually constraining tools and bodies of evidence from the cognitive system, a unified picture of implementation of model of variation can be painted.

This sort of approach is certainly more complicated in terms of the number of conceptual and operational components; I believe that this additional complexity, however, is not only justified but also required to inform a cognitive embedding of the grammar. As shown here, including these components adds challenges to experimental setups and implementations (e.g., contextually embedded target stimuli, measures of variability, large study sample, etc.). But since any research project must be question-driven, a question about the broader human language faculty requires the inclusion of these factors. In contrast, if the research question is about how a given computational algorithm can describe linguistic data, then these factors are not necessary to incorporate into the investigation. Such approaches, which are building

egory labels for certain regions of a spectrum of variability. An inclusive view of variability understands these categories to be natural manifestations of variability, rather than marked or categorical divisions of ability.

mathematical systems (with internal machinery not necessarily constrained by the internal machinery of the cognitive system) that can match all and only the documented outputs of a human language system, are critical to be sure, but are not able to address the neurocognitive language behaviors of humans in real-time.

5.3 Compositional story: how do humans comprehend a locative *have*-sentence?

Given such a model of variation that serves as a cognitive framework for the different components of semantic variability, I now turn to the question of how humans actually comprehend locative *have*-sentences in real-time. There are two main purposes for investigating these human behaviors. The first is that understanding the way in which we comprehend *have*-sentences can highlight the incompatibilities of the accounts and therefore arbitrate between them. The second is that understanding the way in which humans comprehend *have*-sentences situates the proposed model of meaning variation directly into the actual way humans comprehend language. Each of the model's individual components are already motivated by findings from other approaches toward understanding human cognition: outside of the broad array of approaches toward studying human language, they make use of findings from clinical, comparative, cognitive, developmental, and neuro-psychology to constrain the possible ways in which meaning variability in human language can be understood. It is therefore crucial to "complete the circle" by studying the implementation of the actual model in the behavior of human speakers and comprehenders.

Accordingly, the compositional story for *have*-sentences reveals what precisely the human language system (the "parser") must do when it encounters these sentences. This psychological account therefore does not replace the derivational approach of the transitive copula account. The derivation is an algorithm that decomposes the human-generated sentence into smaller units by using a specific set of tools. The derivation is not supposed to explain directly how humans understand these sentences; it is intended to provide a highly articulated account of the syntactic and semantic structure of human sentences, but not an account of human behavior and not by using the neurocognitive mechanisms of the human cognitive system.

I argue, instead, that the compositional story can not only characterize the way humans understand locative *have*-sentences, but also characterize in detail the syntactic and semantic structures of these sentences. Specifically, the compositional story makes predictions for the syntactic and semantic structure building that must take place when humans comprehend (and produce) these sentences. The value-add, therefore, is a step-by-step algorithm that explains the linguistic phenomenon (which is a human-generated linguistic behavior), and is also rooted in the way the human cognitive system works (which is the same system that generates the linguistic behaviors to start), instead of using cognition-external mathematical tools to describe human behavior.

In summary, there are a number of benefits of such an approach. One is that since the account is not limited by a set of tools that were not designed to address the problem of meaning variability in human language, we can obtain a more eloquent and therefore parsimonious solution to the problem of meaning variability. Another is that the compositional story can explain *why* languages pattern and people behave the way they do; in contrast, the derivational account does not give an explanation for why such variability exists–it only explains how such variants can be constructed using the algorithm. And at the end of the day, my question is about the meaning of *have*-sentences, which is a psychologically real kind of linguistic behavior, and to address this question, I turn to approaches that investigate how humans comprehend *have*-sentences.

5.3.1 The unified LCS account

The unified LCS account takes the process of language comprehension to be the incremental concatenation of lexical items (as in (33) from §2.3.2), which reflects the way that humans perceive language (one word at a time) (see Altmann and Steedman, 1988; Jackendoff, 2014). The four-part structure of the lexical item thus requires four parallel channels of processing. One way to conceptualize this is that the lexical item is the constellation of four kinds of linguistic information–concatenating lexical items is the alignment of each of the four points on the first lexical item with the corresponding four points of the next, and the four channels of processing dealing with their specific inputs in parallel. The four parallel processes do not take place entirely symmetrically; language production is led by the meaning composition and outputs a auditory or visual signal while language comprehension is led by the perceived signal to arrive at a composed meaning. In both cases, what happens "first" is the information by which each lexical item is retrieved from memory, that is, in production lexical items are identified by the intended meanings, and with that retrieval comes information about morphosyntactic co-location requirements and articulatory commands, while in comprehension, lexical items are retrieved by matching incoming phonetic signals with memorized phonetic information, and with that identification comes the retrieval of meanings, aided by morphosyntactic requirements. In both, however, there is primacy of either signal (as ambimodal "phonetic" information) or meaning, since after all, language is a set of sound-meaning pairings, which is enriched by morphosyntax.

Accordingly, I focus here on the syntactic and semantic compositional processes, acknowledging that phonetic, phonological, and morphological processes, such as coarticulation, stress assignment, and agreement, among many others, are happening simultaneously.

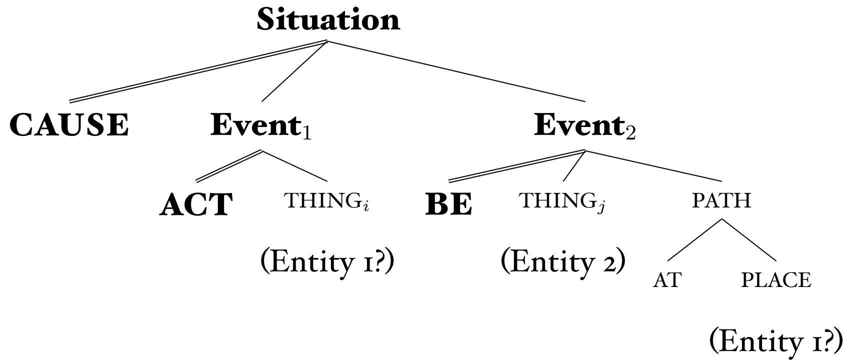
Syntactic composition

The syntactic composition in this account is straightforward. My proposal for the lexical item *have*'s syntactic structure is a verb head that subcategorizes for one NP. Accordingly, the processing steps are simply to concatenate a subject NP (Entity 1), the verb (*have*), and the object NP (Entity 2)–the verbal complement. This account is constrained by the linguistic material present in a *have*-sentence, and is therefore more conservative than an account which postulates silent syntactic constituents. This process also puts the explanatory burden for the meaning variability of *have*-sentences into the meaning (lexico-conceptual structure) of the lexical item, rather than its syntax. Additional syntactic material, such as a locative PP, would be concatenated either as a verbal or nominal adjunct (as per the discussion in §2.4).

Meaning composition

The meaning composition in this account is also straightforward. Mirroring the syntactic NP-V-NP composition, the meaning is composed with the meanings of the three lexical items in a NP-*have*-NP sentence, which comprises a THING, the LCS in (77), and another THING. In this sequence, there is exhaustive retrieval of the LCS, given the model of compositional process outlined above, and at the point at which Entity 2 (the second THING) is comprehended, there is a contextualization process that takes place. This contextualization process makes use of the human causal perception mechanism and evaluates the two entities in terms of their connectedness and control asymmetry; the final evaluation of this process will result in a determination of the degree of causal potential in the relation, and thus the resulting interpretation of the *have*-sentence.

(77) LCS of *have*: Entity 1 *has* Entity 2



The real-time implementation of this structure therefore proceeds as follows:

1. The first entity of *have* is heard and is held in working memory, represented as just a THING, as no relational meaning can be interpreted without the second entity.

2. *Have* is heard and retrieves the entire LCS.

3. **LCS composition**: Entity 1 could take one of two places (i.e. be understood as either a controller or a location), depending on the relation determined:[2]

   (a) The PLACE in Event$_2$, which could be prompted by conceptual predispositions (*e.g.* ground > figure), if the degree of causal potential is perceived to be low.

   (b) The actor (THING$_j$) in Event$_1$, which could be prompted by conceptual predispositions (*e.g.* animate > inanimate, agent > patient), if the degree of causal potential is perceived to be high.

4. Entity 2 takes the THING$_i$ position in Event$_2$ by a lexcalizable linking rule.

5. **Contextualization**: The causal potential relation between the two entities is then determined based on their ontologies and the information from context. This process is causal perception, the crucial operation in the processing of *have*, as its result determines the degree of salience of the causal adjunct in this structure, and from that, the specific reading for the *have*-sentence.

[2] Individual comprehenders could also vary in their prior expectations or preference for a default interpretation or in the certainty of that provisional interpretation. Presumably, comprehenders with greater linguistic context-sensitivity, might hold off in making a provisional interpretation at all, until the full entity set is interpreted. Comprehenders who rely more on their prior expectations or on the maximal LCS, may settle on an interpretation to a stronger degree at this point. I return to this discussion in Chapter 8 in light of the real-time processing and neuroimaging data, which supports this notion of different comprehender strategies in using and reliances on the LCS structure or contextual features.

I emphasize now that the visual layout of the LCS is not a representation of the compositional steps, that is, there is not a directionality encoded in the LCS. It is rather a representation of what must be understood for the meaning of a *have*-sentence. Consequently, there is not a real-time "assignment" of structural locations in the LCS, but rather, the crucial determination is whether Entity 1 plays a CAUSER role or a non-CAUSER, locational role in the meaning relation. Similarly, the "assignment" of Entity 2 to as THING in $Event_2$ is not the assignment to some location in a structure, but the understanding of how Entity 2 fits into the final relational meaning: will it be a possessee/controlled entity, that is, the less causal entity in the control asymmetry determination? Or will be it a non-control-asymmetric entity, such as the entity that is located at a given location?

In a prototypical possession relation, such as *Sue has a book*, the causal perception operation would consider the degree of connectedness and control asymmetry of the two entities, and result in an understanding that an entity like *Sue* has the potential for a high degree of control over an entity like *a book*, leading to the use of the causal adjunct of the LCS. For the incidental locative reading to become salient, the rationale for the possession relation must be made less salient, that is, there must be no plausible reason to invoke a stronger rationale for the location, given the intrinsic properties of the participants and the linguistic context. For example, in the sentence *The table has a book*, the causal perception operation would consider the degree of connectedness and control asymmetry of the two entities, and result in an understanding that an entity like *The table* does not have the potential for a high degree of control over an entity like *a book*, and also that the two entities do not have a high degree of connectedness or inextricability. Because the informativity of this bare *have*-sentence is lower (and possibly because it requires not making use of the entire retrieved LCS), it requires additional support, in the form of relevant context (such as *There is a newspaper on the desk and*) or additional linguistic material, perhaps in the form of a locative PP (such as *on it*). This results in the backgrounding of the causal adjunct, and the understanding that the relational meaning is not one of a high degree of causal potential. The success of the operation depends on how effectively an individual can mine their own knowledge–comprising self-supplied omnipresent context and the linguistic context–to determine the precise relation to interpret, along the dimensions of connectedness and control asymmetry. This lexico-conceptual structure representation is connected to the conceptual space in that lexicalization serves as a compression or packaging mechanism for meaning structure.

5.3.2 The transitive copula account

It is not possible to make a direct comparison with the transitive copula account, in terms of comprehension and real-time processing, because the aim and tools of this account do not make direct predictions about psychological reality. There are not explicit and established groundings of syntactic structure building, derivation, and lambda calculus into the way that humans comprehend incoming linguistic material in real-time (incrementally, left-to-right).[3] As discussed in §2.3.2, the transitive copula account is not intended to be a model of how individuals understand *have*-sentences in real-time, but rather, a highly articulated descriptions of linguistic utterances within a specific algorithmic framework. The account also does not make specific claims about the directionality of psychological composition (bottom-up vs. top-down) or the real-time ordering of steps; it does of course follow the strict rules of composition in the framework. It also does not make specific predictions about how and when the phonetic, phonological, and morphological processes take place. Consequently, the real-time comprehension predictions I describe here, in order to compare the two accounts, are logical extensions into the cognitive domain, rather than the first-hand claims of the original accounts. Accordingly, I proceed with a description of my interpretation of the extension of the transitive copula account as consequences for a psychologically real process.

[3]See Jackendoff (2011), in particular Section 4, on a comparison between the real-time processing implementations of the Minimalist Program and the Parallel Architecture, as two flagship frameworks representing step-by-step versus constrain-based computational approaches.

Because comprehension of language happens incrementally, I take the same incremental approach from the previous section: the first NP[4] composes with the verb, which then takes the second NP as its complement. This NP has the structure [D [Poss N]$_{PossP}$]$_{NP}$, with a silent PossP and Poss head, in the case of a possessive complement, and the structure [D [N [P NP]$_{Loc-PP}$]$_{N'}$]$_{NP}$, in the case of a locative complement.

The real-time comprehension consequences of the Entity 2/DP$_2$-internal syntactic is that (a) since the relational meaning of the *have*-sentence is unambiguously encoded into the meaning/structure of the second entity/DP, then there will be no contextualization or other effort required once this entity/DP is heard and comprehended, and (b) without a locative PP, a bare locative *have*-sentence results in a ungrammaticality that must be repaired by a syntactic operation, namely the post-hoc insertion of a locative PP.[5]

There are consequences to this approach. The first is that while the unified LCS proposes that *have*-sentences of all kinds share a standard compositional process involving semantic contextualization at the point of the second entity, and are therefore generally equally available, the derivational approach of the transitive copula account takes non-possessive *have*-sentences to be marked and secondary, therefore requiring the insertion of additional syntactic structure to be comprehended. From a processing perspective, there are two immediate limitations: one is that a subclass of these sentences, though well observed, are only possible through post-hoc repair mechanisms, and the second is that these mechanisms require structure that has no physical realization. While both of these situations, a repair mechanism for otherwise standard

[4]I take NP and DP to be notationally equivalent since for the purposes here, there are no theoretical consequences for using one over the other.

[5]There are other possible syntactic operations that could be extrapolated in this family of proposals, as no processing predictions are provided directly by the analyses. See §8.4 for a discussion of alternative syntactic approaches and §9.3 for the implications of those alternatives on the analysis of *have*-sentences. In preview, postulating a PP projection which can be overtly realized or not as part of *have*'s syntax would align the proposal with the unified LCS account, essentially stating that there is a licensed space for a relational meaning to be interpreted. However, this represents a maximal departure from the transitive copula account, which actively ascribes no semantic content and no additional syntactic structure beyond NP-*have*-NP to *have*, so I do not consider this syntactic implementation here.

sentences and silent structure, are possible, they require much higher burdens of justification from real-time processing, which have not been undertaken following the transitive copula account. From a processing perspective, a unified, ordinary, and What-You-See-Is-What-You-Get account for these sentences is the more conservative approach of the two. Ultimately, the relationship between the analytical tools implemented in the transitive copula account and its real-time comprehension reflex remains to be formalized, so it could also be the case that the real-time comprehension process from the transitive copula account would differ from my extrapolations here. The linking between these analytical tools and real-time comprehension must be established in order to truly compare these accounts. But in the absence of such a linking, I proceed with the competing predictions by the two accounts.

5.3.3 Competing predictions

The research question here is: how do comprehenders understand locative *have*-sentences, particularly bare locative *have*-sentences? In a nutshell, the unified LCS answers the question by proposing that the comprehension of a *have*-sentence involves the incremental constituent-by-constituent composition of Entity 1, *have*, and Entity 2; crucially, the specific degree of causal potential–and therefore the specific relational meaning of the *have*-sentence–is determined as soon as Entity 2 is composed into the larger structure. This determination process involves considering the nature of the entities themselves as well as relevant information in the context or relevant explicit linguistic material. In the corresponding nutshell, the transitive copula account does not answer this question. However, extrapolating the details of the account into the domain of real-time language understanding, the account proposes that comprehenders cannot understand these sentences. In light of the findings in Study 1a, however, the account would propose that comprehenders must "rescue" and repair the ungrammatical sentence by inserting a locative PP, which is the only possible way to achieve a locative *have*-sentence. I summarize the critical differences between the two accounts regarding the nature of *have* as a lexical item, *have*-sentences, as well as their respective processing predictions in Table 5.1.

Table 5.1: Comparison assumptions and predictions

Have's	Unified LCS account	Transitive copula account
Semantic content	Unified LCS	None
Source of variability	Conceptual breadth of relations	DP-internal XPs
Crosslinguistic typology	Predicted/regular	Unpredicted/anomalous
Comprehension nature	Semantic/conceptual-led	Syntactic-led
Comprehension operation	LCS retrieval + contextualization	DP composition
Bare locative treatment	Normal processing	Error rescue/repair

These distinctions are the focus of the subsequent real-time comprehension studies. In particular, the methodologies described below specifically address the questions of whether the comprehension of *have*-sentences is a syntactic or semantic operation, and whether the comprehension of locative *have*-sentences is a standard comprehension process or an error rescue and repair process. Is it not possible to answer all of these questions in a falsifiable way through traditional linguistic intuition, because they require evidence from the neurocognitive system itself. The ability to answer these questions is therefore an immediately salient contribution of investigating the real-time comprehension process. Directly below, I detail the specific ways in which real-time comprehension techniques can shed light on the nature of the comprehension of *have*-sentences.

5.4 Real-time processing predictions for *have*-sentences

I take the stance that any theory involving a mental faculty (such as language) and aspiring to describe the behavior of humans must be contextualized in the neurocognitive underpinnings of the human mind. While research in psychology can inform understanding of the mechanisms in the brain itself, neuroscientific investigation can also constrain the possible theories and models of mental faculties, like language, in the mind. This insight is crucial especially for the present focus on the linguistic nature of *have*-sentences.

These approaches can directly assess questions that arise from the competing accounts above, namely: is one kind of sentence harder or easier (and therefore marked or unmarked) than another? Is one kind of sentence hard or impossible to comprehend? If one kind of sentence is harder to comprehend, then this cognitive work will be reflected into psychologically real processing cost. These approaches can also directly assess the nature of such processing cost–is it incurred at the word or sentence level? Is it phonetic, morphological, syntactic, or semantic? In the following sections, I detail the real-time processing methodologies and specifically, how they can answer these questions and in turn, arbitrate between the competing accounts of locative *have*-sentences.

5.4.1 Timecourse: the order of operations

One of the primary ways of assessing the psychological reality of a linguistic theory or model is by investigating the timecourse of the comprehension or production process. This is particularly relevant once an offline measure, such as an acceptability judgment, which indicates the "final result" of a given process, is obtained. Experimental paradigms that combine both offline (judgment data) with online measures (reaction/reading time data) to provide insights that are not afforded by either type of study alone (Kaiser, 2013). The timecourse of processing can address the question of how the individual participant arrived at the final result, and what are the operations they engaged in. How does measuring the time it takes for something to be processed connect with the underlying nature of the process? The psychological index of effort, which can be interpreted as psychological processing cost, is time. That is, because of the physical nature of the neurocognitive system is rooted in the physical transport of atoms and molecules across distances, neurocognitive operations have temporal reality. The greater the operation, the greater the temporal reality. Specific to locative *have*-sentences, since Study 1a showed that context facilitated the comprehension of bare locative *have*-sentences, it is possible to investigate whether participants incurred extra cognitive work (processing cost) and whether that extra work was of a syntactic or semantic nature, using methodologies which target the timecourse of processing.

There are two parameters for identifying processing cost in terms of time. One is degree of the cost, which corresponds to the amount of extra time incurred by a process. The general setup for timecourse processing studies is always one of relative comparison. Since there are not absolute time measures for anything cognitive (i.e., one cannot determine that comprehending a passive sentence takes 12 seconds or 800 milliseconds), identifying any processing cost requires establishing a minimal pair, not necessarily with a single linguistic unit, but with a single hypothesized operational difference. If there is an observed temporal difference between the two members of the minimal pair, that time can be ascribed to a difference in the underlying processing operation between the two members. Accordingly, one of the members must be set up as the baseline case, in order to assess the "extra" processing cost (and its temporal reality) of the test case. The second parameter of processing cost is the location (along a timeline) of the processing cost. Taking the same setup as above, if multiple sequential units of measurement are established, then a processing cost can be localized in the sequence. This setup is that used in self-paced reading.

It is also possible to establish the nature of the processing cost: specific to language, is a cost incurred due to extra syntactic, morphological, or semantic processing? By comparing a controlled experimental pair with electroencephalography, a processing cost can be determined to be associated with a certain kind of processing.

Method and predictions: self-paced reading

The present study used reading time measurements (in milliseconds) from a masked non-cumulative moving-window self-paced reading paradigm as an index of the contextual facilitation effect. In this type of SPR study, each participant reads sentences at their own pace; each press of a button makes the next word appear onscreen. The words not being read are replaced with a mask composed of dashes to give the subject a sense of the total length of the sentence. Thus, the duration from the onset of the presentation of one word to the onset of the presentation of the next is a taken to be the reading time of each word. Variations of reading times in corresponding windows of different experimental conditions are taken to be measures of processing cost (e.g., Ferreira and Henderson, 1990; Kaiser, 2013; Gibson and Warren, 2004).

I use SPR to localize the processing cost of the hypothesized contextualization, which should occur at the point of the noun complement of *have*–when Entity 2 is comprehended and the contextualization operation can take place. Using the exact same sentences as in Study 1, however, poses a problem for the SPR paradigm, because the noun complement is the last word in the target sentence. In SPR, the last word of a sentence is known to engender large increases in reading time that result from a reinstantiation of the entire sentence (Kaiser, 2013), so for the stimuli in the SPR study, an additional descriptive detail in the form of a three-word relative clause was added to each of the target sentences in order to separate the predicted task-evoked effects at the critical noun complement window from the sentence-final wrap-up effects. These three words act as a spill-over buffer—a series of cost-free windows that isolate delayed sentence-processing effects from the wrap-up, since processing costs in SPR often show up across several windows, either due to multi-window-length costs, or costs that accrue beyond the timespan of a single window. Accordingly, the modified target sentence would appear as in (78).

(78) The maple tree **has** a car that is red.

For this sentence, there are two predictions, regarding the two possible parameters for processing cost identification in SPR: the direction of cost and the location of the cost. The target in (78) has been found to be facilitated by contextual information that decreases the salience of the causal frame and therefore supports the non-causal locative reading of the sentence. As such, the unified LCS account predicts that a facilitatory locative context should engender lower reading times for a bare locative *have*-sentence, corresponding to the increased acceptability found in Study 1, than a non-facilitatory possessive context. This means that bare locative *have*-sentence after a non-facilitatory context will be harder to process and therefore cause a slow-down in reading time at the point where the contextualization operation is supposed to take place. Accordingly, a difference in reading times between a facilitatory (locative) and non-facilitatory (possessive) context would support the unified LCS account, while no difference in reading times between a facilitatory and non-facilitatory context would lend support to the transitive copula account. In terms of location of cost, in this sentence, following the unified LCS account, the contextualization operation should take place at 'car' since that is when Entity 2 is comprehended and the degree of causal potential can be evaluated for the two entities. If, however, the critical operation taking place is one of syntactic repair, then processing cost should be observed starting only at the following window 'that' (**?**). This is because at the point of 'car', the parser could still encounter a locative PP, but encountering 'that' signals the absence of the locative PP complement. Accordingly, when the processing cost begins will support one or the other account proposed.

In summary, the unified LCS account predicts that a facilitatory context will engender faster reading times for a bare locative *have*-sentence starting at the window containing the second entity of the *have*-sentence, compared to a non-facilitatory context. This faster reading time represents an attenuated cost of contextualization in light of the facilitatory context. The transitive copula account predicts either no difference in reading times between facilitatory and non-facilitatory contexts or a difference that begins at the window following the second entity, indicating a repair cost once the parser detects the absence of a locative PP.

Method and predictions: event-related potentials

Electroencephalography (EEG) is a neuroscientific technique that measures the continuous changes in electrical potentials in millionths of a volt (μV) on the surface of the scalp that results from the firing of neurons en masse in the cortex of the brain. These signals are measured using small electrodes (typically 16-256 of them) that are placed in specific locations on the scalp. EEG data has high-temporal resolution–usually measured to the millisecond. Event-related potentials (ERPs) are time-locked deflections in the EEG signal that are consistently observed in response to specific types of cognitive processes. For example, word-level processing (when compared to a baseline control), semantic unexpectedness, consistently triggers a negative deflection peaking around 400 ms post-stimulus-onset which is typically observed in the central and posterior parietal regions; this ERP component is thus called the N400. Sentence-level processing (again, when compared to a baseline control), consistently produces deflections in the positive direction between 600-700 and 850-1000 ms post-stimulus; hence the P600 or late-positivity components. The former, P600, reflects processing of a syntactic nature, while the latter, the late-positivity, reflects processing of a semantic nature, specifically sentence-level contextualization. These components have emerged from thousands of systematic studies and offer a toolkit for identifying the nature of a given cognitive operation. The presence/absence and strength of the component is indicative of the underlying cognitive processes and can therefore arbitrate between proposed processing mechanisms. In sum, there are three parameters for ERP: the onset of the response, the polarity, and the scalp region.

Because SPR can only localize processing cost differences, I employ ERP to identify the types of processing that are taking place in the window identified by the SPR results. The non-facilitatory context should evoke an N400 at the noun complement of the target *have*-sentence, indicating that comprehenders are sensitive to the nature of the context and its effect on the target. Additionally, the contextualization operation should elicit a late-positivity ERP component in the same window, which has been shown to index contextualization effort

(DeLong et al., 2014; Weiland et al., 2014; Piñango et al., 2017). If, in fact, the processing of *have* does involve the syntactic repair of locative PP insertion, then components that index syntactic processing, namely the P600 (Frisch et al., 2002; Burkhardt, 2007; Bornkessel-Schlesewsky and Schlesewsky, 2008), should be identified.

5.4.2 Brain bases: the neurocognitive mechanisms

The other primary way of assessing the psychological reality of a linguistic theory or model is by making use of the fact that the surface (cortex) of the brain is topographically organized, with different regions performing different functions and operations. For example, the processing of incoming visual information from the eyes happens in a very topographically constrained area at the back of the brain, while the control of various parts of the body is highly specified in a strip of cortex in the middle of the brain. Investigating the brain regions that underlie specific operations involved in the comprehension process can address the questions of how an individual arrives at a final interpretation and what operations they engage in to do so.

There are two general approaches toward making use of brain data for linguistic inquiry. The first parallels the ERP approach, by using an existing framework of neural traces to arbitrate between models. These neural traces can make use of and shed light on the larger framework of language processing within the cognitive system by asking what areas of the brain "belong" to language and what doesn't? That is, how does the comprehension of *have*-sentences (or any sentence) depend on neurocognitive resources that are highly specialized for language as well as neurocognitive resources that are recruited domain-generally? For arbitrating between the two accounts of *have*-sentences, investigating brain areas that are known to underlie syntactic processing and brain areas known to underlie semantic processing will lend key support for one account of another. Crucially, these brain areas are non-overlapping, and are therefore provide a clear test for the two accounts. Finding activations of cortical regions associated with semantic composition will support the unified LCS account, while finding activations of cortical regions associated with syntactic composition will support the transitive copula account. This parametric approach complements and supports the ERP findings by identifying the core linguistic operations that are proposed by each account to be involved in the comprehension of *have*-sentences.

The second approach is more broad in that it makes use of the entirety of cortical localization research in identifying and discretizing the operations that must be taking place, given the known functions of certain brain areas over others. Such an approach is more exploratory, in contrast to the first approach described above, which is more confirmatory. The neuroimaging results could shed light on the nature of an operation, that is, whether is it "standard" versus "error repair" depending on regions activated, given that some regions, like the anterior cingulate cortex, are systematically activated during error detection tasks (Alexander and Brown, 2019). Complementarily, the recruitment of general or specialized working memory cortical regions serve as a measure of processing cost, specifically relating to effort. For example, computationally demanding tasks will elicit greater activations in generalized working memory regions like the dorsolateral prefrontal cortex (Hagoort, 2005; Binder et al., 2009), which could serve as a potential parallel for the ERP indices of effort, like the late-positivity component. Other cortical regions can also index features of the operation such as emotional arousal (Mather et al., 2006) or uncertainty (Volz et al., 2004). Finally, activations can also provide insight into the content of the target process: for example, cognitive operations involving physical layouts and object relationships in space will preferentially recruit specific regions of the brain (Ganis et al., 2004), while operations involving the visualization or recall of human faces will recruit other specific areas (Weiner and Grill-Spector, 2012). Altogether, investigating the brain bases of a given process can illuminate the underlying neurocognitive mechanisms involved; beyond arbitrating between non-complementary accounts of a process, brain localization data can provide insight into other involved operations that are not visible in targeted experimental paradigms like ERP.

Method and predictions: functional magnetic resonance imaging

The principal method for identifying brain areas involved in a candidate cognitive process is through functional magnetic resonance imaging (fMRI), a technique that measures changes in blood flow throughout the brain (Logothetis et al., 2001). In short, the MR scanner uses physical properties of atomic subparticles to identify oxygenated and deoxygenated hemoglobin molecules and map the changes in the proportion between them in high-resolution across the brain–the units of fMRI images are called voxels (essentially a three-dimensional or volumetric pixel) and typically are measured at a cubic-millimeter resolution. The movement of oxygenated blood toward a given region of the brain is called the Blood Oxygen Level Dependent (BOLD) response, which is predicated on the logic that if a certain area of the brain is being preferentially recruited by a given task, it will require an observable increase in oxygenated blood. Therefore, a BOLD response for a given area is taken to index greater recruitment of that cortical region. The BOLD response is comparatively slow–happening on the scale of seconds rather than milliseconds–and therefore is not suited for making the precise temporal measurements that a technique with high temporal resolution, such as ERP, is suited for. As a result, these two techniques together provide a multimodal triangulation of the processes that underlie a given operation and the order in which they are executed (Logothetis, 2008).

Crucially for experimentation, however, the entire brain is always active and consuming oxygen-rich blood, so the fMRI paradigm makes use of the subtraction method to identify differences between two minimally different experimental conditions; this setup reveals the regions that are systematically recruited for one condition versus another, above and beyond any regions that are recruited for both conditions. I will therefore use this neuroscientific approach to compare the real-time processing profiles of bare locative *have*-sentences following supportive locative contexts and non-supporting possessive contexts, in line with Studies 2 and 3. Specifically, I will use functional localization to identify the cortical regions that are implicated in the contextualization operation at the core of the unified LCS account.

The key cortical regions of interest are areas that have been consistently shown to underlie linguistic processing; these areas are elements of the larger language network in the brain, which comprises areas highly specified for linguistic operations as well as areas that are understood to be domain-general cognitive resources, but that are implicated in certain types of linguistic tasks (Hagoort, 2014). The transitive copula account takes bare locative *have*-sentences to be ungrammatical but repairable through the insertion of a locative PP, which is the source of the locative meaning. Accordingly, the account predicts that cortical areas associated with error detection and ungrammaticality, as well as areas associated with syntactic composition and reanalysis will be recruited during the comprehension of these sentences. Finding activations in these two areas, which are systematic and circumscribed, would correspond to finding the P600 ERP component and support the transitive copula/syntactic composition account for *have*. The unified LCS account, on the other hand, takes locative *have*-sentences to be standard interpretations for *have*, and not ungrammatical sentences to be rescued through a repair mechanism, though these interpretations require additional support with respect to the conceptual relationship between the two entities of the *have*-sentence. Accordingly, the account predicts that cortical areas associated with lexico-semantic conceptual composition and contextualization, which are distinct from the aforementioned syntactic composition regions, will be recruited during comprehension of the target sentence. Finding activations in these regions would support the unified LCS account of *have*-sentences, in which the compositional burden is borne out in the causal potential evaluation operation, and not insertion of additional syntactic constituents.

Harnessing the topographic organization of the brain serves as a key tool for arbitrating between theoretical accounts of a psychological and linguistic phenomenon, namely the comprehension of *have*-sentences. Investigating the neurocognitive implementation of these sentences also can provide insights into the nature of the process beyond the direct comparison of two competing accounts. Ultimately, these approaches exemplify the perspective of the unified model of meaning variation (as described in §5.2) by grounding linguistic inquiry, as a study of the human mind, into a study of human biology.

5.4.3 The role of individual-level variability in linguistic context-sensitivity

A critical dimension of the real-time process of comprehension is the degree to which individual participants differ in the contextualization process as a function of their linguistic context-sensitivity. The unified LCS and transitive copula accounts predict different patterns of variability across the studies: the former predicts variability in the contextualization effect, given known variability in individuals' degree of linguistic context-sensitivity, while the latter makes no direct predictions about variability, due to no possibility for variability in its organization of the language system. However, extrapolating into the real-time comprehension, no variability should be observed in the hypothesized syntactic repair operation, since such operations are taken to be universally identical and automatic.

The manifestation of individual-level variability associated with the AQ measure has been found to show discrepancies across methodologies. For example, Xiang et al. (2013) identified AQ-structured variability for a parallel task in acceptability judgments but not self-paced reading, while Nieuwland et al. (2010) found AQ-structured variability in both acceptability judgments and ERP measures. The findings in Study 1b, which serve as the motivation for the subsequent studies, were offline acceptability judgments, which could have two types of differences compared to real-time processing studies. The first is that the two methodologies invoke different types of engagement with context by the participants. The second is that the underlying engagement with context is the same, but the methodologies differ in the time window of measurement, leading to differences due to identification of variability at different time points. That is, real-time processing measures capture immediate, automatic responses within approximately one or two seconds of the critical stimulus onset, while acceptability judgments are gathered on the timescale of three to ten seconds. Accordingly, identifying individual-level variability in both study types will shed light on the nature of the contextualization process and whether individuals' varying degrees of linguistic context-sensitivity manifest in their unconscious and automatic contextualization processes and/or in their conscious reasoning involved in a judgment task.

5.5 Conclusion

I have now brought together the three components of my proposed model of meaning variation, justified it in context of the motivating questions, and applied it to the real-time comprehension of locative *have*-sentences.

In the next chapters, I present the details of the three studies that assess the psychological and neurological reality of the contextualization operation for bare locative *have*-sentences invoked by the unified LCS account. In doing so, I not only show the three components of the model of variation in action, but also how it arbitrates between the two accounts of the comprehension of *have*-sentences in question.

Chapter 6

Study 2: the psychological reality of contextualization

Contents

6.1 Prediction: context-dependent compositional effort at *have*'s noun-complement

In line with the unified LCS account of locative *have*-sentences, SPR results should identify compositional effort due to the nature of the context at the noun complement window. This compositional effort should manifest as lower reading time for a bare locative *have*-sentence after a facilitatory context as compared to a non-facilitatory context. Identifying the start of the compositional effort, additionally, will help arbitrate between this account and the transitive copula account: observing context-induced cost beginning at the window of the noun complement suggests that the cost is one of the semantic contextualization required to obtain the final meaning of a *have*-sentence, while observing cost beginning in the next window would suggest that the cost is one of syntactic repair, incurred when the parser discovers the lack of a locative PP and must repair the sentence by inserting one. Moreover, the unified LCS account, along with the cognitively grounded model of meaning variation, predicts individual-level variability governed by degree of linguistic context-sensitivity in this contextualization process. Specifically, individuals who are less context-sensitive should show a smaller effect of contextual facilitation than their more context-sensitive peers.

6.2 Methods: self-paced reading

6.2.1 Participants

Sixty-five native speakers of American English were recruited from the Yale University student body (37 female, ages 18-27, mean age 20;8 years) to participate in the study. All participants were right-handed and by self-report, had no history of psychological illness, neurological disease, brain injury, learning or reading disability, and had normal or corrected-to-normal vision. All participants gave written informed consent in accordance with the guidelines set by the Yale University Human Subjects Committee and were compensated for their participation.

6.2.2 Materials

Linguistic stimuli

The stimuli for Study 2 were created, based off the stimuli from Study 1a, using the same context-target paradigm and the same semantic criteria about the relationship between the entities employed. In light of the Study 1 results, two types of contexts were provided: the Locative-*have* Context-type, which contains a locative relationship using a *have* sentence and the Possessive Context-type, which contains alienable and inalienable possessive relationships using a *have*-sentence. No other floor conditions were included considering both the Study 1 findings as well as the methodological constraints of the real-time processing paradigms.

Given the methodological requirements of SPR, a three-word relative clause was added to each target sentence in order to provide a spill-over buffer, a series of cost-free windows that provide separation of the target reading time effects from the sentence-final wrap-up effect. The corresponding descriptive detail was added to each context to ensure conversational felicity. The addition of these modifiers also serves to prevent a pragmatic bleaching effect (attenuated processing costs from a semantically and pragmatically valueless sentence), since informativeness has been shown to modulate reading time (Levy, 2008). One example set of stimuli are presented in Table 6.1. In each set, there are a total of three sentences: one with the Locative-*have* Context-type and target and two with the Possessive Context-type and target (one alienable possession relation and one inalienable possession relation). Fifty sets were created, for a total of 150 sentences shown to each participant.

Table 6.1: Example stimulus set for real-time processing

Context-type	Context	Conj.	Target
Locative-*have*	The pine tree has a silver motorcycle under it	and	the maple tree has a car that is red.
Possessive	The pine tree has big branches		

Measures of individual-level variability

Participants completed the AQ questionnaire, described in §4.4.1, in order to calculate the Awareness of Communicative Dynamics (ACD) scale, described in §4.5. For this study, the ACD measure was used to quantify each participant's degree of linguistic context-sensitivity.

6.2.3 Design

Eight unique self-paced reading scripts were created for the study. Scripts 1-4 contained identical material in different orders comprising half of the total materials, while Scripts 5-8 contained the other half of the materials, in different orders as well. Each experimental item set was split so that half the set was present in Scripts 1-4 while the other half was presented in Scripts 5-8; the split halves were counterbalanced across all sets. Each participant was shown a unique combination and order of two scripts, (see Cowart, 1997). Within each script, all items were pseudo-randomized such that no two items of the same experimental set or of the same condition appeared consecutively.

Comprehension questions followed 75% of the questions, while the other 25%, distributed equally and randomly across conditions, were followed by an instruction to press either the "yes" or "no" key. The correct answers were half "yes" and half "no" to prevent a response bias.

6.2.4 Procedure

Prior to the start of the study, participants were given written and oral instruction about the experiment. Participants were seated in a chair at a desktop computer in a quiet room. Experimental items were presented one at a time on the computer monitor.

Stimuli were presented following a standard noncumulative moving-window self-paced reading paradigm, created and presented using the E-Prime software suite. For each sentence, a mask composed of series of dashes representing the total length of the sentence was presented on the screen to give participants a rough sense of the length of the sentence, without any indication of its content. Participants then proceeded through the sentence word-by-word by pressing the spacebar on the keyboard. Every spacebar press displayed the next word in the sentence and replaced the old word with the mask.

Participants were instructed to read through the sentence at as natural of a pace as possible while maintaining full comprehension of the sentences. They were also instructed that comprehension questions following the sentences would ensure their attention and comprehension of the items.

The study began with a practice session of three example sentences based off the experimental items. The practice session ensured the participants understood and were familiar with the paradigm prior to beginning the study. Participants were required to answer all the practice questions correctly before moving on to the experiment; if any questions were answered incorrectly, the practice session was given again. No participant completed the practice session more than twice.

6.2.5 Preprocessing and analysis

Because average reading times do not reflect differences in word length across windows or differences in reading speeds between participants, a residual analysis was performed (see

Trueswell et al., 1994; Gibson and Warren, 2004, for discussion). For each subject, a regression equation was constructed, based on all the reading time data for each participant, that predicted a reading time in milliseconds from the length in characters in each window. For each window, the predicted reading time from each participant's regression equation was subtracted from their actual reading time for a residual reading time. Accordingly, if a participant's actual reading time was exactly the predicted reading time, the value for that window would be zero. Therefore, this residual reading time, which factors out window length and individual reading speed, is a more direct index of processing cost.

Reading times were measured for every word in the sentence, but only the critical window, and two windows before and after it are analyzed. The critical word begins at the onset of the noun complement of *have* in the target sentence, when the contextualization operation in the unified LCS account is predicted to begin. Because the target sentence is the same for all Context-types within each set, any differences in reading times can be attributed to the influence of the context, as the target being measured for each Context-type within a set is the same. Sample excerpts of two experimental sets are given in Table 6.2.

Table 6.2: Critical word placement

C-2	C-1	C	C+1	C+2
has	a	car	that	is
has	a	cactus	that	is

For the reading time analysis, linear mixed-effects models were constructed in R (R Core Team, 2016), using the *lme4* package (Bates et al., 2015), for each of the five segments using the fixed effects of Context-type (2 levels) and the continuous ACD measure as well as their interaction term, in addition to, as random effects, random intercepts for participants and items as well as by-participant random slopes for the effect of context-type. Statistical significance (p-value) was obtained by a likelihood ratio test of the full model with the effect in question against the null model without the effect in question.[1]

For the individual-level variability analysis, individual linear regressions were conducted using a second dependent variable, calculated to directly isolate each participant's degree of linguistic context-sensitivity. This measure, henceforth the Δ measure, is the arithmetic difference between the response to the target after the facilitatory locative context and the response to the corresponding target after the non-facilitatory possessive context. The Δ measure is therefore serving as an explicit measure of the magnitude to which each participant showed a context-type effect. Correlation coefficients were calculated between participant Δ measures and ACD scores, but these correlations were not evaluated for statistical significance due to the small participant sample size. Instead, correlation coefficients are evaluated for meaningfulness in the context of convergent findings across study paradigms (see §8.4.4 on the relationship between effect significance and effect meaningfulness).

6.3 Findings: the processing cost of contextualization

Mean residualized reading times for the segments of interest (two windows before and after the critical window, which contains the noun complement of *have*) are presented in Figure 6.1. Significant main effects of Context-type were observed in the critical word (C) window, as well as the two windows (C+1, C+2) following it (all $\chi^2(2)<13.0$, n=65, all $p<.001$), indicating that context affected the real-time comprehension of the target locative *have*-sentence beginning at the critical window. No significant main or interaction effects of ACD were found (all $p>.4$), and all three Δ measure correlations were weak (all $r<.1$), indicating that individual comprehenders showed relatively uniform reading times over the course of the target sentence.

[1] This method computes a χ^2-value, as opposed to other statistical techniques which may compute, say, a t- or F-value.

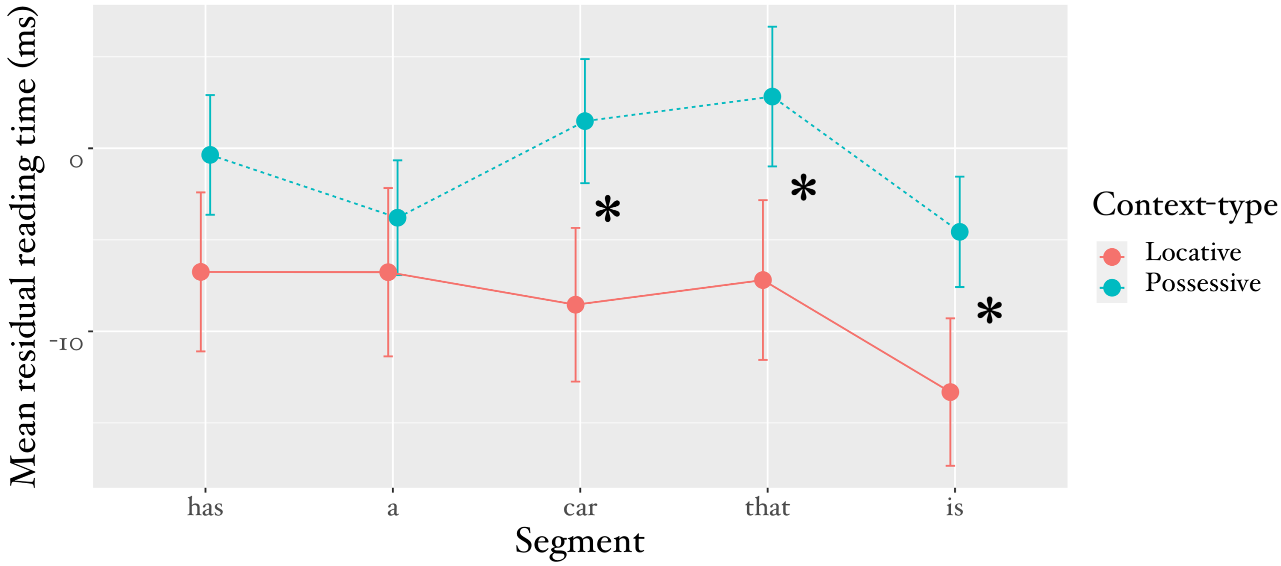


Figure 6.1: Mean residualized reading times by context-type

6.4 Discussion: real-time contextual facilitation

The unified LCS account for the behavior of locative *have*-sentences predicted that a facilitatory locative context would engender faster reading times in a bare locative *have*-sentence, beginning at the point in the sentence where the noun complement was comprehended, due to an attenuated contextualization effect, which would be visible by slower reading times for the target sentence after a non-facilitatory possessive context. In contrast, the real-time processing predictions extrapolated from the transitive copula account of *have*-sentences posit no difference due to the context, since, the argument goes, context plays no role in determining the meaning of a *have*-sentence, and any potential syntactic repair mechanism required to "rescue" the target sentence would be observed in the target after both context-types.

In terms of the direction of the processing cost, the results are consistent with the unified LCS account, which predicted a facilitated speed-up of the target sentence after only the facilitatory context-type. Since Study 1 findings show that a possessive context was equivalent (in its effect on acceptability ratings) as a context containing a descriptive predicate (e.g., *The pine* *tree is very green*), the reading time profile for the Possessive Context-type can be interpreted as being similar to that of no relational context at all. This interpretation renders the Possessive Context-type as the "baseline" with which the Locative Context-type reading time profile can be seen as facilitated. In terms of the localization of the processing cost, these results are also consistent with the unified LCS account, which predicted that the contextualization effort would be visible starting at the window containing the noun-complement of *have*.

One consequence of this overall pattern is that with context, bare locative *have*-sentences are standard, normal processing, especially in conjunction with the Study 1 findings. That is, with appropriate contextual support, there is no "extra" work that must be done to arrive at the locative reading. In contrast, the contextualization operation is visible in the Possessive Context-type reading time profile, which suggests the parser is attempting to seek out relevant contextual information, yet fails to obtain it (as shown in Study 1) due to the non-facilitatory context and lack of other possible sources of disambiguating information, like a locative PP.

While the localization pattern appears to clearly support the contextualization effort, it could be the case that both contextualization and syntactic repair operations are taking place. Due to spillover effects, where the processing cost (reading time slowdown) incurred from a single operation could be observed across multiple windows, it is likely that the cost incurred is all due to the hypothesized contextualization operation. But, to be maximally conservative, these reading time patterns do not rule it out, especially since there is a slight increase in reading time across both conditions from the critical word window (C *has*) and the following window (C+1 *that*). This increase could be interpreted as increased cost across both conditions because the measure here is of residualized reading time.

These results clearly show a facilitatory effect of context as well as the hypothesized contextualization effect beginning at the right point. However, these results do not rule out the presence of a syntactic repair operation, like locative PP-insertion, because of the spillover effect as well as the fact that reading times cannot distinguish between the nature of a processing cost as arising from either syntactic or semantic sources. To make this distinction, I turn to ERP measures (Study 3) in the following chapter, to address this question.

It is interesting to note that no effects of individual-level variability were observed in the reading time measures. A few possibilities could explain this. First is an issue of temporal window. Since the Study 1 findings do show differences between comprehenders as a function of their degree of linguistic context-sensitivity, it could be the case that the temporal windows investigated do not reveal an individual-level variability effect. Because the Study 1 measures are obtained over the timescale of several seconds, while these measures are obtained over the timescale of approximately one second (about 300 ms per window), it may be the case that the contextualization operation does not begin to differ across participants until much later–specifically, that the contextualization operation begins with an automatic (and common) sub-operation, and later manifests differently across participants as a function of their context-sensitivity. In that case, it could be that variability in contextualization can only be measured after the sentence is completely processed, beyond the temporal window available to SPR methods.

Second is a potential task effect. In Study 1, participants were asked to evaluate the acceptability of a sentence, while in Study 2, they were merely asked to read for comprehension. This difference in type of engagement with the stimuli could have differentially manifested variability in context-sensitivity. Xiang et al. (2013) also observe variability in offline but not online effects, and posit a few differences, including the greater dependence on automatic processes (e.g. working memory encoding and retrieval) during online tasks masking any potential variability effects, though their experimental setup assesses a completely distinct linguistic phenomenon.

Third is an issue of resolution. SPR can be regarded as the most basic of real-time processing methodologies, in that it is unable to distinguish between different types of processing cost–it cannot reveal the underlying nature of an observed operation's effect on reading time.

Since the contextualization effect is possibly "hiding" a potential syntactic repair operation, it could be the case that there are multiple effects within the observed slowdown, between which individual-level variability effects manifest differently. Such a conflation between effects that show or do not show variability effects could obscure the overall measurement of any variability effects that are present. This possibility in particular adds further motivation for the ERP study to identify the nature of the observed processing cost in reading times.

In summary, SPR results show a contextual facilitation effect by which a facilitatory locative context supplies the relevant contextual information required to interpret a bare locative *have*-sentence. In contrast, the same bare locative *have*-sentence without the facilitatory context undergoes a contextualization operation at the point when the noun complement (Entity 2) of the *have*-sentence is processed, consistent with the unified LCS account of *have*-sentences. However, SPR reading times do not identify the linguistic nature of an incurred processing cost, so ERP measures are required to both validate the semantic nature of the contextualization operation as well as verify that no syntactic repair operation is taking place at the same time.

Chapter 7

Study 3: the linguistic nature of contextualization

Contents

7.1 Prediction: context-dependent semantic contextualization, not syntactic repair

To evaluate the real-time processing of contextually facilitated locative *have*-sentences, I will evaluate three ERP components: the N400, as an index of general word-level semantic expectedness, the P600, as an index of syntactic repair operations, and the late-positivity, as an index of semantic contextual integration operations. Due to the Study 2 findings, the processing cost has already been localized to the point in the sentence when the noun complement of the *have*-sentence is processed–ERP results will shed light on whether this processing cost is of a semantic context integration nature or a syntactic repair nature.

In line with the unified LCS account of locative *have*-sentences, ERP results should identify an effect of semantic contextualization at the point of the noun complement. This contextual integration process should manifest as a late-positivity component for the non-facilitatory context compared to the facilitatory baseline. In contrast, identifying a P600 component, indexing syntactic repair, for the facilitatory context would be more consistent with the transitive copula account. Observing an N400 component for the non-facilitatory context-type would be consistent with both accounts, as this index of word-level semantic expectedness would be indicative of a mismatch detection between non-facilitatory possessive context and the locative target at a word-level compositional level, and not a broader, sentence-level contextualization effort.

Moreover, the unified LCS account, along with the cognitively-grounded model of meaning variation predicts that individual-level variability in degree of linguistic context-sensitivity will be observed in the late-positivity component, but not the N400 component. Specifically, more context-sensitive comprehenders should show a greater late-positivity component amplitude than their less context-sensitive peers for the non-facilitatory Possessive context-type. The transitive copula account does not make predictions about individual-level variability.

In summary, observing a late-positivity component correlated with individual context-sensitivity (ACD) measures would support the unified LCS account, while a P600 component with no correlation with the variability measure would lend support to the real-time processing mechanism extrapolated from the transitive copula account. Both accounts predict an N400 component due to semantic expectations established by the context.

7.2 Methods: Event-related potentials

7.2.1 Participants

Twenty-nine Yale University students (19 female, ages 18-24, mean age 20;5), were recruited from the Yale University community. By self-report, all participants were right-handed and had no history of psychological illness, neurological disease, or brain injury for which they had lasting symptoms or are currently being treated, as well as no learning or reading disability. All participants also reported normal or corrected-to-normal vision. All participants gave written informed consent in accordance with the guidelines set by the Yale University Human Subjects Committee and were compensated for their participation.

7.2.2 Materials

The linguistic stimuli (Table 6.1) and measures of individual-level variability in linguistic context-sensitivity used in Study 2 were employed for Study 3.

7.2.3 Design

The 150 sentences were presented in a unique order for each participant; the order was pseudo-randomized such that no two consecutive items were from the same set or of the same context-type. Yes/no comprehension questions followed 75% of the sentences to help ensure attention; in the remaining cases, participants were asked to press the "yes" or "no" keys. The total breakdown between "yes" and "no" responses was equal to prevent a response bias.

7.2.4 Procedure

Participants were seated in a darkened room in front of the stimulus presentation computer. Sentences were presented one word at a time in the center of the screen in a white font on a black background; in an rapid serial visual presentation paradigm, each word was presented for 500 ms with no inter-stimulus interval. At the end of each sentence assigned a comprehension question, the participant were given 10000 ms to answer the question. A fixation cross was displayed for 1 s between the end of an experimental item (sentence + question) and the start of the next. Participants were instructed to read each sentence and were informed of the comprehension question procedure. Participants were asked not to blink or move during the stimulus presentation to minimize eyeblink or motion artifacts in the EEG data.

Electrophysiological measures were recorded using Neuroscan Synamps2 amplifiers and a 64-channel Quik-Cap (sintered Ag/AgCl electrodes, 5% system configuration; Oostenveld and Praamstra (2001)) with an online Cz reference, at a 1,000 Hz sampling rate. Horizontal and vertical electrooculograms were recorded with electrodes above and below the left eye and on both outer canthi to control for eye-movement artifacts. Impedances were kept below 5 kΩ for each electrode.

7.2.5 Preprocessing and analysis

The EEG waveforms were first visually inspected for artifact rejection, and then using EEGLAB (Delorme and Makeig, 2004), were filtered (0.1–80 Hz bandpass with a notch filter at 60 Hz), re-referenced offline to averaged mastoids, epoched around the critical words (200 ms pre- to 999 ms post-stimulus), baseline corrected using the pre-stimulus interval, and averaged within each condition for each subject.

Event-related potentials (ERPs) were time-locked to the onset of the noun complement of *have*, as shown previously in Table 6.2. This critical word is the start of the contextualization operation, as indicated by the Study 2 findings. Mean amplitudes were calculated over commonly used windows in the psycholinguistic ERP literature (e.g., 400-500 ms post-stimulus-onset for N400; 600-800 ms post-onset for P600; and 850-1000 ms post-onset for late-positivity (Kutas and Federmeier, 2011; Schumacher, 2011; Schumacher and Avrutin, 2011; Schumacher, 2013, 2014; Piñango et al., 2017)).

Four subjects' data were excluded from the analysis due to insufficient data from technical artifacts; the data from the remaining 25 participants (15 female) were included in the analysis. All statistical analyses were performed in R (R Core Team, 2016).

For the ERP analysis, linear mixed-effects were constructed using the *lme4* package (Bates et al., 2015) for each of the three component windows: N400, P600, and late-positivity. Each model had as fixed effects: Context-type (2 levels), Location (9 levels: left anterior,medial anterior,right anterior, left central, central medial, right central, left posterior, medial posterior, right posterior, see Piñango et al. (2017) for the specific grouping of channels) and the continuous ACD measures as well as all interaction terms. The random effects included random intercepts for participants and items as well as by-participant random slopes for the effect of context-type. Statistical significance (p-value) was obtained by a likelihood ratio test of the full model with the effect in question against the null model without the effect in question.

For the individual-level variability analysis, Pearson correlations were calculated using participants' Δ measures, which were obtained separately for each ERP component, and their ACD scores, but these correlations were not evaluated for statistical significance due to the small participant sample size. Instead, correlation coefficients are evaluated for meaningfulness in the context of convergent findings across study paradigms.

7.3 Findings: semantic contextualization but no syntactic repair

The mixed-effects models revealed a significant effect of Context-type for the N400 window across the six anterior and central scalp regions (all $\chi^2(1)>7.0$, n=25, all $p<.01$). The corresponding models for the late-positivity window revealed a significant effect of Context-type across the six central and posterior scalp regions (all $\chi^2(1)<4.0$, n=25, all $p<.04$). No effects of Context-type were found for either the early (0-400 post-stimulus-onset) window (all $\chi^2(1)<1.5$, n=25, all $p>.2$) or for the P600 window (all $\chi^2(1)<1.0$, n=25, all $p>.4$).

Figure 7.1 shows the EEG traces for all nine scalp regions; the central medial scalp region is highlighted to show the specific ERP components observed. The N400 is visible at approximately 450 ms and appears as the Possessive Context-type EEG trace deflecting upward and the Locative trace deflecting downward, as it is standard practice to plot EEG traces with the *y*-axis reversed (negative values on top). The late-positivity is visible at approximately 850 ms with the Possessive trace deflecting down and the Locative trace deflecting up.

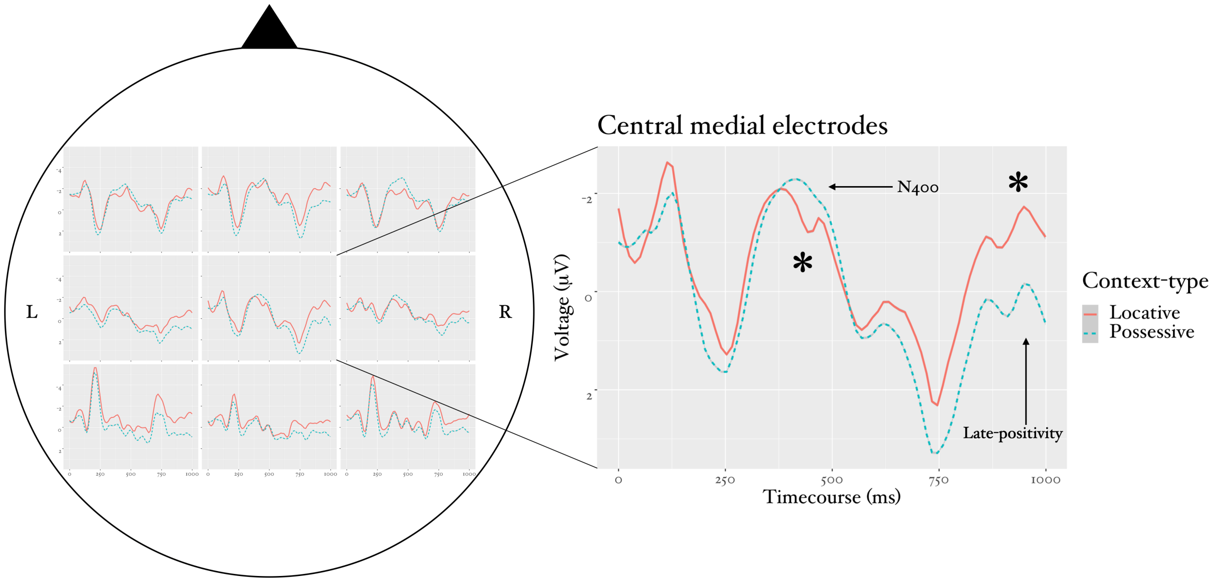


Figure 7.1: Grand average ERP components by context-type

7.3.1 Individual-level variability in contextualization

A significant interaction effect between Context-type and the ACD measure was observed in the late-positivity mixed-effects model (χ^2(1)=22.3, *n*=25, $p<.001$). I thus turn to the Δ measure (=late-positivity amplitude$_{non-facilitatory_context}$–late-positivity amplitude$_{facilitatory_context}$) as a direct measure of the degree to which participants were affected by context. Figure 7.2 shows each participant's mean late-positivity amplitude in the medial anterior scalp region as a function of their ACD score. The correlation coefficient (*r*(23)) for this relationship registered as -.24, as a small-to-medium effect following the benchmarks outlined by Cohen (1988) for the social sciences. The coefficient of determination (R^2) registers as .06, indicating that the ACD measure accounts for approximately 6% of the total variability in the late-positivity amplitudes.

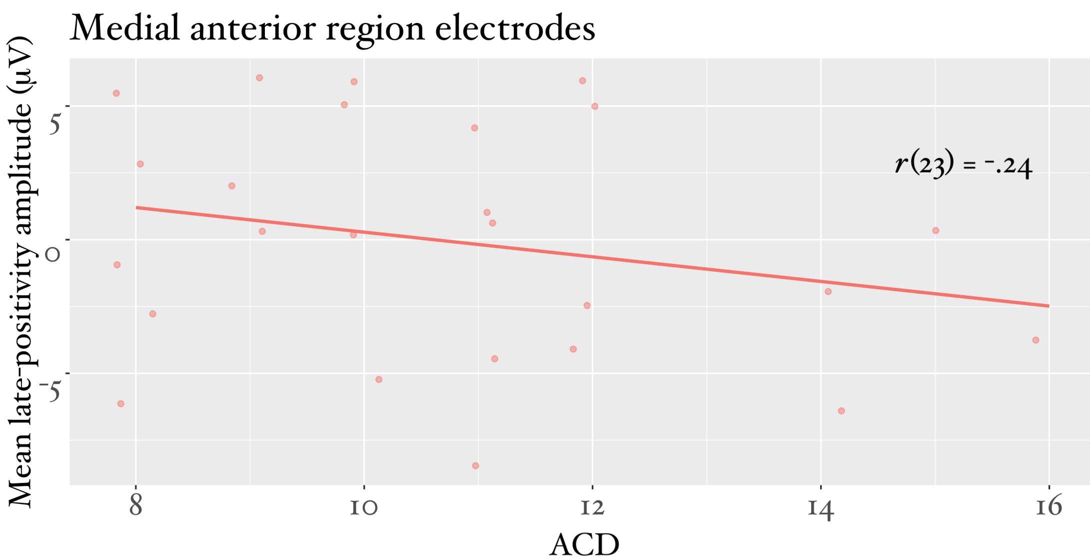


Figure 7.2: Mean late-positivity Δ measure by ACD score

7.4 Discussion: the semantic nature of contextualization

Overall, the distribution of ERP components in this study render clear, interpretable bearings on the proposed account of locative *have*-sentences. The patterns are consistent with the unified LCS account of locative *have*-sentences, in which locative *have*-sentences are **(a)** part and parcel of *have*'s repertoire, but due to lower informativity about the relation between the two entities in a *have*-sentence, **(b)** require additional support in the form of relevant contextual information that decreases the degree of causality perceived in the entities' relation. The patterns are not consistent with the transitive copula account, in which locative *have*-sentences without explicit locative PPs are ungrammatical, and must be rescued through the syntactic repair operation of locative-PP-insertion. I now discuss the ramifications of each ERP component specifically.

The N400 component indicates a clear context-based semantic effect: an incongruent semantic context-target pairing results in a reliably evoked brain response that indicates the comprehender's semantic expectations about this word were violated. This component is yet another indication that *have*-sentences can indeed be modulated by contextual information.

The N400 does not arbitrate between the two accounts proposed, because it is an index of word-level semantic unexpectedness, which arises from the otherwise unexpected locative relationship in the target sentence when it follows the possessive context. The N400, therefore, is indicating a fundamental mismatch between context and target, which supports the claim that comprehenders are sensitive to the nature of the context and its effect on the target, but do not conclusively rule out the transitive copula account because it is only a word-level meaning effect.

The late-positivity indicates another clear context-based semantic effect: a non-facilitatory semantic context results in additional context-integration effort that is undertaken to support an otherwise dispreferred locative *have*-sentence. This component verifies that the processing cost observed in the Study 2 findings, and taken to be associated with the contextualization operation detailed in the real-time processing profile in §5.3, is indeed semantic in nature, the critical piece of evidence that supports the unified LCS account and fails to support the transitive copula syntactic repair account. While this result clearly arbitrates between the two accounts, it does not indicate whether or not there is some degree of measurable contextualization happening for the facilitatory locative context-type. This is because this ERP component is a relative measure, so without a separate baseline measure that clearly has no contextualization, it remains to be determined the degree to which the facilitatory context also shows a late-positivity component. Consequently, this evidence does not clearly show that contextually facilitated locative *have*-sentences are entirely cost-free, but they certainly do not appear to be a product of error detection and syntactic repair. Ultimately, the components, while not illustrating a completely cost-free processing profile, are consistent with the more parsimonious view that contextual-integration effort is part of the standard processing of a *have*-sentence.

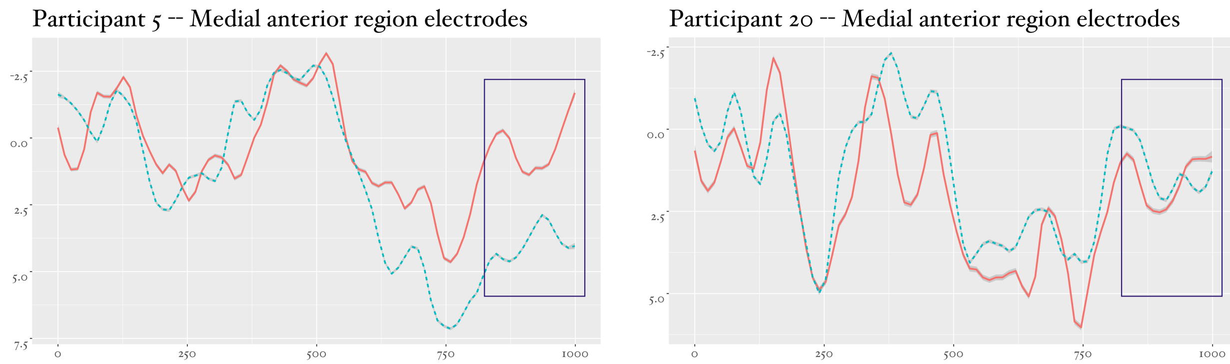
Finally, the lack of a P600 component indicates that no syntactic repair mechanisms took place in these locative *have*-sentences, which goes against the predictions made by the transitive copula account, that bare locative *have*-sentences are ungrammatical and require a syntactic repair mechanism to render them acceptable. While the ERP traces in Figure 7.1 do show a slight gap between Context-types in the 600-750 ms window, there are two reasons supporting the interpretation of no P600. First, if a P600 were to be observed, it would be seen in the Locative Context-type, as this is the context, shown in Study 1, that is judged to be acceptable, hence, in the transitive copula account, the locus of the putative syntactic repair operation. The traces do indeed show a small gap in which the Possessive Context-type is more positive than the Locative, which is the opposite direction of that prediction. Second, the difference between ERP traces over this window was not found to be statistically significant; in light of the significance determinations for the other components, there is a sufficient degree of statistical power to assess the presence and absence of these three ERP components (in contrast to other ERP components, like the mismatch-negativity, which are much smaller in nature).

7.4.1 The linguistic consequences of divergent neural responses

I take the correlation, w between the ACD measure and late-positivity Δ measure, while small, to be meaningful. The ACD measure is a conceptually principled and mathematically validated improvement on the existing AQ measure that has served as the basis for quantifying variability in linguistic context-sensitivity in the literature. With correlations in small samples, evaluating meaningfulness must be done in the context of other applications of the measure. I make this evaluation along three parameters: effect direction (whether the correlation is positive or negative), effect magnitude, and its improvement over the original AQ measure. In terms of effect direction, I note that the negative ACD correlation aligns with all the observed AQ effects in the literature, which show that individuals with lower context-sensitivities (and therefore higher AQ scores) show less context-induced differences across methodologies. Looking back to the Study 2 findings, while not significant, the corresponding ACD measure shows a small, negative correlation as well ($r(63)$=-.07). In terms of effect magnitude, I note that the correlation here is comparable in magnitude to the effect size for the ACD measure described in Piñango et al. (in prep), from §4.5, which designed and validated the ACD measure with a sample size of over 800 participants in a range of methodologies. This correspondence suggests that perhaps it is the case that the ACD measure can only explain, maximally, a small but consistent proportion of the overall variability in a linguistic contextualization task. And finally, in terms of improvement over the AQ measure, the ACD correlation in this sample ($r(23)$=-.24) is approximately six times greater than the AQ correlation for the same sample ($r(23)$=.04), suggesting that the validated improvements made by Piñango et al. (in prep) are manifested in these data as well.

Ultimately, with a small sample like this, quantitative generalizations regarding individual-level variability are difficult to make. Instead, I explore two representative participants' ERP component profile to illustrate the linguistic consequences of individual-level neurocognitive variability. In Figure 7.3, I show the ERP traces for a participant with high context-sensitivity (low ACD score) on the left, and a participant with low context-sensitivity (high ACD score) on the right. Participant 5 has the second lowest ACD score in the study sample, while Participant 20 has the sample's fourth highest ACD score. The key observation is that Participant 5 shows a large late-positivity component in line with the groups' combined effect, while Participant 20 shows no late-positivity effect whatsoever; this contrast is highlighted by the parallel rectangles overlaid on the plot.

I present this distinction to illustrate the point that the analytic tradition of identifying group averages can sometimes paint a misleading picture about the behavior of the individuals that contribute to the average. While these specific participants' data were of course selected for their clarity, I emphasize that the selection of individuals to make up a study sample can greatly impact not only the quantitative result of the study, but also the linguistic theory that is based on evidence from a study. Especially in the situation of highly context-dependent (and still fragile) locative *have*-sentences, the impact of the specific individuals in a study sample



a. High context-sensitivity participant

b. Low context-sensitivity participant

Figure 7.3: Representative participants' late-positivity components

could be monumentally consequential when the sample is small; the effect of the individual decreases as a sample size increases, which further emphasizes the importance of adequate samples for any linguistic investigation. The three principal representatives of the transitive copula account, Ritter and Rosen (1997), Harley and Jung (2015), and Myler (2016) do not report the methods they employed to make the claim that bare locative *have*-sentences are not acceptable to native speakers of English, on which they ground their proposals of linguistic theory. If each had asked for an acceptability judgment from a single person of the Participant 5 (context-sensitive) pattern, perhaps their arguments would be different (in allowing the possibility for a bare locative *have*-sentence to be grammatical for native speakers).

One observation arising from this comparison is regarding the relationship between the N400 component, an index of word-level meaning processing, and the late-positivity component, an index of sentence- or discourse-level meaning processing.[1] In the two participants' data above, the high context-sensitivity participant's large late-positivity follows a small N400, the low context-sensitivity participant's small late-positivity follows a large N400, potentially indicating a tradeoff in the resources allocated toward word-level or context-level meaning

[1]While the relationship between the N400 and P600 components has been well-discussed (see Frenzel et al., 2011; Brouwer and Crocker, 2017), there is not yet a clear understanding of the relationship between the N400 and late-positivity components.

processing. This tradeoff would align the general idea introduced in Chapter 1 about a continuous meaning that is variably captured by lexical structure: where does word meaning end and context begin? Following this logic, variability in the divergence in word-level versus context-level meaning processing would suggest that some individuals within a speech community rely more on lexical structure versus others who rely more on context to guide the disambiguation of underspecified language and comprehension in general.

In Figure 7.4, I present a quantitative summary of this processing tradeoff: the correlation between the mean amplitudes for the N400 and late-positivity components[2] within the same electrode regions shown above. The correlation coefficient registers as a large effect ($r(23) = -.71$) following the Cohen (1988) thresholds. The correlation shows that the larger (more negative) a participants' N400 component, the smaller (less positive) their late-positivity component.

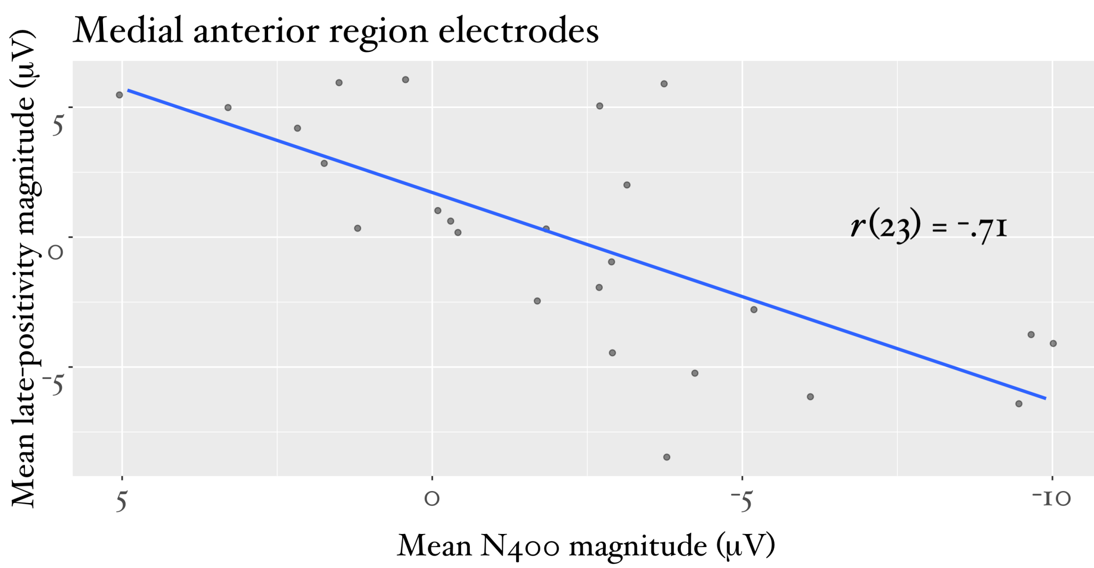


Figure 7.4: N400 - late-positivity correspondence by participant

[2]The amplitudes were calculated by subtracting "smaller" value from the "greater" value for each component. This means that for the N400, the "greater" (more negative) value is that in the Possessive context-type, so this amplitude was calculated as N400-amplitude$_{Possessive}$ - N400-amplitude$_{Locative}$. For the late-positivity, the "greater" (more positive) value is also the Possessive context-type, though the polarity of the value is reversed, hence the negative correlation.

This relationship bears out the divergence above in which individual comprehenders show a tradeoff in their reliance on word-level or context-level meaning processing mechanisms. The fact that both components are elicited for the non-facilitatory Possessive context-type over the facilitatory Locative context-type suggests directly that in response to a semantic interpretation challenge, some speakers effectively "try" harder to make use of the full LCS (the composition operation), while others "search" harder in the context (the contextualization operation).

Overall, such a divergence across two participants in the study sample represents real evidence supporting the idea that individual-level variability within a speech community is critical to account for, especially in situations involving context-dependent linguistic constructions not only for experimental validity, but as the basis for a theoretical model of language. The anticorrelation of the ERP components indexing word-level and context-level meaning processing indicate a differential reliance on the LCS composition and contextualization operations, though both are still implicated in the real-time processing of *have*-sentences.

These patterns of two categorically different behaviors and the correspondences between them, which are not accounted for by traditional group-level analytical procedures, drives home the idea that individual-level variability is an intrinsic and important part and property of the language system, as described in the proposed model of meaning variation.

7.5 Conclusion

The key findings from the ERP study detailed here have clear implications for the two accounts of English *have*-sentences: the presence of a late-positivity component indicates that the processing cost incurred by the non-facilitatory context is one of a semantic context-integration nature, which is not observed in contextually facilitated locative *have*-sentence–a pattern which supports the unified LCS account. Moreover, the absence of a P600 component indicates that no syntactic repair operations, such as locative PP-insertion, are taking place, which elucidates the findings from Study 2. Together, the Study 2 and 3 findings fail to support the processing predictions extrapolated from the transitive copula account for locative *have*-sentences.

In terms of individual-level variability in linguistic context-sensitivity, Study 3 showed a small effect of the ACD measure. This effect was consistent in three ways with other work on linguistic context-sensitivity, suggesting potentially that the ACD measure, at most, explains a small but consistent portion of the overall amount of variability in a linguistic contextualization task. Crucially, participants differed in their reliance on context at the expense of their reliance on the full LCS, indicating a tradeoff between lexical composition and contextualization in comprehender strategies. Future work must further elucidate additional dimensions of systematic individual-level variability in order to better understand the variability effects observed here in Studies 2 and 3. This additional work can further clarify the exact nature of this variability–be it an inability or unwillingness to identify relevant information from the context, an inflexibility or intolerance of making use of identified relevant contextual information, or something different, as discussed in §4.4.5.

Overall, the real-time processing studies presented here not only advance the unified LCS account for the behavior of locative *have*-sentences in English, but also deepen the neurocognitive grounding of the proposed model of meaning variation.

Chapter 8

Study 4: the neurocognitive bases of contextualization

Contents

8.1 Predictions: standard lexico-semantic conceptual composition

To evaluate the neurocognitive bases of contextually facilitated locative *have*-sentences, I investigate the brain activation patterns resulting from the same experimental contrast as in Studies 2 and 3: a target bare locative *have*-sentence following a locative or possessive context. Briefly summarizing the approach, as described in §5.4.2, the study compares a bare locative *have*-sentence following a facilitatory locative context and a non-facilitatory possessive context. I describe the brain activation predictions from each account below, but in short: the transitive copula account's extrapolated processing hypothesis predicts that syntactic composition and repair are the key processes in the comprehension of *have*-sentences; the unified LCS account directly predicts that comprehension relies on semantic and conceptual (LCS) composition and contextualization. Identifying distinct (non-overlapping) patterns of activation that support each of these operations, within known neurocognitive networks underlying language as well as across the entire brain, will lend decisive support to one of the two competing accounts. In sum, the neural activation patterns will reveal the nature of the comprehension process, thereby arbitrating between two linguistic analyses.

The transitive copula account is at its core an account involving syntactic composition, in which the meaning of a *have*-sentence is determined based on the syntactic constituency within the second DP argument of *have*. Specifically, a locative *have*-sentence is only possible with the inclusion of a locative PP in the domain of that second DP. Therefore, the account straightforwardly predicts that cortical areas that underlie syntactic composition, namely the left inferior frontal gyrus, specifically BA 44 and 45 (Segaert et al., 2013; Henderson et al., 2016), traditionally associated with Broca's area, should be recruited during the comprehension of these sentences, since syntactic composition is the key differentiator between different readings of a *have*-sentence. Bare locative *have*-sentences, in this view, are taken to be ungrammatical but repairable through the insertion of a locative PP. Accordingly, cortical areas associated with error detection and ungrammaticality, like the anterior cingulate cortex (Volz et al., 2004; Alexander and Brown, 2019) or the medial prefrontal cortex (Gauvin et al., 2016; McCormick and Telzer, 2018), should also be recruited during the comprehension of these sentences. While the lack of P600 effect in Study 3 is evidence against a syntactic source of the meaning of a *have*-sentence, the direct connection between the P600 and cortex has not yet been established; (Service et al., 2007) find evidence for a superior temporal cortex source of the P600, suggesting for the purposes here that the lack of a P600 is not necessarily indicative of a lack of cortical activation associated with syntactic processing.

In contrast, the unified LCS account of *have*-sentences takes locative *have*-sentences to be standard interpretations for *have*, and not ungrammatical sentences to be rescued through a repair mechanism, though these interpretations require additional support with respect to the conceptual relationship between the two entities of the *have*-sentence. While this account straightforwardly predicts no neural signatures of error detection, ungrammaticality, or repair/rescue mechanisms, its conceptual and semantic compositionality could manifest through a few possible neural patterns, as the localization of meaning composition is more broadly distributed across the brain than syntactic processing. The first set of patterns would lie within canonical language areas in the left hemisphere: traditionally, semantic processing has been associated with the temporal cortex (Friederici et al., 2003; Brennan et al., 2012), though much of this swath of cortex (particularly the anterior superior temporal gyrus) is associated with argument structure and therefore would not necessarily arbitrate between the competing models (Bornkessel and Schlesewsky, 2006). Crucially, within the temporal lobe, lexical-semantic processes have been identified to recruit the middle temporal gyrus and surrounding areas, namely the posterior temporal cortex and angular gyrus (Obleser et al., 2007; Lau et al., 2008). Of these two, the superior posterior temporal gyrus has been found to underlie lexically driven semantic "completion" operations that involve identifying lexical material that can satisfy the semantic requirements of previous structures, as in long-distance dependencies (Piñango et al., 2016). The angular gyrus is associated with conceptual-semantic integration (Badre et al., 2005; Boylan et al., 2015; Lai et al., 2020), and the supplementary motor area has been found to support activity in the angular gyrus (Piñango et al., 2017; Schwartze et al., 2012) in more computationally demanding conceptual-semantic integration tasks. These last two cortical regions are particular signatures of lexically driven composition and lexico-semantic selectional restrictions (Hickok and Poeppel, 2004; Shetreet et al., 2009; Friederici, 2012; Lai et al., 2014; Piñango et al., 2016), and would directly support the lexically driven semantic composition operation of the unified LCS account. Additionally, the contextualization operation required to support the locative interpretation of the target *have*-sentence could recruit cortical regions associated with causal perception in the parietal lobe (Woods et al., 2014; van Dam and Desai, 2016), language-focused working memory in the prefrontal cortex (Sabb et al., 2007), the visual cortex (Gaffrey et al., 2007; Petersen and Posner, 2012), or dorsolateral prefrontal cortex (Hagoort, 2005; Binder et al., 2009; Piñango et al., 2017), or right-hemisphere correlates of left-hemisphere language areas (Devlin et al., 2003; Wende et al., 2013; Piñango et al., 2016), areas outside of the canonical language networks that can support language function but are external to linguistic processes proper. In line with the distribution of variability in Study 2, individual-level variability in linguistic context-sensitivity is predicted to manifest in cortical regions associated with effort, such as the language-focused working memory regions described above. Additionally, individual differences in working memory capacity (as measured behaviorally) have been correlated with activation in the posterior cingulate cortex and precuneus during sentence comprehension (Newman et al., 2013), an area associated with constructing representations of events. Crucially, individual-level variability due to linguistic context-sensitivity is not predicted for cortical regions within traditional language networks involved in the LCS composition operation itself, such as the left angular gyrus.

In summary, the key neural evidence would be a non-overlapping activation of cortical regions underlying syntactic composition (namely anterior left cortex), which would support the transitive copula account, or lexico-semantic conceptual composition (namely posterior left cortex), which would support the unified LCS account.

8.2 Methods: functional magnetic resonance imaging

8.2.1 Participants

Thirty native speakers of American English were recruited from the Yale University community (16 female, ages 18-29) to participate in the study. All participants met the same exclusion criteria as the previous two studies, and additionally, safety requirements for entering a magnetic resonance scanner, such as no ferromagnetic materials in or on the body. All participants gave written informed consent in accordance with the guidelines set by the Yale University Human Subjects Committee and were compensated for their participation.

8.2.2 Materials

The linguistic stimuli (Table 6.1) and measures of individual-level variability in linguistic context-sensitivity used in Studies 2 and 3 were also employed for Study 4.

8.2.3 Design

The total set of 150 sentences were divided into 10 groups, resulting in 15 sentences per run. Each sentence was visually presented segment-by-segment using E-Prime (Psychology Software Tools, 2012), with all the words appearing in white text at the center of a black screen. Within each run, the sentences were pseudo-randomized such that no successive sentences were of the same context-type or entity set. Participants were presented with a comprehension question after 50% of the sentences (distributed equally across context-types) to ensure they maintained engagement with the stimuli. Each question was presented for 6000 ms. Before each sentence, there was a fixation cross (+) displayed at the center of the screen for 1000 ms; between the end of the context and the start of the target, there was a 1000 ms pause, and after the sentence there was another 1000 ms pause, which was then followed by either the next item's initial fixation cross or the comprehension question. There were 16-18 words per sentence, and each was presented for a duration of 750 ms, resulting in a total duration of 15-18.5 s per sentence without a question and 20-23.5 s per sentence with a question. Therefore, each run lasted between 4 min 20 s and 5 min 18 s.

8.2.4 Procedure

Prior to the start of the study, participants were given written and oral instruction about the experiment. Participants completed one practice run identical in format but with different sentences from the experimental run in a room outside of the scanner to acclimate to the feel of the task. They were required to answer at least 90% of the comprehension questions in the practice run correctly before moving on to the experiment; if more than 10% of the questions were answered incorrectly, the practice session was completed again. No participant completed the practice session more than twice. In the scanner, participants completed 10 functional scans (runs) and all the anatomic MR scans, with short breaks as needed between each scan.

8.2.5 Image acquisition

Anatomical images

MR data were acquired on 2 identically configured Siemens 3T Prisma scanners equipped with a 64-channel head coil at the Yale Magnetic Resonance Research Center. Acquisition parameters were the same across scanners. Each session began with a 3- plane localizer, followed by a sagittal localizer, and an inversion recovery T1 weighted scan. Anatomical images for the functional slice locations were then obtained using spin echo imaging in axial planes parallel to the AC-PC line with TE= 2.61, TR=285 ms, matrix 192×192, FOV=220 mm, flip angle=70°, bandwidth=501 Hz/pix, 51 slices with 2.5 mm thickness.

Functional images

Event-related functional MRI was conducted using gradient echo-planar imaging (EPI) blood oxygenation level dependent (BOLD) contrast, with TE=30 ms, TR=956 ms, matrix 84×84, FOV=210 mm, flip angle=62°, bandwidth=2289 Hz/pixel, slice thickness=2.5 mm, with 327 measurements (images per slice). The scanner was set to trigger the stimulus presentation program, which enabled the image acquisition to be synchronized with the stimulus presentation.

At the end of the functional imaging, a high-resolution 3D Magnetization Prepared Rapid Gradient Echo (MPRAGE) was used to acquire sagittal images for multi-subject registration, with TE=2.77 ms, TR=2530 ms, acquisition matrix 256×256, FOV=256 mm, bandwidth=179

Hz/pix, flip angle=7°, 176 slices with 1 mm slice thickness.

8.2.6 Preprocessing and analysis

The data were converted from Digital Imaging and Communication in Medicine (DICOM) format to the format for analysis using XMedCon (Nolfe, Voet, Jacobs, Dierckx, & Lemahieu, 2003). The first 6 images at the beginning of each of the 10 functional runs were discarded during the process to enable the signal to achieve steady-state equilibrium between radio frequency pulsing and relaxation, leaving 321 images per slice per run for analysis. Functional images were motion-corrected with the Statistical Parametric Mapping (SPM) 8 algorithm for three translational directions (x, y, z) and three possible rotations (pitch, yaw, roll). Trials with linear motion that had a displacement exceeding 1.5 mm or rotation exceeding 2° were rejected. The data from one participant were excluded from further analysis due to excessive head movements. All further analyses were performed using Yale BioImage Suite (Papademetris et al., 2006).

Individual subject data was analyzed using a general linear model (GLM) on each voxel in the entire brain volume withregressors specific for each task. As described above, each sentence was segmented into two events (i.e. two regressors), shown in Table 8.1 below, which isolated the hypothesized processing stages involved in the comprehension of the target locative-*have* sentences.

Table 8.1: Analytic window segmentation

Event 1	Event 2
The pine tree has a motorcycle under it and the maple tree	has a car that is red.

Event 1 included the onset of the context sentence to the offset of the subject noun phrase of the target. Event 1 ranged between 6000 and 7500 ms, depending on the length of the noun phrases in the context sentence). Event 2 included the onset of the verb *have* in the target sentence until the offset of the target sentence. Event 2 lasted 8000 ms for all sentences across conditions. Accordingly, Event 2 is when the critical contextualization operation of the unified LCS account takes place, as shown from the Study 1 and Study 2 findings.

The resulting beta images of each task were spatially smoothed with a 6 mm Gaussian kernel to account for variations in the location of activation across subjects. The output maps were normalized beta-maps, which were in the acquired space (2.5 mm × 2.5 mm × 2.5 mm). Three registrations were then calculated within the BioImage Suite software package to map the data onto a common reference space. The first registration carried out a linear registration between the individual subject raw functional image and that subject's 2D anatomical image. Then the 2D anatomical image was linearly registered to the individual's 3D anatomical image. The 3D differs from the 2D in that it has a 1×1×1 mm resolution whereas the 2D *z*-dimension is set by slice-thickness and its *x*-*y* dimensions are set by voxel size. Finally, a non-linear registration was computed between the individual 3D anatomical image and a reference 3D image. The reference brain used was the Colin27 Brain (Holmes et al., 1998) in Montreal Neurological Institute (MNI) space (Evans et al., 1992). All three registrations were applied sequentially to the individual normalized beta-maps to bring all data into the common reference space.

Using BioImage Suite, two-tailed paired *t*-test maps were generated to examine the differences between tasks. Family-wise error (FWE) correction for multiple comparisons was conducted with Monte Carlo simulation using AFNI's 3dClustSim, using the autocorrelation function option and 10,000 iterations, and using an input smoothness (6 mm and a connection radius of 6.97 mm on 3.44 mm x 3.44 mm x 5 mm voxels) estimated from the residuals of the *t*-tests. A *p*-value of 0.005 was considered statistically significant for whole brain family-wise error correction, based on the spatial extent of contiguous suprathresholded individual voxels, and a cluster correction of p=0.05 was used. The cluster-forming threshold was 320 mm^3.

8.3 Findings: LCS composition-centered network of activations

The whole-brain analyses showed a network of activations centered around left hemisphere cortical regions implicated in lexico-conceptual semantic processing, conceptual composition, and language-dedicated working memory.

For the comparison of interest (Locative > Possessive), preferential activations were observed for the target Event 2 region (*have* + complement) in the left angular gyrus (AG, BA 39), left supplementary motor area (SMA, BA 6), precuneus (BA 7), right AG, and right frontal cortex (BA 8). Comparing the two conditions using subtraction means that these regions were preferentially activated when participants were comprehending the target locative *have*-sentences. In contrast, the reverse subtraction (Possessive > Locative) showed preferential activations in the left inferior frontal gyrus (IFG: BA 47) and the anterior cingulate cortex (ACC). The details of each activation is presented in Table 8.2 and the preferential activations are shown below in Figure 8.1.

Table 8.2: Imaging results: regions of activation

Cortical region	Volume (mm^3)	Max. (Mean) t-value	Max. MNI coords. (x, y, z)
Precuneus	5353	6.21 (3.54)	(-8, -62, 48)
Left superior AG	1693	6.46 (3.70)	(-32, -74, 38)
Right BA 8	1139	4.67 (3.51)	(30, 17, 49)
Right AG	1095	4.86 (3.42)	(39, -72, 38)
Left BA 6	646	4.85 (3.61)	(-22, 7, 56)
Left inferior AG	628	4.78 (3.65)	(-49, -69, 19)
Left BA 47	803	-5.51 (-3.67)	(-27, 33, -15)
ACC	739	-4.78 (-3.49)	(-4, -6, 36)

Note: AG = angular gyrus, BA = Brodmann area, ACC = anterior cingulate cortex.

In summary, the neural activation patterns showed preferential recruitment of regions underlying lexico-conceptual semantic composition and event representation, and crucially, no regions associated with syntactic composition, lending support to the unified LCS account and

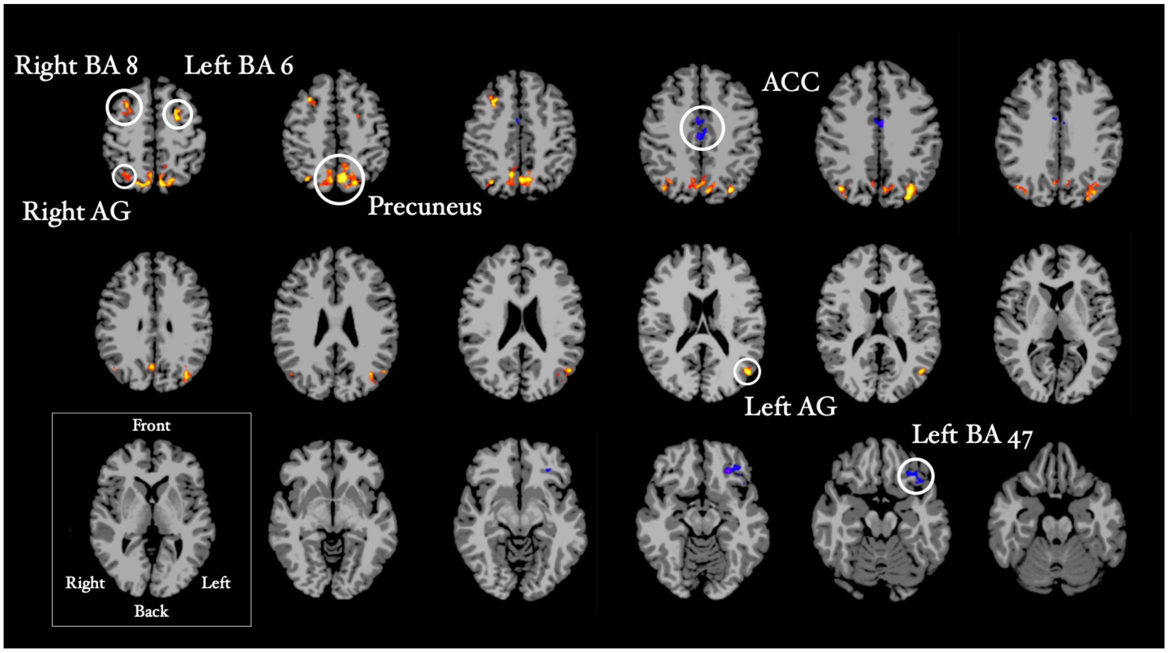


Figure 8.1: Axial slice views for activations in the Locative > Possessive subtraction.
Note: Images are presented in radiological format, which means that the left hemisphere is depicted on the right side of the image. Axial slices are shown from the superior to inferior from left to right in each row; the first image is the first slice at the top of the brain, and the last image is the last slice at the bottom of the brain. Because this figure represents the Locative > Possessive subtraction activations in orange/yellow, the preferential activations for the reverse subtraction (Possessive > Locative) are shown in blue/purple.

not the transitive copula account. Directly below, I present a discussion of these activations patterns. First, I discuss the predicted and unpredicted activations in areas of cortex known to support language function, and then describe the activations outside of these areas. I conclude by presenting corresponding individual-level variability findings of the ACD measure across brain regions.

8.4 Discussion: the neural bases of lexico-conceptual semantic composition

8.4.1 Comprehension as composition and contextualization

In unpacking the neuroimaging results, I first return to the operationalization of the comprehension process for *have*-sentences, which consists of the incremental syntactic composition of an NP-*have*-NP structure, the incremental LCS composition of a two-entity relational meaning, and the contextualization of a causal potential that ultimately disambiguates the specific relation to be understood. The results show preferential activations in brain regions associated with construction of the meaning of these sentences, which is understood to be a lexico-conceptual semantic composition operation that depends on the evaluation of a causal potential between the two entities in the *have*-sentence. I describe in turn, the areas that actuate the LCS composition operation, and then two networks that reveal additional effort in the comprehension process.

Left angular gyrus as the center of LCS composition

The key result from this study is the preferential activation of the left angular gyrus (AG) in the comprehension of contextually supported bare locative *have*-sentences. The left AG has been shown to underlie composition of the meanings of words as it relates to both linguistic and conceptual domains, specifically referred to as conceptual-semantic integration (Badre et al., 2005; Binder et al., 2009; Lau et al., 2008; Seghier et al., 2010; Boylan et al., 2015; Price et al., 2015; Schell et al., 2017). Notably, Lai et al. (2020) find that the mapping of specific conceptual-semantic features of nominal entities into conceptual structure template of a verb recruits the left AG. Similarly, in the comprehension of locative *have*-sentences, I take the process of evaluating the conceptual features of the entities and situation within the retrieved lexical meaning structure of *have* in order to determine the intended relational meaning of the target sentence to be the source of the observed AG recruitment. The two principal takeaways from this specific finding are that **(a)** LCS composition, as the nexus of lexical-semantic and conceptual-structure integration, is the core operation of understanding *have*-sentences, and **(b)** bare locative *have*-sentences are part of regular semantic composition networks and processes and should thus be treated as "normal" sentences rather than categorically ungrammatical. Both of these interpretations are entirely consistent with the unified LCS account proposed here.

Supplementary motor area and right angular gyrus support LCS composition

While the LCS composition underlying the bare locative *have*-sentences in the experimental setup takes place within the standard processing mechanisms, it is not entirely easy, however, as additional areas involved in supporting language function were systematically recruited, namely the supplementary motor area (BA 6)[1] and the right hemisphere angular gyrus (AG).

For a variety of cortical regions that show lateralization, such as the left-lateralization of language function, right hemisphere regions have been shown to support the function of their left hemisphere homologues (van Ettinger-Veenstra et al., 2010), especially in the case of extra demands or processing required (Hugdahl, 2000; Hinkley et al., 2016), and even assume the linguistic operations after left-hemisphere stroke (Xing et al., 2016; Gainotti, 2015).[2] In this case, I take the preferential activation of the right hemisphere AG to indicate, in the same manner

[1]BA 6 is divided into two sub-regions that both have implications for language areas. The inferior portion of BA 6 is proximal to the cortical regions typically ascribed to Broca's area (Hagoort, 2014), while the superior portion of BA 6 is immediately anterior to the motor cortex and is therefore typically referred to as the supplementary motor area (SMA), or pre-motor cortex, because it is implicated in supporting complex physical movements and muscular coordination (Nakagawa et al., 2016). In this case, the activations in BA 6 are in the superior region, corresponding to existing findings that show that the SMA is implicated in demanding semantic tasks (Alario et al., 2006; Hertrich et al., 2016) beyond the clear connection between speech production and the non-speech motor coordination functions of the SMA. In contrast, finding an activation in the inferior region of BA 6 might support the hypothesis that demanding syntactic processing is a key component of understanding *have*-sentences (Schell et al., 2017).

[2]For an interesting, in-depth discussion of the evolutionary advantages and costs of systematic ("population") lateralization, see Rogers (2002); Vallortigara and Rogers (2005).

as the SMA activation, an increased demand in processing power for the lexico-conceptual semantic composition taking place during the comprehension of the *have*-sentences in question. This increased demand for the otherwise regular LCS composition is attributable to the non-canonicality of these bare locative *have*-sentences.

Again, the additional processing power involved in the compositional process is highly circumscribed to areas that systematically support canonical language function, suggesting that this additional processing is ontologically inherent to the standard cortical infrastructure for language. That is, that a contextually supported but less canonical bare locative *have*-sentence requires additional processing of the standard variety. The contrasting case would be additional processing of an ontologically different kind, namely wholesale activations in the bilateral prefrontal and frontal cortices, which are domain-general resources implicated in "panic" or asystematic demands of an unexpected nature (Hubers et al., 2016), or even the amygdala, which is an evolutionarily ancient neural center for negative emotional processing (Brennan, 2016).

In sum, the additional recruitment of the SMA and right AG, and crucially, not bilateral prefrontal and frontal cortex, supports the unified LCS prediction that the comprehension of bare but contextually supported locative *have*-sentences is standard semantic composition and not a "crash" and repair mechanism. Importantly, it is not the case that the unified LCS account predicts that these sentences are entirely preferred or maximally straightforward, but that they do not present an undue challenge to the linguistic system since they make use of the LCS associated with the lexical item *have*. As detailed in Chapters 2 and 3, the dispreference of bare locative *have*-sentences results from lower informativity and language-specific lexical blocking effects, and not from a categorical ungrammaticality due to a mismatch in the syntactic structure. The resulting dispreference in turn contributes to lower frequency in the language, which itself manifests as requiring additional effort; experimentally, more comprehension effort has been shown to lead to lower task-elicited acceptability ratings or judgments, even though the sentences themselves may not be less acceptable in everyday use (Lai and Piñango, 2019). These findings add to an effort within the psycho- and neurolinguistic literatures to distinguish between processing costs and error signals (see Christensen and Wallentin, 2011).

BA 47 and anterior cingulate cortex underpin effort in the contextualization operation

I turn now to the "negative" activations, which are the regions shown with blue and purple coloring in Figure 8.1. These "negative" activations in the subtraction method represent hemodynamic activity associated with the subtrahend, namely the target sentence following the Possessive context-type. To understand this pattern, I first describe the possible role of the context itself, and then highlight a few possibilities of what processing mechanisms are involved in the experimental condition. The content of the Possessive context-type is a prototypical inalienable or alienable relation, which precedes the target locative *have*-sentence. Based on the findings from Study 1a, these contexts contribute very little semantic bias because they represent the most canonical and frequent uses for *have*-sentences in the language. In fact, they resulted in acceptability ratings that were indistinguishable from the Attributive context-type, which provides a semantic relation outside of the domain of relational meanings, suggesting that this context-type did not contribute any helpful information for disambiguating the specific relational meaning for the target. Accordingly, the participants are faced with an essentially context-less bare locative *have*-sentence, and upon comprehending the second entity, must evaluate the causal potential between the two entities, as usual for a *have*-sentence. At this point, participants encounter a low-frequency and underinformative locative meaning, thus requiring a greater contextualization effort to identify a possible situation or event to license it. Effectively, participants are mining the context for a semantic or communicative motivation to decrease the salience of the causal component of the LCS of *have*, which is a much greater contextualization effort than in the facilitatory Locative context-type. For those participants that are able to do so, there may be an additional process of detecting and possibly reconciling the mismatch in relational meaning between the context and target in a conjoined setting.

The negative activation patterns are directly consistent with this interpretation of effortful contextualization, that is, extra processing work for the target locative *have*-sentence after a possessive context as compared to the same target after a locative context. Specifically, the ventrolateral prefrontal cortex (BA 47) is understood to be a cortical source for language-oriented working memory and has been connected to extra effort associated with cognitive control in attention-mediated, demanding tasks (Sabb et al., 2007; Heyman et al., 2015; Coderre et al., 2016), semantic ambiguity resolution (Badre et al., 2005; Rodd et al., 2012; Lai et al., 2020), as well as resolving conflicting contextual information and a target sentence (Piñango et al., 2017). This cortical region has also been shown to underlie the encoding of context-dependent memory by connecting salient items with their contextual features (Zhang et al., 2017).

Furthermore, the anterior cingulate cortex (ACC) underlies the detection of errors and conflict monitoring; in fact, it was one of the earliest functional areas to be identified in the human brain mapping effort (Carter et al., 1998; Van Veen et al., 2001; Botvinick et al., 2004), and operates across a variety of domains (Volz et al., 2004; Gauvin et al., 2016; Alexander and Brown, 2019), including in language, specifically in both semantic (Blanco-Elorrieta and Pylkkänen, 2016) and phonetic (Haupt et al., 2009) congruence tasks. In the case of *have*-sentences, the mismatch detection could be relevant at two levels: the first being the conflict within the conjoined context and target between their initial acceptability, canonicity, or frequency in the language, and the second being between the specific relational meanings, i.e., possessive versus locative, respectively. For the latter to be true, it would be the case that only a subset of the participants, presumably the more context-sensitive ones that are better able to construct a facilitatory context to support the otherwise dispreferred target, would show ACC activation, or that these participants would show a greater degree of ACC activation.

Overall, this contextualization interpretation matches the interpretation of the late-positivity ERP component, in which an index of extra processing cost was identified for the non-facilitatory context. While some studies have associated with the late-positivity with the ventrolateral prefrontal cortex (Liu et al., 2012) and the ACC (Sun et al., 2017), the most direct comparison within the semantic domain associates it instead with the middle temporal gyrus (Pauligk et al., 2019), though the experimental paradigms across studies are not directly comparable. The study presented here offers an ideal setup for an investigation of the neural generator of the late-positivity, as it uses the same stimuli and population[3], though with slightly modified timings. The convergent measures of contextualization effort in the ERP (late-positivity component) and fMRI (ventrolateral prefrontal cortex and ACC) present not only a result in support of the unified LCS account, but also strengthen the case for multimodal research in identifying complementary but overlapping sets of findings that shed light on different aspects of language comprehension.

8.4.2 Comprehending *have*-sentences is not differentiated by syntactic composition

The second key finding from this study is the lack of activation of any areas associated with syntactic composition or processing: specifically, the pars opercularis (BA 44) and the pars triangularis (BA 45) in the left inferior frontal gyrus (Friederici et al., 2003; Santi and Grodzinsky, 2012), the typical locus of Broca's area.[4] Specifically, the potential repair operations consistent

[3]Here, population refers to the characteristics of the population from which the individual study participants come from, not the specific individuals themselves.

[4]Broca's area is of course implicated in a range of linguistic functions beyond syntactic composition, though syntactic processing has been reliably used to trigger preferential activation in Broca's area. Recent research has also proposed identifying a more broad cortical distribution of areas underlying syntactic processing (Blank et al., 2016), as areas involved in syntactic processing at a lesser degree than Broca's area can fail to surface in traditional fMRI analytical procedures. I take this to be an extremely important stance for future neuroimaging work, though for the purposes here, I consider the lack of activation of the most reliable and robust cortical area

with the transitive copula account, PP manipulation (insertion or ellipsis), has been shown explicitly to involve the workings of the left inferior frontal cortex (Fiebach et al., 2005; Mätzig, 2009). While increasing the lexicalized-ness of syntactic operations, which could be involved in *have*-sentences given their centrality to English, has been shown to shift the cortical activation toward the posterior temporal gyrus (Yang et al., 2017), there is no evidence of activation in this region either.

Since the subtraction paradigm for evaluating this kind of brain data highlights differences between the relevant comparisons, the lack of syntactic activation does not imply that no syntactic composition is happening. Rather, the syntactic processing that underlies the locative and possessive meanings is entirely shared, a finding that is not reconcilable with the transitive copula account, which predicts that the two meanings are differentiated by their syntax. This finding also parallels the lack of P600 effect in Study 3, again demonstrating the utility of multimodal language processing research, using two neural indices of syntactic composition and processing to arbitrate between the two competing linguistic accounts.

Finally, the lack of activation in the left inferior frontal gyrus for the contextualized bare locative *have*-sentences also suggests that there is no notion of ungrammaticality at play, as ungrammatical sentences have been shown to activate these cortical regions reliably as well (Hubers et al., 2016; Piñango et al., 2016). This renders further support for the unified LCS account's proposal that locative meanings are core to the semantic range of *have*-sentences in English.

Alternative syntactic analyses

One of the issues dealt with in this dissertation is understanding the scope of the transitive copula account in the context of a psychological language faculty: this account's analysis does not make processing predictions, due to the nature of the tool, and is therefore unable to be

associated with syntactic processing to be supportive of the unified LCS account.

directly tested, supported, or falsified using psycho- or neurolinguistic methods. Accordingly, the instantiation of the transitive copula account in these studies is my best logical extrapolation into a possible operationalization. It is possible that the lack of syntactic effect, which I interpret to be a failure to support my extrapolation of processing hypotheses from the transitive copula account, is due not to the analysis but of my extrapolation, that of PP manipulation. The flagship proposals within this account family claim that bare locative *have*-sentences are ungrammatical (Ritter and Rosen, 1997; Harley and Jung, 2015; Myler, 2016), which is not consistent with anecdotal reports in the literature (Belvin and Den Dikken, 1997), nor acceptability judgments from a large sample of native speakers (Study 1a and Zhang et al. 2022).

These accounts have no prediction nor explanation for the acceptability of these sentences; so in order to test them, I extended them into the processing domain by proposing a repair mechanism in which a locative context can somehow trigger the insertion of a locative-PP, the exclusive source of a locative interpretation, into an otherwise unspecified or possessive *have*-sentence. Since the framework used for the analysis does not have a linearization algorithm, there are a few other possibilities that would be consistent with the findings from Studies 3 and 4, which show no difference in the syntactic processing between the contextually facilitated locative and possessive readings of the target *have*-sentence.

Logically, there are three possibilities consistent with the findings: **(a)** no syntactic structure beyond the surfaced NP-V-NP is being processed; **(b)** *have* encodes a maximally specified syntactic structure with all the possible projections for a possible *have*-sentence and these surface as needed; or **(c)** there are covert syntactic operations involving unpronounced structure that have no processing traces, that is, they are undetectable by any psychological means.

Possibility **(b)** is entirely consistent with the unified LCS proposal, in which a maximal structure is retrieved with *have* and context or other factors are able to make salient the most relevant portions of the structure depending on the interpretation. Specifically for these sentences, this analysis would predict an obligatorily constructed locative PP that surfaces in the case of locative *have*-sentences and remains silent for the case of possessive *have*-sentences. The lack of syntactic effects in the findings would correspond to the fact that in both interpretations, the locative PP is constructed; this analysis would have to predict that the contextually driven surfacing of the already-built locative PP in the locative readings would not rely on syntactic processing operations, since none were observed (no P600 ERP component and no BA 44/45 activation). This syntactic analysis is consistent with the processing data and entirely parallel to the unified LCS account, which predicts a maximal meaning structure involving a core locative relation that is then modulated by context. However, this analysis is a maximal departure from the transitive copula account, since Myler (2014) states that "The further an analysis pushes the idea that *have* is meaningless, the more successful it turns out to be." This highlights that a syntactically versus semantically implemented account is not the relevant question for debate here; the evidence fails to support an analysis of *have* in which there is no semantic content or syntactic infrastructure for a PP-like complement. The crucial difference between the unified LCS and transitive copula accounts is the semantic content and syntactic structure that comes with the lexical item *have*.

The third option, one of psychologically undetectable covert operations, is challenging due to its untestable nature. While there is a large literature relating overt syntactic phenomena with sentence processing (see Grodzinsky and Friederici, 2006; Frazier, 2013, for an overview), there is markedly less work relating covert syntactic analyses to processing. Some effort has been made to operationalize covert syntax with processing predictions, largely for the case of *wh*-in-situ constructions, particularly in Mandarin Chinese. Xiang et al. (2014) compares *wh*-in-situ questions with corresponding declaractive sentences and finds that the former take longer to process, as measured through a speed-accuracy-tradeoff paradigm; these results are consistent with a covert movement to the left edge of either a covert *wh*-element or an interrogative operator. However, these processing differences could also be explained by an expectation violation, since the *wh*-element is encountered in situ and therefore the comprehender could have just been expecting a declarative sentence. They could also be due to a difference in the meaning of the two sentences: a statement and a question have differences in numerous aspects of linguistic structure, including in pragmatics and in prosody. Other efforts in identifying processing traces of covert movement lie in the multiple *wh*-question domain, though results from Kotek and Hackl (2013a,b) are also confounded with other possible operations, including overt *wh*-movement.

ERP studies have also sought to identify processing traces of covert movement. Ueno and Kluender (2009) finds no P600 component for Japanese, which is a *wh*-in-situ language, contrasting findings of P600s for *wh*-movement in English. This evidence does not support the hypothesis that *wh*-movement, covert or overt, has the same processing trace. It only supports a syntactic operation for the overt *wh*-movement. Similarly, Lo and Brennan (2021) find no support through another syntactic ERP component–the sustained anterior negativity–for the covert movement associated with *wh*-in-situ; this effect is robust for overt *wh*-movement languages. In sum, there seems to be little processing evidence for covert movement in this domain, even though the covert movement analysis is generally standard in this framework. The evidence instead shows evidence only for overt movement. This is a separate domain from PP manipulation operations, but the takeaway is that these analyses generated testable hypotheses that can assess the development of the analysis.

Another large body of work assessing the presence or absence of null syntactic structure has emerged through the investigation of ellipsis phenomena; ellipsis is directly relevant to the idea of locative PP insertion, but this account is largely supported by processing traces, and Study 3 shows no neural signature of ellipsis in the processing of these sentences (see Martin, 2018). However, the PP insertion mechanism is not explicitly spelled out in terms of ellipsis, so future work could rigorously assess this by building off of the strong body of processing evidence and analyses for ellipsis (see Merchant, 2019; Frazier, 2019; Culicover and Jackendoff, 2019a, from a recent handbook on ellipsis).

The takeaway message from my discussion here is that our analyses should seek to describe our language data; the neurocognitive processing results here constitute direct language data. And these data show no difference in syntactic operations for the locative-biased and possessive-biased *have*-sentences. With the assumption that any syntactic repair mechanism such as PP insertion would show observable traces, the data fails to support an analysis in which the interpretations of a locative and possessive *have*-sentence differs crucially on their syntactic composition–this is the main idea of the transitive copula account. Alternative syntactic analyses that rely on syntactic operations that do not make predictions about neurocognitive processing could still accurately describe the differences between locative and possessive *have*-sentences. These analyses, however, cannot claim to shed light on the mental representation and execution of the sentences, until they have clear linking hypotheses and algorithms that generate processing predictions. Here, I rule out only one syntactic possibility resulting from the transitive copula account; future work must be done to assess the viability of other possible syntactic composition-based analyses of the meaning variability in *have*-sentences. I take up this topic again, at a different level of engagement, in §9.3.

8.4.3 A neural basis for locative *have*-sentences?

The remaining activations, though not directly predicted, further support the unified LCS account by offering a possible grounding of the cognition of relational location and locative *have*-sentences in the actual function of the brain. In this section, I will discuss the three remaining activated cortical regions as support for a neurocognitive embedding for understanding locative relations through the LCS of *have*.

Visuospatial representation is rooted in the precuneus

In the case of the target locative *have*-sentences, one of the main strategies that participants used to comprehend the sentences for the purposes of the comprehension question was by envisioning a visual scene with the four entities (e.g. *There is a pine tree under the motorcycle and the maple tree has a car.*), which is exemplified by the context elicitation results described in Chapter 2. Visuospatial imagery could be helpful in the absence of any causal relationships, which are the source of narrative construction, a fundamental component of linguistic communication. I take this operation to be the trigger for the preferential activation of the precuneus in the Locative > Possessive subtraction, as the precuneus is a well-established neural center for the processing of visuospatial information (Fletcher et al., 1995; Cavanna and Trimble, 2006). Moreover, within the domain of visuospatial cognition, the precuneus has also been implicated in the representation of oneself in space and the associated perspective-taking (Freton et al., 2014).

The precuneus has also been implicated in certain relevant linguistic functions as well: Shetreet et al. (2009) report recruitment of the precuneus for comprehending prepositional phrases. This result is entirely consistent with the precuneus underpinning visuospatial representation, since prepositional phrases by and large encode and support meanings of location.

Another possible neural source for location is also the superior portion of BA 6, referred to as the SMA above, which has been found to be preferentially activated by constructions involving spatiotemporal configurations over conceptually abstract (nonphysical) constructions (Romero Lauro et al., 2013). The SMA activations described previously could also in part be due to the locative nature of the target meanings, though further manipulation would be required to dissociate activations due to lexical composition or visuospatial representation in this region.

A neural signature of the representation of location could also be the source of the BA 8 activation as well, since BA 8 contains the fronto-eye fields, which support control of eye movements in terms of their physiological operations, such as fixation and saccadic motion, as well as connected cognitive processes, such as attentional orienting and visual awareness (Vernet et al., 2014). BA 8, however, has also been connected to uncertainty in a range of cognitive operations (Volz et al., 2005). Specifically, activity in BA 8 correlated with two types of uncertainty: external, which refers to uncertainty about the outside world or perceived stimuli (as in the case of an ambiguous visual image), and internal, which refers to one's own uncertainty about one's knowledge of a situation (as in rules of a game or social setting). In this study, both sorts of uncertainty could be at play, since the target *have*-sentences are inherently ambiguous (as per the unified LCS account) and participants could be uncertain about the acceptability of the locative readings, as they are indeed low frequency and dispreferred in English. In sum, the BA 8 activation could be underlying participants' hesitancy in accepting the target meaning, consistent with the Study 1a findings in which contextually facilitated locative *have*-sentences showed increased acceptability judgment ratings, but still not to a ceiling level.

Causal perception is rooted in the left inferior frontal gyrus

Another interesting result was the activation in the left inferior frontal gyrus (BA 47) for the possessive context-type over the locative, which connects to both the causal potential evaluation proposed in the unified LCS account as well as existing findings in the literature implicating this very cortical region in causal perception in neurotypical (Fugelsang and Dunbar, 2005; Kranjec et al., 2012; Wende et al., 2012) and clinical (Wende et al., 2015) human populations, as well as across a variety of primate species (Khemlani et al., 2014). van Dam and Desai (2016), specifically, found that sentences expressing caused motion activated BA 47 preferentially over sentences that did not. This body of work, as well as the findings presented here, do not clearly distinguish between the possibility that this region underlies the causal evaluation mechanism or the representation of causality, though in both cases, the operationalizations are consistent with the activation of this region for the possessive context over the locative. While the causal evaluation mechanism is hypothesized to be at play in the comprehension of all *have*-sentences, it could be the case that the non-causally facilitatory context succeeds in rendering less salient the causal adjunct of *have*'s meaning, leading to a decreased effort to identify causality. Consequently, this causal evaluation mechanism would be activated to a greater degree for the possessive context. The activation could also be directly reflecting the causal representation in the possessive context itself. These results provide potential evidence for the neurocognitive grounding of a variety of relational meanings, specifically distinguished by the degree of causality as proposed by the unified LCS account, though further exploration is required to validate the role of the left inferior frontal cortex, and BA 47 in particular, and the evaluation or representation of causality.

Overall, the cortical areas activated in response to the *have*-sentences support locative *have*-sentences as being a standard case of lexico-conceptual semantic composition that also relies on some degree of contextual support, and not a result of a marked syntactic repair mechanism. Additional cortical areas offer a preliminary network for the comprehension of *have*-sentences that is centered around visuospatial/locative representation and causal perception. Together, these patterns of activation are entirely consistent with the unified LCS analysis of English *have*.

8.4.4 Constrained individual-level variability in the neurocognitive bases for language

The neuroimaging results also show patterns of individual-level variability that are interpretable in the context of the suite of studies in this dissertation as well as the broader linguistic context-sensitivity literature. These results serve as an exploration into the potential nuances of what different participants are doing in the face of these sentences. I will evaluate the results following the interactions of a few parameters of variability: the directionality of the correlation (positive or negative, indicating that, for example, more context-sensitive comprehenders show greater or lesser activation), the brain area itself, and the presence or absence of variability in a given region (variability observed or not, indicating that, for example, a certain brain area indexing a cognitive operation is not observed to be variable across participants, while others may be).

I first note that the three components for evaluating a correlation (effect size, effect significance, and effect meaningfulness) can vary independently from another (Hemphill, 2003)–one well-cited example is the correlation of r = .03 between taking aspirin and preventing heart attack, which, though small, bears outsized meaning for society at large–that is to say, effects must be evaluated in context. To do so, I offer two points of consideration.

The first is to recognize the inherent limitations set by the available experimental tools. Though it seems clear that AQ-based tools are targeting one or more aspects of the cognitive system, it has yet to be shown conclusively what domain of the cognitive system these dimensions lie in. One possibility is that linguistic context-sensitivity, as indexed by the total AQ or even by the ACD measure used here, is rooted in working memory, as working memory has been shown to correlate positively with selective attention and inhibition of distracting information (Engle, 2002; Lavie et al., 2004). Yu et al. (2011) tested both working memory and AQ in a parallel task to that reported in Yu (2010) and found that higher working memory correlated with lower AQ. This finding suggests that a component of context-sensitivity is the ability to store more contextual information for processing at a given time. Another possibility is that the AQ indexes a multitude of cognitive factors, some of which are more related to context-sensitivity than others. Mathmematical evidence for this lies in the AQ's well-reported subscale collinearity and factor cross-loading, as described in Chapter 4, a finding complicated even further by English et al. (2020), who describe over 20 different AQ-trait constellations that result in the same total AQ score, since different configurations of subscale scores can add up to the same total. While these limitations are somewhat superseded by the statistically supported AQ-based tools described in Piñango et al. (in prep) and in Chapter 4, the connection between the cognitive operations underlying the ACD measures and the task-evoked preferential activations of certain cortical regions is yet to be fully instantiated.

The second is that the larger goal for this body of work is to identify possible sources of the variability that has been observed in linguistic behavior in order to nuance our understanding of the language faculty in context. Incorporating factors that can explain systematic differences in linguistic behavior between individuals strengthens existing work on the systematic commonalities in linguistic behavior. The studies presented here are but one instance of the broader effort to incorporate variability as an intrinsic part of the system, rather than exclude it conceptually or mathematically as "noise." Accordingly, we do not expect any single measure to capture all the variability in such a complex system, which is known to be rooted in a multitude of neural, cognitive, social, and other factors. Moreover, correlation effects interpreted as meaningful can be variable across paradigms, questions, and domains (Bosco et al., 2015), in contrast with the widely used benchmarks from Cohen (1988). I take these findings to be indicative of a direct connection between factors already hypothesized to be related, that contribute to an individual's cognitive style and their linguistic behavior—specifically, the way they identify information in the communicative context to satisfy the requirements of a linguistic expression in that context.

I take these results to be both meaningful and interpretable, despite a lack of statistical significance, on the grounds that they resemble, along multiple quantitative dimensions, previous findings using the same tools, stimuli, and participant populations. That is, the ACD measure reliably results in a correlation of around .2 in tasks involving comprehending a target sentence after a supporting versus neutral context. I attribute the lack of statistical significance to a lack of statistical power for the sample of 29 participants. A power analysis reveals that for an effect size of r=.2 at an α-level of .05 and a statistical power of .8, a sample of 194 participants would be required, while an effect size of r = .4 at the same thresholds would require 46 participants, which are numbers in line with both the Study 1a findings as well as the findings from Piñango et al. (in prep) described in Chapter 4. A sample of 194 is clearly not feasible nor required for the principal purpose of this fMRI study, suggesting that quantitative limitations on statistical significance testing should be evaluated independently of the correlation patterns observed. These findings, therefore, represent not only support for the existing work on the ACD measure and other AQ-based tools for quantifying variability in adult populations but also the beginnings of a neurocognitively grounded framework for language-specific dimensions of variability. Future work must continue refining both the methodological instruments and conceptual models in order to precisify our understanding of the relationship between variability in domain-general cognitive factors and variability in how individuals use language.

Variability in the right angular gyrus as variability in LCS compositio effort

The first pattern of variability within the activation patterns concerns the bilateral angular gyri; as described above, the left angular gyrus (AG) is taken to underlie the standard lexico-conceptual semantic compositional processing that takes place during language comprehension, while the right AG is taken to represent its hemispherically homologous processing support. Within these related cortical regions, the hemodynamic activity in the left AG did not correlate with the ACD measure of individual-level variability ($r(27)=.04$) while the activity in the right AG correlated with the ACD measure to a moderate degree ($r(27)=.23$). These correlations are presented in the top and bottom panels of Figure 8.2, respectively.

The positive correlation for the right AG indicates that individuals with lower ACD scores (and are therefore considered to be more context-sensitive) showed a lesser degree of recruitment, while less context-sensitive comprehenders recruited this processing support region to a greater degree. The pattern is particularly noteworthy because of the distribution of variability: crucially, within the core language network, the left AG, as the neurocognitive center of the LCS composition operation, does not show systematic variability across individual comprehenders, while the additional processing resource regions in the right AG do show systematic variability along the measure in question. The key takeaway is that individual comprehenders do not vary in the degree to which they are performing LCS composition, but rather in the

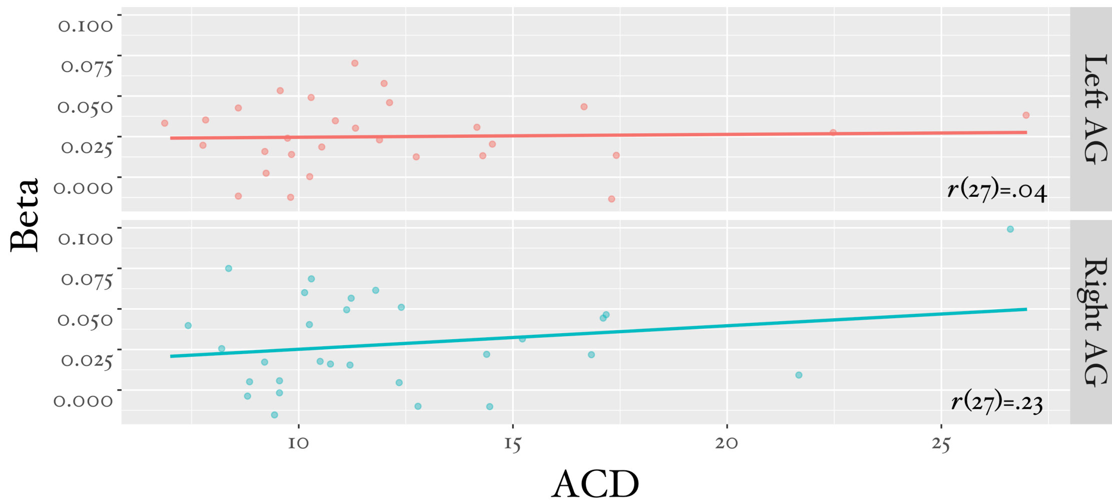


Figure 8.2: Bilateral angular gyrus activation by ACD score

degree to which they require additional support for that composition. Individuals who show a lower degree of linguistic context-sensitivity, specifically operationalized with the ACD measure as an awareness of communicative dynamics, require additional support to perform the otherwise universally invariant LCS composition.

Variability in ventrolateral prefrontal and anterior cingulate cortices as variability in contextualization effort

The second pattern of variability offers a complementary finding regarding the role of variability in linguistic context-sensitivity. Here, the correlations are localized to the ventrolateral prefrontal and anterior cingulate cortices, which are, as described above, taken to underlie effortful contextualization of a target, which is attenuated with the presence of a relevant, facilitatory context. The ACD measure correlated negatively with the activity in both the ACC ($r(27)$=-.14) as well as BA 47 ($r(27)$=-.15), respectively, as shown in Figure 8.3; combining these data yielded a correlation of ($r(56)$=-.14), suggesting that the variability captured by the ACD was the same for both cortical regions.

The negative correlations here indicate that individuals with higher ACD scores (which

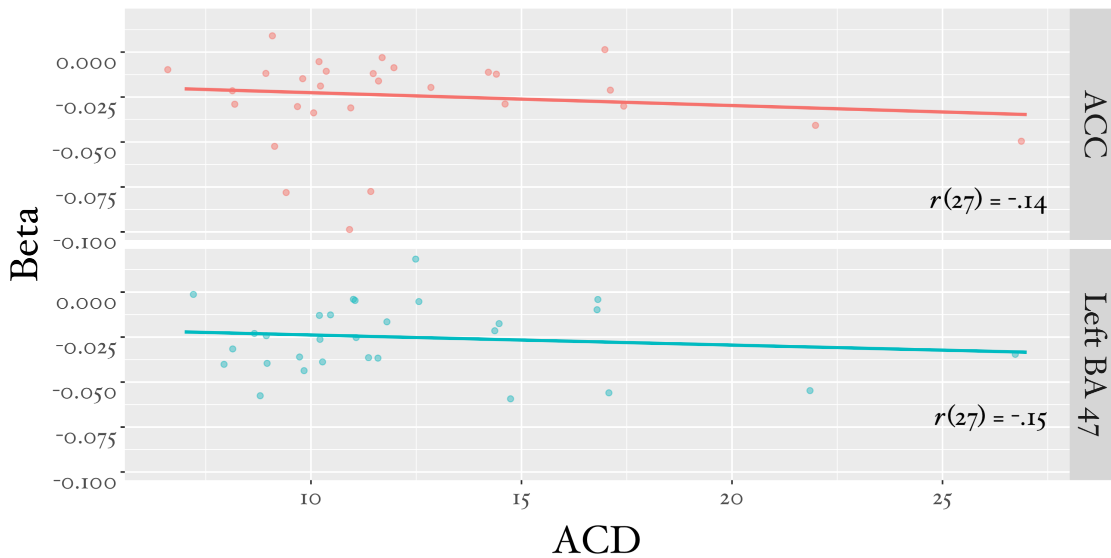


Figure 8.3: Ventrolateral prefrontal and anterior cingulate cortex activation by ACD score

connect to a lower degree of context-sensitivity) showed a lower degree of recruitment of these areas, while more context-sensitive comprehenders recruited this contextualization region to a greater degree. A greater activation in BA 47 for the most context-sensitive comprehenders is consistent with BA 47 underlying the effort to identify or generate a licensing context in the face of a contextual demand. Furthermore, a greater activation in the ACC for the same comprehenders bolsters this interpretation, as this region is associated with mismatch detection, suggesting that only the comprehenders that were better able to support the locative meaning of the target were recognizing the conflicting conjunction of the context and target sentences.

Variability is intrinsic to, yet circumscribed within, the neurocognitive system underlying language

How do these patterns of variability shed light on the nature of context-sensitivity? What can be said about how individual comprehenders are understanding these sentences? The general pattern emerging from the neuroimaging results suggest that individuals with lower context-sensitivity are showing more compositional effort and less contextualization effort, while individuals with higher context-sensitivity are showing the opposite pattern: less compositional effort and more contextualization effort. This manifests as some speakers relying more on the entire encoded LCS and its inherent properties (i.e., a strong bias toward a more informative (maximally causal/possessive) reading from its entire LCS) versus some speakers relying more on relevant contextual features (i.e., a flexibility in modulating the salience of the causal adjunct). This dichotomy aligns with known findings about individual preferences for more rule-based or context-dependent cognitive processing, particularly when comparing individuals with autism spectrum condition and neurotypical peers (Wing, 1988; Plaisted, 2001; Russo et al., 2007, a.o.).[5] The pattern also connects directly to the anticorrelation of the N400 and late-positivity ERP components discussed in Chapter 7. The constrained pattern of variability in composition versus contextualization bolsters the cognitive grounding of linguistic context-sensitivity by showing its instantiation beyond linguistic behavior into the actual function of the brain.

This tradeoff in attentional burden connects with the larger linguistic idea of the inversely related context-dependence and conventionalization, whereby certain composite linguistic constructions can be lexicalized to a degree where a relevant context is no longer necessary, as is the case for systematic metonymy (e.g. *The students read Shakespeare in 7th grade*, in which *Shakespeare* refers to the written works of William Shakespeare and not the person himself), in contrast to circumstantial metonymy (e.g. *The ham sandwich wants another cup of coffee*, in a restaurant, in which the *ham sandwich* refers to the orderer of a ham sandwich and not the food item itself).[6] Here, I connect the context-dependence versus conventionalization dichotomy as a property of linguistic constructions to a possible parameter in individual speaker preferences, in which speakers may choose to use or be better at using linguistic construction variants

[5]The operationalization of this behavior as a preference connects to the well-discussed chicken-and-egg issue of whether preferences arise from ability or vice versa.

[6]This example has been conventionalized to some degree in the metonymic literature itself, and can be contrasted to less conventionalized metonymic constructions such as *The red Adidas wants to pay in cash*, at a shoe store, or *That pomegranate kombucha has a sick jacket*, at a hip cafe in Brooklyn.

that are more or less context-dependent.[7] This preference could be one possible driving force in the lexicalization or conventionalization of such constructions.

In sum, the contribution of this line of evidence is that individual-level variability in cognitive predispositions is inherently connected to both linguistic behavior as well as neurocognitive function, strengthening the legitimacy of variability as an intrinsic part of the language system, and in turn, strengthening the grounding of language as a human behavior and therefore language as a biological capacity at its core. Understanding the role of variability in the language system for both linguistic structures and language users can not only inform more comprehensive and cognitively grounded models of linguistic theory, but can also offer insights into the mechanisms for the actuation and propagation of variation and change.

8.5 Conclusion

The key findings from the fMRI study detailed here have clear implications for the two accounts of English *have*-sentences: the patterns of cortical recruitment indicate that the comprehension of a *have*-sentence is a standard process of lexico-conceptual semantic composition associated with the lexical item *have* and of contextualization of the conceptual features of the entities in the *have*-sentence required for the causal perception evaluation–patterns that support the unified LCS account. Moreover, additional cortical areas suggest that understanding *have*-sentences is a process grounded in visuospatial locative representation as well as causal

[7] One possibility for further specifying the role of variability in a broader model of change is by understanding the reliance or preference for maximizing the entire LCS structure as a specific prior probability of activation, and the available context as the likelihood of activation. In this formalization, the inter-comprehender variability lies within the domain of the priors, with the more LCS-dependent (less context-sensitive) comprehenders showing a higher prior for the maximality lexical structure itself in the GCI space and the more context-sensitive comprehenders showing a lower prior for the maximality of the unified LCS. The likelihood is taken to be constant in this schematization, though it may certainly be the case that an interaction between these would be observed in more specified modeling. Moreover, I take it to be the case that the unified LCS is part of all individuals' representation of *have*, though it may be that this representation is also variable across speakers. Further understanding the respective roles of variability in the priors, the likelihoods, or both, represent a fruitful area of research that would not only connect this cognitively driven model with computational approaches, but also enable more precise characterizations of the scopes of different dimensions of variability.

perception, aligning with the two key semantic components of the lexical meaning of *have*: a core locative relation as well as a causal potential evaluation operation. In contrast, the absence of neural indices of syntactic composition, syntactic processing, or ungrammaticality aligns with the ERP findings in failing to support the processing predictions extrapolated from the transitive copula account for locative *have*-sentences.

In terms of individual-level variability in linguistic context-sensitivity, neural activations reveal a functional tradeoff between individuals who, in the face of semantic ambiguity, lean into the properties of the lexical meaning or into the properties of the context. This tradeoff in neurocognitive effort substantiates the construct of linguistic context-sensitivity as a relevant parameter of variability in language use.

Overall, the event-related imaging study presented here not only advances the unified LCS account for the behavior of locative *have*-sentences in English, but deepens the neurocognitive embedding of the proposed model of meaning variation.

Part III

Altogether

Chapter 9

Conceptual and cognitive foundations of linguistic meaning variation

Contents

9.1 A neurocognitive model of variation through the window of English *have*

In this dissertation, I have sought to construct a model of meaning variation built upon variability in linguistic structure, conceptual structure, and cognitive makeup, and in doing so, exemplify an approach to studying meaning that is both linguistically principled and psychologically grounded. As my window into the internal structure of the mind, I make use of the English lexical item *have* by proposing a novel analysis of its meaning based on its well-described variability in English and its embedding into crosslinguistically consistent patterns of variation and change. I support this analysis by investigating its real-time comprehension patterns through behavioral, electropsychophysiological, and hemodynamic brain data, thereby incorporating dimensions of domain-general cognitive variability as crucial determinants of linguistic variability. Here, I review the entire narrative and the components of the analysis, model, and evidence. This summary serves as a recapitulation and extension on the points made in §5.2, in light of the whole project. I follow the narrative with a brief discussion on what I hope are the principal contributions and takeaways as well as implications for the continued study of linguistic meaning. Finally, I conclude the dissertation by highlighting potential avenues for growing a model of meaning change out of this model of meaning variation.

The dissertation begins with a description of the meaning variability observed in English *have*-sentences; in **Chapter 2**, I focus on the relational meanings and propose that the lexical item *have* encodes a generalized lexico-conceptual semantic structure that can give rise to the entire set of relational meanings, from incidental location to inalienable possession. This unified LCS account of *have* states that the meaning of *have* is a locative relation at its core with a variable relation that is determined on the basis of the causal potential that one entity in a *have*-sentence has over another. Varying the degree of causal potential gives rise to the range of relational meanings: a low degree of causality perceived will result in a more locative relation, while a high degree of causality perceived will result in a more possessive relation. Crucially, the causal potential evaluation can be supported by conceptual features of the entities, explicit markers for sub-regions of the range of relational meanings, or even contextual features of the communicative situations. The unified LCS account for the meaning of *have* is presented in opposition to the "transitive copula" account, which takes *have* to be a semantically null identity function. In this account, the semantic variability of *have*-sentences are taken to arise from a limitless set of syntactic heads inserted into the DP of the second entity of *have*. The competing accounts generate different predictions for the case of bare locative *have*-sentences: the unified LCS account predict that these sentences, though informationally dispreferred, are acceptable with supporting context, while the transitive copula account predicts that they are categorically ungrammatical. Acceptability ratings in **Study 1a** are consistent with only the unified LCS account.

I relate the meaning variability of relational meanings to a broader set of crosslinguistic patterns of variation and change in **Chapter 3**, and show that these meanings, differentiated for *have* by degree of causality, can be parameterized using two conceptual dimensions of causality, leading to a structured explanation for why these meanings are lexicalized across the world's languages in systematic ways and for how relational markers show constrained, unidirectional pathways of change over time. Crucially, the LCS of *have* is proposed to lexicalize over the entire gradient conceptual infrastructure, leading to the wide range of relational meanings encodable by *have*-sentences.

I introduce the final ingredient for the model of meaning variation, linguistic context-sensitivity, a cognitive dimension of individual-level variability, in **Chapter 4**. To implement it experimentally, I first describe the cognitive bases for this parameter as well as a recently developed tool to index it, which I employ in **Study 1b**. These results show that individuals vary systematically in the degree to which they show the contextual-facilitation effect in Study 1a; individuals who have a higher degree of context-sensitivity showed greater acceptance of an ambiguous target after a facilitatory context over a parallel non-facilitatory one, while individuals with a lower degree of context-sensitivity did not show a difference between contexts on ratings for the target. This pattern of variability suggests that linguistic context-sensitivity is an integral component for a model of meaning variation, as variability across individual speakers and comprehenders can result in divergent linguistic choices and uses of variants.

In **Chapter 5**, I spell out the interaction of the three ingredients for a model of meaning variation, and describe the compositional story for how *have*-sentences are understood in real-time. The unified LCS account directly predicts that locative *have*-sentences, and all *have*-sentences, for that matter, are comprehended through a sequential process of LCS composition, through the retrieval of *have*, and a contextualization operation that evaluates the causal potential of the entities based on their conceptual features as well as features from the communicative context. In this view, locative *have*-sentences are entirely standard processing that result simply from a low degree of causal potential between the two entities. On the other hand, my extension of the transitive copula account into a processing operationalization predicts that locative *have*-sentences are possible (in light of Study 1a) only through the detection of an error and a resulting syntactic-repair operation. These predictions set the stage for two real-time processing studies in **Chapters 6 and 7** and a neuroimaging study in **Chapter 8**.

Self-paced reading results (**Study 2**) reveal processing cost at the noun-complement of *have*, supporting the unified LCS account by showing that the comprehension of *have*-sentences is a straightforward process of contextualization in which the critical disambiguation work happens upon comprehension of the noun-complement. Electropsychophysiological results (**Study 3**) show that this processing cost evokes a late-positivity ERP component, an index of semantic contextualization effort. Crucially, a P600 component, an index of syntactic repair, is not observed. Moreover, the individuals with lower context-sensitivity measures showed a highlight attenuated late-positivity component (and a strengthened N400), which could be the neurocognitive basis for the lack of contextual facilitation found in Study 1a, further establishing the inseparable nature of cognitive variability from real-time meaning comprehension.

Finally, brain activation data from fMRI (**Study 4**) reveal a network of cortical regions associated with conceptual composition and contextualization that underlies the comprehension of *have*-sentences, consistent with the unified LCS account; crucially, no cortical areas involving syntactic composition or repair were preferentially recruited, consistent with the real-time processing evidence, further failing to support the transitive copula account. In addition, cortical regions associated with visuospatial/locative representation as well as causal perception were activated for the locative context-type, further grounding the unified LCS account of *have* into actual brain function. The divergent neurological signatures of LCS composition and contextualization, in parallel with the N400-late-positivity correspondence, also substantiate a linguistic divide between individuals along the dimension of context-sensitivity in terms of a reliance or preference in communication on the structure of the lexical item in isolation or on the lexical-semantic structure as interpreted within the features of communicative context.

Altogether, the four studies provide multimodal support for the unified LCS account, its processing predictions for English *have*-sentences, and the broader model of meaning variation. They show that meaning variation is an emergent phenomenon arising from the interaction, in real-time, of linguistic, conceptual, and (neuro-)cognitive variability.

9.2 Principal contributions and takeaways

While the content of this dissertation touches upon a variety of topics in linguistics and cognitive science, I describe here five main ideas of consequence for future work.

The first is regarding **the semantic content and richness of *have***. One emergent parameter in the literature on *have* is whether *have* has any semantic content of its own accord; the unified LCS account and its predecessors ascribe various degrees of lexical meaning to *have*, while the transitive copula family of accounts are identified by their semantic vacuity for *have*. While my proposal is not the first to ascribe a rich semantics for *have*, and not even the first to analyze possession as controlled or caused location (Evans, 1995), it is the first to use the tools of conceptual semantics (Jackendoff, 2019) and two-level semantics (Lang and Maienborn, 2019) to propose a comprehensive lexical analysis that not only accounts for the semantic variables in terms of entities and relations, but also provides an articulated connection of conceptual factors and contextual features to the lexical meaning itself.

Moreover, the unified LCS account provides **a specified conceptual structure that grounds the range of lexical meanings**. Specifically, the gradient conceptual infrastructure provides a conceptually principled system for organizing the set of relational meanings. By distilling causality into conceptual dimensions that are rooted in two of the most primary core cognition operations (that of causal perception and object individuation), the infrastructure not only provides the framework for characterizing the observed crosslinguistic patterns of lexicalization and change, but also provides a more systematic tool for describing the various relational meanings. This conceptually principled systematicity lies in direct contrast with more intuitionally generated and researcher-specific groupings, such as stereotypical versus non-stereotypical (Karvovskaya, 2018) or intrinsic versus extrinsic (Storto, 2005) which are not formally defined and do not provide sufficient resolution for describing specific relational meanings, or ad-hoc individuation (Myler, 2016), in which specific meanings are limitlessly enumerated through listed functional heads or related lexical entries. These characterizations of relational meanings are not inherently flawed as they serve different types of inquiry, such as variation description, but crucially, do not shed light on the source, structure, breadth, or limits of such variation.

Combining these two advantages, the unified LCS account provides an articulated channel for **context-dependence in the lexical meaning**. Within the model-theoretic tradition, the most relevant account of possessive meanings (Karvovskaya, 2018) accounts for context-dependence, but is not able to specify the precise role that context plays in determining a single relational meaning from the set. The analysis for *have* presented here allows for nuanced, conceptual and contextual features to contribute to the determination of the relational meaning through the causal potential evaluation operation, even though the featural combinations may not as of yet be quantifiable. For example, the two sentences in (79) may be classified as the same relation, depending on the analytical tradition of choice, but clearly have some difference in meaning.

(79) a. I have a child who's three years old.
b. I have a child who's thirty years old.

They are both inalienable relational meanings, both kinship relations, both relational nouns (i.e., no π-type-shifting required, à la Barker 1991), as well as syntactically, argument-structurally, type-theoretically, and even conceptual-primitively identical. The crucial difference lies in the degree of causal potential perceived between the two entities. Here, the causal potential relational is more asymmetric in the case of the three year-old than in the case of the thirty year-old. Additionally, different degrees of causal potential are possible depending on the antecedent of the subject; this could vary depending on the speaker and comprehenders' conception of parental roles or knowledge of the specific referents of the pronoun. The gradient conceptual infrastructure allows for a continuous degree of relational meaning variation, over which languages can individuate using their specific lexicalization inventories, as manifested through the meaning of the lexical item. Again, the output of the causal evaluation operation has direct linguistic consequences because it is the crucial determinant for the relational meaning interpreted as well as the language-specific lexical strategy chosen to express the relation.

Furthermore, the context-dependence in the lexical meaning allows for **a contextualization versus conventionalization tradeoff**, as both the electrophysiological and brain activation data revealed a neural distinction between a reliance on lexical meaning structure or contextual features in the face of an ambiguous target during comprehension. In English, there is a clear lexical preference for a possessive interpretation of a *have*-sentence, given the maximal informativity of the LCS (see Chapter 2). Formally, this preference could be situated on a Horn scale or connected to the Maximize Presupposition norm (Heim, 1991), though the details of such a formalization would require further specification. However, the range of relational meanings is still available, with the locative reading requiring additional support through either explicit marking, as in a locative PP, relevant linguistic context, as in Study 1a, or other contextual features. For example, contextual features given in a visual context paired with relatable museum personal experience fully supports the locative relation in Figure 9.1.

"I like this painting because it has a bench."

Figure 9.1: A bare locative *have*-sentence in the wild
Note: Cartoon by Amy Hwang published in the New Yorker magazine, April 2019.

In this cartoon, the visual context and relatable personal experience from fatigued museum-going provide the justification for a low degree of causality between the two entities in the *have*-sentence, leading to a perfectly acceptable PP-less locative *have*-sentence. Providing an explicit locative marker (e.g. *I like this painting because it has a bench in front of it.*) or a relevant linguistic context (e.g. *There's a chair in front of this sculpture but this painting has bench that seats two.*) are also effective ways to disambiguate the intended locative relation. From the perspective of the unified LCS account, the incorporation of a space for contextual and conceptual features into the lexical semantics of *have* enable to it to capture cases such as this one in a straightforward, comprehensive, and principled way.

Finally, the unified LCS account is grounded in **multimodal neuropsychological reality**. The real-time composition and contextualization operations elucidated from Studies 2-4 follow from the analysis' semantic structure. Importantly, the process of comprehending a *have*-sentence, as predicted by the unified LCS account, is not one based on errors, repairs, and reconciliation, but constitutes a beautifully flexible, adaptable strategy for capturing a wide range of relational meanings through a powerful but simple lexical meaning. The neuropsychological reality of inherently connects the unified LCS account, again, to the role of individual-level variability, which is independently the topic of an entire branch of psychology. This constrained variability, that is, variability that is circumscribed to relevant dimensions, emerging from the cognitive system gives rise to the psychological real communication styles shown in the data from Studies 1b, 3, and 4. While accounting for these additional factors at fundamental level complicates the linguistic system, these extra parameters are justified by the systematic nuance they contribute to our understanding of how individuals' linguistic behaviors precipitate patterns of variation and change. This variability has been widely adopted in a number of linguistic subdisciplines, and in fact forms the basis for a number of them, but has yet to be incorporated into the most dominant theories of linguistic meaning. The work here serves as one first step toward doing so.

9.3 Implications for the study of meaning

In this section, I discuss four main implications for the incorporation of context-dependent conceptual structure, neuropsychological reality, and variability into the study of linguistic meaning.

Methodological convergence (and divergence) of linguistic tools

The communication of meaning through language is the most fascinating of all psychological operations, in my opinion, though this perspective is not mine alone, as a vast array of investigative approaches have been deployed by an army of semanticists of all flavors to understand it. Their tools vary widely not only in their mechanics, but also in their goals and scopes. In this dissertation, I have sought to align complementary approaches in my analysis of *have*, bringing in model-theoretic, conceptual, and two-level semantics to provide an articulated description *have*'s compositionality and lexical meaning.[1] I ground this description into an organized conceptual space to enumerate the boundaries of the observed semantic variability as well as provide it internal structure. Moreover, this analysis generates testable hypotheses for processing, that I then assess through a suite of complementary techniques that shed light on the timing, nature, and operationalization of the linguistic analysis, and ground it in the function of the neurocognitive system.

The large literature on *have* in English, relational markers across the world's languages, and the linguistic structure of location and possession meanings more broadly have contributed a wealth of insight into the behavior of these linguistic devices, as described in Chapter 2. They largely make the right insights in terms of observations about the data, but often are limited by their analytic tools. Take for example, Karvovskaya (2018), who implements a context-

[1] A special tip of the hat is due to the two-level semantics framework, which allows for the beginnings of integration of the lexicality and compositionality of the two other approaches. While I expect that as our ability to quantize and understand the substance of conceptual and linguistic meaning develops, we may no longer need such an intermediary framework, though this of course remains to be seen.

dependent semantics for deriving an ambiguous relational meaning, but only goes as far as classifying those meanings as stereotypical or non-stereotypical. In this way, the proposal is limited in its scope (and potentially in its goal), as model-theoretic semantics is not particularly well-suited for characterizing the content of lexical meanings or a gradient conceptual dimension such as degree of causal potential. Paired with a conceptual semantics analysis for lexical meaning and a cognitively grounded conceptual infrastructure, however, it can describe the linguistic phenomenon in a more complete way. In the syntactic approaches toward deriving *have*-sentences as transitive copular constructions, there is not a clearly sanctioned mechanism for introducing and precisely incorporating context-dependence, which prevents the synergy of (a) a highly articulated account of the variability of *have*-sentences in English and *have*-like sentences crosslinguistically and (b) a conceptually principled infrastructure for constraining the possible meanings to begin with.

Methodologically speaking, it is of utmost importance to understand both the power and the limitations of each tool. I exemplify this point with a brief discussion on the way the two accounts, the syntactic-composition-based transitive copula and the semantic-composition-based unified LCS, have been positioned relative to one another. An ecologically appropriate theory of language requires both accurate description of the syntactic structures observed in a language as well as cognitively grounded mechanisms for generating those syntactic structures, among other components.

Structural description and processing are not by any means mutually exclusive, and in fact, should be maximally convergent for a thorough characterization of the language faculty.[2] Traditional approaches toward describing syntactic and semantic structure do not inherently make claims about their cognitive and real-time generation; instead, these approaches rely on com-

[2]See recent discussion on the false divide between representation/theory and processing/experimentation Pablos et al. (2018); Phillips (2021), for a thorough argument for why these are one in the same and cannot exist independently, if the goal is to understand and explain human language. A particular point is made to denounce the claim that processing approaches are devoid of theory, which is a potential sociohistorical consequence of the field's development.

binatorial principles that emerge from logical, algorithmic, and even intuitive sources that are not constrained by the mechanisms of the cognitive system. The connection to the actual substance of language production and comprehension, the utterances, is left to un- or underdeveloped linearization functions and PF spellout algorithms.

One argument for not accounting for these other aspects of language is that of scope: the enterprise is to develop a mathematical system for predicting all and only the grammatical sentences of a language.[3,4,5]

I take issue with this argument for a few reasons. The first is while the scopal limitation means that these analyses do not address the substance of linguistic meaning, only the syntactic structures that may support the meanings, the claims regarding the lack of semantic content of *have* are strong. The second is that the role of context must be clearly operationalized; a proposal for the meaning of *have*-sentences, which have been shown to be affected by context, is not complete without a clear mechanism for context-dependence. How does con-

[3] In this section, the use of the term "syntax" is largely referring to the Minimalist framework of linguistic syntax, and perhaps should be characterized as "capital-S" Syntax–the enterprise of the subdiscipline of syntax. For sociohistorical reasons, this Syntax is often conflated with syntax, referring to the rules that govern the order of constituents in language and the body of phenomena relating to word order. This latter syntax is not a matter of belief or choice–it is a documented set of linguistic phenomena and the properties thereof; the (former) Syntactic enterprise that dominates the study of syntax is, however, but one of several ways to investigate it.

[4] In this sense, a formal account of language can never reach explanatory adequacy because it does not seek to nor have the ability to explain how the language system works; it can only accurately describe and predict the outputs of that faculty. Without processing evidence, no amount of formalism can synthesize a model of the human language faculty. One parallel from this is in the natural sciences: while mathematical formulas can describe and predict the behaviors and interactions of atoms, it is not a question of whether or not atoms "know" the formulas. The same can be said about the mind and brain regarding language; no matter how comprehensive a formal theory of language is, it cannot be said, without the right kind evidence, that the human implementors of language must "know" this formal theory. The indisputably best approach is a partnership and synergy of a multitude of tools, formal description and real-time processing being two of them, in which findings from each tool are able to constrain the parameter space and interpretations of others'.

[5] One consequence of this scopal overreach is the use of terms like "repair," which is a theory-internal characterization that arises from the limitations of the algorithm, and not of the behavior itself. A truly descriptive account of a linguistic phenomenon as a human phenomenon would require a specific set of neurocognitively grounded evidence to consider a given operation to be one of "repair" status. Importing "repair" into the cognitive domain from a theory-internal source can mislead inquiry into the actual ontological status of a psychological operation, as described previously in a "repair" versus "contextualized" operation for the comprehension of locative *have*-sentences. These two approaches lead to different conceptualizations of the language system as either fixing something or making the most of the incoming information. This serves as another example of the idea that theoretical limitations do not constitute evidence for cognitive impossibility.

text interact with the linguistic structure; what are the places where it can have an affect and what are the places it cannot? What is the substance of context itself? The admission of some role of context and the limitation of the system to account for it are not valid justifications to support the claim.

The principal limitation of the frameworks in which the transitive copula account are developed is that they are not falsifiable by processing data, because they do not make predictions about how an analysis is borne out in real-time language processing. As discussed in §8.4.2, the findings in Study 3 and 4 only discount one possible syntactic instantiation of the transitive copula account–the locative PP insertion repair–but there are other possible real-time processing instantiations. I do not recount them here, but escalate the issue to a larger parameter in linguistic analysis: whether the baseline of parsimony is a minimal syntactic structure or no linguistic meaning without the support of overt or covert syntactic structure. In other words, this is the difference between no syntax or null syntax to support linguistic semantic or meaning composition. The former perspective is embodied in the Simpler Syntax Hypothesis (Culicover and Jackendoff, 2019b), which states that "syntactic structure is only as complex as it needs to be in order to establish the relationship between phonological structure and semantic interpretation." Consequently, there cannot be null syntax that is not directly borne out through processing evidence. Meaning composition has its own structure and combinatorial principles that need not be underlain by syntactic structure. This approach represents a maximally minimal syntax. On the other hand, the latter approach takes the view that syntax is the principal (or even only) system with its own structure; meaning is an amorphous conceptual substance carved into linguistic structure by syntax. This view results in the positing of null syntactic structures that are claimed to support known semantic composition processes. In theory, there are not necessarily advantages to one or the other; the important consequence is that the connection between null syntax and real-time linguistic processing is not enumerated.

Null syntax is one way of characterizing language data, within the rules of the syntactic framework, but not necessarily within the cognitive embedding of the language system.[6] While there is no *a priori* reason not to posit invisible structure, the burden of its justification should be very high and supported by evidence from the way humans implement such structure, as in the well-studied case of filler-gap dependencies. If a proposal for covert syntax has no basis in or even predictions for processing, it cannot be tested.

And therein lies the problem: null structure is often invoked to solve a formal problem, but it is much less often connected to psychological reality. The consequences thereof are enormous: the endeavor of science, as a way of discovery, is predicated fundamentally upon falsifiability of testable hypotheses. Without grounding in the neurocognitive system from which human language emerges, the disciplinary status of linguistics as a proper science is at stake.

Identifying and acquiring enough of the right data

Accordingly, the acquisition of the right data is of utmost importance for the scientific inquiry of language: the right human data is obligatory to make appropriate characterizations of a human phenomenon. One clear example of this is the basis for the transitive copula accounts in Harley and Jung (2015) and Myler (2016), as the two most recent representatives of this family of proposals. The entire analysis rests upon the categorical ungrammaticality of sentences like (80).

(80) The maple tree has a car that is red.

These sentences without context have already been reported to have varying degrees of acceptability by native speakers (Belvin and Den Dikken, 1997), which are corroborated by the Study 1a and 1b results presented in this dissertation. These results show that at least a

[6]This again is a manifestation of the status of the language system as a mathematical system capturing the outputs of a black-boxed human behavior, or as the psychological system underlying human communication. Such a divide between language is encapsulated by the ideas of "humans implement language decently but imperfectly" versus "the only language there is is what humans produce."

subset of the native speaker community finds these sentences, especially with context as in (81), acceptable and crucially, not ungrammatical.

(81) There is a silver motorcycle under the pine tree and the maple tree has a car that is red.

What if these proposals had considered the data from these results? The absence of the ungrammaticality marker bears enormous consequence on the existence of an entire family of proposals within the transitive copula approach. Methodologically speaking, this raises a few questions regarding the sentences that launch a family of analyses. Who gets to assert the grammaticality of a sentence? How do we decide the validity of this assertion? Is the nature of grammaticality binary (i.e., ±*)?

In light of these questions, I again emphasize the importance of goal-directed, domain-specified research in context. If the goal is to characterize linguistic meaning in the human language system, then a different kind of data is needed than if the goal is to mathematically complete a formal derivation. In this perspective, the inability of a given tool to account for a phenomenon does not necessarily constitute evidence about the nature of human language. Again, if linguistics is to be approached scientifically, the rigorous testing of processing implications of analyses should feed back into the formulation of those analyses. This iterative process is the lifeblood of the scientific enterprise.

How does this translate into future research? It does not necessarily entail that multimodal neuroimaging investigations or triple-digit study samples are mandatory, by any means. What it does mean is that a deep understanding of the source and nature of any grammaticality judgment is required. The fewer judgments, the deeper this understanding must be, given the nature of both known and unknown dimensions of variability in language.

One immediate area for deepening the understanding of the data is regarding the context of the data. Utterances that serve as the basis for linguistic analysis must be better contextualized in terms of its linguistic context: what discourse is it embedded in, what was its prosodic implementation, what was the utterance that immediately preceded it? Understanding this final point, specifically, alters the judgment of the sentence in question, particularly in the case of the *have*-sentences. Although utterances in isolation are often regarded as the object of study, I consider whether the principal target of linguistic analysis should be founded upon decontextualized utterances in the same way that monolingual language has been taken to be the default situation. In the same way that multilingualism is in fact the majority situation, and perhaps serves as a better model for human language behavior, single utterances rarely exist in total isolation. Even if they are not preceded by explicit linguistic context, we know that the communicative, discourse, and social contexts may play a role in the understanding of a given utterance. This idea further promotes the importance of understanding the cognitive contexts of the individuals and the communicative and social contexts in which they are providing both utterances and judgments of utterances. Experimentally, this manifests as creating and validating contextually appropriate stimuli.

Many questions and their associated investigative efforts in our science are no longer advanceable through a binary categorization of grammaticality; our reconceptualization of any individual human being as being situated at the intersection of a great number of gradient dimensions of cognitive style and social identity means that understanding the way these dimensions interact and manifest through language is vital to understanding the meaning or evaluation of any given utterance. This reconceptualization in turn forces a reconceptualization of the status of ungrammaticality as being specific to a context, an individual, and a point in time. In sum, I hope that this dissertation advocates for understanding the source of our data at a deep level: humans are complex and multi-dimensional, so we must ensure that the data from people we think we are investigating are in fact the data we are investigating.

Language as a biological capacity

Striving for the scientific underpinning of linguistics brings me to two points I would like to emphasize about the biological basis of the human language faculty.

The first is about the importance of real-time processing. Linguistic communication is a behavioral operation that is rooted in the neurocognitive system. Consequently, studying language processing in the neurocognitive system itself cannot be considered an accessory to an analysis, especially on the grounds of logistical or operational effort. It is the scientific instantiation of the linguistic enterprise. Real-time processing studies reveal the psychological reality of linguistic structure, providing insight into the order of operations during production and comprehension, the representational substrate and the resource demands of a given operation, and the relative recruitment of conventionalized lexical meaning structure or contextual factor. These aspects of production and comprehension, among others, are inseparable from an explanatorily adequate linguistic analysis.

The second is about the importance of variability. Variability is intrinsic to language as a biological capacity, and should be a key desideratum not only for a more high-resolution and precise understanding of the cognitive context of the language system, but also because variability impacts individuals' use of language. The brain data in particular highlights a potential tradeoff between relying on lexical meaning structure versus contextual features in the course of real-time comprehension. This divergent pattern of variability in neurocognitive function could be a source of variability in linguistic choice, specifically in the case of *have*, for individuals who may choose to use contextually grounded ambiguous *have*-sentences versus alternative lexical structures that highlight particular subspaces within the relational meaning space. These linguistic consequences of measurable differences in brain function highlight the singularity of language as a biological capacity and sociocommunicative system.

All things considered, these patterns of variability illustrate how linguistic structure, and lexico-conceptual semantic structure in particular, and the processing mechanisms through which we can see that structure are so deeply intertwined with its cognitive system foundation, not only in the core resources such as long-term and working memory which support the mental lexicon and real-time comprehension and production, respectively, but also in the informational and procedural constraints on lexicalization, and the forces that shape its stability and variability within an individual and across communities.

9.4 Moving forward: a neurocognitive model of linguistic variation (and change?)

Ultimately, this framework for variation also serves as a natural, prerequisite setting for meaning change. What are some possible parameters in the model in which change can be seeded, that is, the spaces for variability to accumulate? One possibility is the lexicalization of ambiguity, as the trapping of systematic context-dependence by word-meanings. Incorporating features of the context represents a reach in the boundaries of lexical compositional structure–a process that could take place through conventionalization. That is, if a lexical form X systematically occurs in context Y but not Z, or W and Y but not Z, the incorporation of Y or W and Y into the lexical meaning of X represents a viable pathway of change that would be supported by the subset of the population, as in Study 4, who show an increased reliance on the lexical compositional structure, rather than sensitivity to and dependence on features of the context that can disambiguate a word meaning. Further research into the dynamics of these opposing forces could illuminate patterns of stable variation as well as unidirectional or bidirectional change.

Connecting these underlying dimensions of variation to existing patterns and principles in more traditional linguistic approaches may also be a fruitful way to coordinate parallel approaches in the study of language. For example, one recent effort has been made to understand the ontology of Heim (1991)'s Maximize Presupposition not as a "normative constraint on language use" nor a "defeasible tendencies in behavior motivated by general considerations about cooperative communication" but as a speaker *preference* emerging from independent cognitive predispositions (i.e., cognitive style) that manifest systematically in language use (Lauer, 2016). Connecting existing well-adopted principles in linguistic theory, such as this one, to related principles in language change, such as presupposition accommodation (Schwenter and Waltereit, 2010) or presuppositional content asymmetry (Sanchez-Alonso, 2018), can provide immediate seeds for extending the model of variation into one of change.

Further unpacking the cognitive sources of variability in the use of and dependence on context is also an important avenue for expanding the model of variation into a model of language change. While Studies 1b and 4 do show that a measure of linguistic context-sensitivity plays an important role in the contextual facilitation of locative *have*-sentences, additional work is required to verify the connection between the questionnaire itself and the underlying cognitive capacities it is indexing. Moreover, multimodal approaches consisting of qualitative and quantitative research are the key to distinguishing speaker preference and speaker ability, the distinction described in §8.4.4, which cannot be ascertained based on these findings alone.[7] This ontological distinction is important for the development of variation into change, as abilities and preferences are differentially affected by the social and communicative contexts in which they play out.

One important missing ingredient to actuate change out of this model of variation is these sociocommunicative contexts. This body of factors, social meaning and social dynamics, addresses the motivations individuals have in using the linguistic devices they do. For example, possible motivations for using, say, an expressive variant (over an economical variant) could include pleasure, acceptance, or novelty, among others. These social meaning motivations

[7] As shown by Piñango et al. (in prep), this work may require much larger study populations than are typically recruited for linguistic and psycholinguistic studies; solidly grounding the development of these novel psychometrics from the start will enable more widespread use and ease of use and ideally, will establish a tradition of incorporating measures of variability in all investigations of human language.

originate separately but interact with properties of the variants themselves, which can differ in terms of ambiguity/specificity and informativity, among others. Moreover, varying social dynamics of individual interactions arising from features of identity, social structure, power, among others, are always at play. Together, these sociocognitive factors can drive the use of different variants, and therefore the propagation of certain variants over others within a speech community. Enumerating the parameter space for sociocommunicative variability through large-scale data collection, such as the KiezDeutsch-Korpus (Wiese et al., 2012) or the Maybachufer Market project (Wiese, 2020), is important for establishing a systematic foundation for future research. Extending a model of variation into a model of change requires the incorporation of such factors in an articulated way.

In sum, this cognitively grounded proposal is borne out in the actual cognitive implementation of real-time language use: each linguistic utterance is a communicative act in which a speaker chooses one linguistic device out of a set in order to achieve a specific communicative goal. For the comprehender, discovering the message requires interpreting the incoming linguistic material in context. The conceptual structure underlying lexical-semantic structure and relevant context cooperate in guiding comprehension by increasing the salience of different potential meanings, in real-time, as comprehension unfolds. The degree to which individual comprehenders are affected by and make use of contextual information during real-time comprehension is also variable; these linguistic and cognitive factors together form the core of normal language processing and, with a gradient conceptual framework, the minimal infrastructure for meaning variation and change. Models such as this one contribute to deepening our overall understanding of how the linguistic system and conceptual structure, embedded in the broader cognitive system, ultimately give rise to the expressive power of the human language faculty.

Appendix: Experimental stimuli

Studies 1a and 1b

1. The bag is under the table and the chair has a box.
2. The motorcycle is under the pine tree and the maple tree has a car.
3. The mug is next to the book and the notebook has a cup.
4. The encyclopedia is on top of the textbook and the dictionary has a phonebook.
5. The saucepan is inside the salad bowl and the stock pot has a cake pan.
6. The fern is beside the door and the mirror has a cactus.
7. The table has four legs and the chair has a box.
8. The pine tree has big branches and the maple tree has a car.
9. The book has a dust jacket and the notebook has a cup.
10. The textbook has an online supplement and the dictionary has a phonebook.
11. The salad bowl has a floral pattern and the stock pot has a cake pan.
12. The door has a deadbolt and the mirror has a cactus.
13. The table has a bag and the chair has a box.
14. The pine tree has a motorcycle and the maple tree has a car.
15. The book has a mug and the notebook has a cup.
16. The textbook has an encyclopedia and the dictionary has a phonebook.
17. The salad bowl has a saucepan and the stock pot has a cake pan.
18. The door has a fern and the mirror has a cactus.
19. The table is made of glass and the chair has a box.

20. The pine tree is very green and the maple tree has a car.
21. The book is leatherbound and the notebook has a cup.
22. The textbook is very heavy and the dictionary has a phonebook.
23. The salad bowl is ceramic and the stock pot has a cake pan.
24. The door is made of metal and the mirror has a cactus.
25. The bag is under the table so the chair has a box.
26. The motorcycle is under the pine tree or the maple tree has a car.
27. The mug is next to the book because the notebook has a cup.
28. The encyclopedia is on top of the textbook because the dictionary has a phonebook.
29. The saucepan is inside the salad bowl until the stock pot has a cake pan.
30. The fern is beside the door or the mirror has a cactus.

Studies 2, 3, and 4

1. The pine tree has a silver motorcycle under it and the maple tree has a car that is red.
2. The willow tree has a red dirtbike under it and the sycamore tree has a four-wheeler that is yellow.
3. The oak tree has a yellow convertible under it and the fir tree has a hummer that is green.
4. The birch tree has a black sportscar under it and the elm tree has a camper with green stripes.
5. The lamppost has a red bicycle next to it and the signpost has a scooter that is pink.
6. The telephone pole has a blue truck under it and the cell phone tower has a minivan that is green.
7. The billboard has a white pickup under it and the flagpole has a jeep that is black.
8. The parking meter has a brown station wagon next to it and the fire hydrant has a sedan that is white.
9. The bike rack has a red Toyota next to it and the parking sign has a Honda that is silver.
10. The table has a paper bag under it and the chair has a box that is cardboard.
11. The desk has a tote bag under it and the stool has a basket that is wicker.
12. The dining table has a large houseplant next to it and the recliner has a side table that is mahogany.
13. The book has a blue mug next to it and the notebook has a cup that is white.
14. The legal pad has a travel mug next to it and the newspaper has a teacup with a saucer.

15. The textbook has a leatherbound encyclopedia on top of it and the dictionary has a phonebook that is paperback.
16. The atlas has a colorful graphic novel on top of it and the yearbook has a children's book with many illustrations.
17. The newspaper has a fitness magazine on top of it and the junk mail has a postcard with three stamps.
18. The salad bowl has a round saucepan inside it and the stock pot has a cake pan that is square.
19. The colander has a square griddle inside it and the Dutch oven has a pie pan that is round.
20. The frying pan has a steel wok on top of it and the saucepan has a cookie sheet that is rectangular.
21. The skillet has a black pressure cooker on top of it and the casserole pan has a roasting pan that is copper.
22. The door has a large fern beside it and the mirror has a cactus that is small.
23. The front door has a beautiful bonsai beside it and the lamp has a lucky bamboo with a ribbon.
24. The garage door has a lawn mower beside it and the water heater has a furnace that is broken.
25. The still-life has a detailed cityscape above it and the portrait has a seascape with three ships.
26. The nude painting has a stormy landscape above it and the Picasso has a painting by Vincent van Gogh.
27. The yacht has a fiberglass kayak next to it and the rowboat has a canoe that is wooden.
28. The houseboat has a white motorboat next to it and the catamaran has a ferry with many passengers.
29. The toothbrush has a blue razor beside it and the comb has a jar with cotton balls.
30. The mascara has a red lipstick beside it and the eyeliner has a box with bobby pins.
31. The mouthwash has a stick of deodorant beside it and the contact lens solution has a can of shaving cream.
32. The spatula has a plastic ladle beside it and the wooden spoon has a whisk that is metal.
33. The oven mitt has a cheese grater beside it and the garlic press has a rolling pin that is wooden.
34. The scone has a chocolate croissant next to it and the muffin has a bagel with sesame seeds.
35. The turkey has a green bean casserole next to it and the gravy boat has a bowl of mashed potatoes.
36. The roast beef has a broccoli gratin beside it and the cherry pie has a dish of scalloped potatoes.
37. The tuna steak has a whole lobster beside it and the swordfish has a salmon fillet that is fresh.

38. The ground beef has a rack of lamb beside it and the chicken breast has a steak with barbecue sauce.
39. The ground turkey has a frozen chicken beside it and the sirloin steak has a package of pork sausages.
40. The avocado has a red bell pepper next to it and the tomato has a potato with red skin.
41. The papaya has a small watermelon next to it and the turnip has a yam with brown skin.
42. The cantaloupe has a box of clementines next to it and the honeydew has a bag with gala apples.
43. The goat cheese has a container of ricotta next to it and the feta cheese has a bottle of olive oil.
44. The sesame oil has a plate of noodles beside it and the soy sauce has a bowl of fried rice.
45. The canopy has a metal chair under it and the awning has a bench that is white.
46. The conditioner has a pink loofah next to it and the shampoo has a soap bar with lavender oil.
47. The moisturizer has a nail clipper next to it and the sunblock has a bottle of women's fragrance.
48. The baby oil has a pair of tweezers next to it and the Vaseline has a tube of acne ointment.
49. The shower curtain has a bathroom scale beside it and the towel has a bathmat that is green.
50. The hand soap has a box of tissues beside it and the toothpaste has a hand towel that is white.
51. The pine tree has a small nest in it and the maple tree has a car that is red.
52. The willow tree has a picnic bench under it and the sycamore tree has a four-wheeler that is yellow.
53. The oak tree has a swing on it and the fir tree has a hummer that is green.
54. The birch tree has a birdhouse on it and the elm tree has a camper with green stripes.
55. The lamppost has a lost dog flyer on it and the signpost has a scooter that is pink.
56. The telephone pole has advertisements on it and the cell phone tower has a minivan that is green.
57. The billboard has some rust on it and the flagpole has a jeep that is black.
58. The parking meter has an out-of-order sign on it and the fire hydrant has a sedan that is white.
59. The bike rack has two bikes on it and the parking sign has a Honda that is silver.
60. The table has a plaid tablecloth on it and the chair has a box that is cardboard.
61. The desk has a small lamp on it and the stool has a basket that is wicker.
62. The dining table has a centerpiece on it and the recliner has a side table that is mahogany.
63. The book has a dust jacket on it and the notebook has a cup that is white.

64. The legal pad has ink smudges on it and the newspaper has a teacup with a saucer.
65. The textbook has post-it notes in it and the dictionary has a phonebook that is paperback.
66. The atlas has a red bookmark in it and the yearbook has a children's book with many illustrations.
67. The newspaper has a coffee stain on it and the junk mail has a postcard with three stamps.
68. The salad bowl has saran wrap on it and the stock pot has a cake pan that is square.
69. The colander has dried lettuce on it and the Dutch oven has a pie pan that is round.
70. The frying pan has a glass lid on it and the saucepan has a cookie sheet that is rectangular.
71. The skillet has Teflon coating on it and the casserole pan has a roasting pan that is copper.
72. The door has a hook for keys on it and the mirror has a cactus that is small.
73. The front door has a Christmas wreath on it and the lamp has a lucky bamboo with a ribbon.
74. The garage door has a decorative handle on it and the water heater has a furnace that is broken.
75. The still-life has cobwebs on it and the portrait has a seascape with three ships.
76. The nude painting has some dust on it and the Picasso has a painting by Vincent van Gogh.
77. The yacht has a waterproof cover on it and the rowboat has a canoe that is wooden.
78. The houseboat has barnacles growing on it and the catamaran has a ferry with many passengers.
79. The toothbrush has some toothpaste on it and the comb has a jar with cotton balls.
80. The mascara has a price tag on it and the eyeliner has a box with bobby pins.
81. The mouthwash has a black cap on it and the contact lens solution has a can of shaving cream.
82. The spatula has some batter on it and the wooden spoon has a whisk that is metal.
83. The oven mitt has some burn marks on it and the garlic press has a rolling pin that is wooden.
84. The scone has lemon glaze on it and the muffin has a bagel with sesame seeds.
85. The turkey has a honey glaze on it and the gravy boat has a bowl of mashed potatoes.
86. The roast beef has some parsley garnish on it and the cherry pie has a dish of scalloped potatoes.
87. The tuna steak has skin on it and the swordfish has a salmon fillet that is fresh.
88. The ground beef has plastic wrap on it and the chicken breast has a steak with barbecue sauce.
89. The ground turkey has a wax paper wrapping on it and the sirloin steak has a package of pork sausages.
90. The avocado has a purple sticker on it and the tomato has a potato with red skin.

91. The papaya has a yellow label on it and the turnip has a yam with brown skin.
92. The cantaloupe has a white sticker on it and the honeydew has a bag with gala apples.
93. The goat cheese has a wax rind on it and the feta cheese has a bottle of olive oil.
94. The sesame oil has a yellow cap on it and the soy sauce has a bowl of fried rice.
95. The canopy has a mosquito net on it and the awning has a bench that is white.
96. The conditioner has detailed instructions on it and the shampoo has a soap bar with lavender oil.
97. The moisturizer has a list of ingredients on it and the sunblock has a bottle of women's fragrance.
98. The baby oil has a transparent label on it and the Vaseline has a tube of acne ointment.
99. The shower curtain has mildew on it and the towel has a bathmat that is green.
100. The hand soap has a white label on it and the toothpaste has a hand towel that is white.
101. The pine tree has big branches and the maple tree has a car that is red.
102. The willow tree has drooping branches and the sycamore tree has a four-wheeler that is yellow.
103. The oak tree has green leaves and the fir tree has a hummer that is green.
104. The birch tree has peeling bark and the elm tree has a camper with green stripes.
105. The lamppost has an incandescent bulb and the signpost has a scooter that is pink.
106. The telephone pole has a concrete base and the cell phone tower has a minivan that is green.
107. The billboard has an Apple ad and the flagpole has a jeep that is black.
108. The parking meter has a solar panel and the fire hydrant has a sedan that is white.
109. The bike rack has a stainless steel body and the parking sign has a Honda that is silver.
110. The table has four legs and the chair has a box that is cardboard.
111. The desk has two drawers and the stool has a basket that is wicker.
112. The dining table has a glass surface and the recliner has a side table that is mahogany.
113. The book has ten chapters and the notebook has a cup that is white.
114. The legal pad has a brown binding and the newspaper has a teacup with a saucer.
115. The textbook has an online supplement and the dictionary has a phonebook that is paperback.
116. The atlas has a spiral binding and the yearbook has a children's book with many illustrations.
117. The newspaper has a classifieds section and the junk mail has a postcard with three stamps.

118. The salad bowl has a floral pattern and the stock pot has a cake pan that is square.
119. The colander has a silicone handle and the Dutch oven has a pie pan that is round.
120. The frying pan has a non-stick coating and the saucepan has a cookie sheet that is rectangular.
121. The skillet has a flat bottom and the casserole pan has a roasting pan that is copper.
122. The door has a deadbolt and the mirror has a cactus that is small.
123. The front door has a peephole and the lamp has a lucky bamboo with a ribbon.
124. The garage door has some window panels and the water heater has a furnace that is broken.
125. The still-life has a black frame and the portrait has a seascape with three ships.
126. The nude painting has a gold frame and the Picasso has a painting by Vincent van Gogh.
127. The yacht has two bedrooms and the rowboat has a canoe that is wooden.
128. The houseboat has a bedroom and the catamaran has a ferry with many passengers.
129. The toothbrush has a blue handle and the comb has a jar with cotton balls.
130. The mascara has a pink cap and the eyeliner has a box with bobby pins.
131. The mouthwash has 0.01 fluoride and the contact lens solution has a can of shaving cream.
132. The spatula has a non-slip handle and the wooden spoon has a whisk that is metal.
133. The oven mitt has a plaid pattern and the garlic press has a rolling pin that is wooden.
134. The scone has chocolate chips and the muffin has a bagel with sesame seeds.
135. The turkey has lemon pepper marinade and the gravy boat has a bowl of mashed potatoes.
136. The roast beef has mushroom stuffing and the cherry pie has a dish of scalloped potatoes.
137. The tuna steak has a sesame soy marinade and the swordfish has a salmon fillet that is fresh.
138. The ground beef has 0.09 fat and the chicken breast has a steak with barbecue sauce.
139. The ground turkey has 0.07 fat and the sirloin steak has a package of pork sausages.
140. The avocado has green skin and the tomato has a potato with red skin.
141. The papaya has black seeds and the turnip has a yam with brown skin.
142. The cantaloupe has orange flesh and the honeydew has a bag with gala apples.
143. The goat cheese has chopped rosemary and the feta cheese has a bottle of olive oil.
144. The sesame oil has vitamin E and the soy sauce has a bowl of fried rice.
145. The canopy has waterproof fabric and the awning has a bench that is white.

146. The conditioner has argan oil and the shampoo has a soap bar with lavender oil.
147. The moisturizer has coconut oil and the sunblock has a bottle of women's fragrance.
148. The baby oil has mineral oil and the Vaseline has a tube of acne ointment.
149. The shower curtain has blue stripes and the towel has a bathmat that is green.
150. The hand soap has vanilla fragrance and the toothpaste has a hand towel that is white.

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