Title

Real-time roots of meaning change: Electrophysiology reveals the contextual-modulation processing basis of synchronic variation in the location-possession domain

Authors

Zhang, Muye
Pinango, Maria Mercedes
Deo, Ashwini

Real-time roots of meaning change:
Electrophysiology reveals the contextual-modulation processing basis of synchronic variation in the location-possession domain

Muye Zhang (muye.zhang@yale.edu)
Department of Linguistics, 370 Temple Street
New Haven, CT 06511 USA

María Mercedes Piñango (maria.pinango@yale.edu)
Department of Linguistics, 370 Temple Street
New Haven, CT 06511 USA

Ashwini Deo (deo.13@osu.edu)
Department of Linguistics, 1712 Neil Avenue
Columbus OH, 43210 USA

Abstract

The present study seeks to substantiate a cognitively-grounded model of synchronic meaning variation and diachronic meaning change. We propose that inter-comprehender variability in CONTEXT-SENSITIVITY drives variation in word-meanings along conceptual structure pathways; we test this model through English *have* and its underlying LOCATION-POSSESSION conceptual structure. Through acceptability ratings, self-paced reading times, and ERPs, we show that relevant context can facilitate the dispreferred but plausible LOC interpretation of a *have*-sentence–the degree of facilitation is predicted by individual differences in CONTEXT-SENSITIVITY, indexed here by gender and Autism Quotient. Altogether, our results suggest that the variation of *have*-sentences' meanings is principled due to its unified conceptual structure, and that conceptual structure together with context cooperate in guiding comprehension by modulating the salience of competing variants in real-time. Ultimately, diachronic change is naturally emergent from this model of normal language processing.

Keywords: context; variation; real-time processing; comprehension; semantics; conceptual structure; gender; AQ; self-paced reading; ERP

Phenomena

In the domain of location and possession, the world's languages show synchronic lexical conflation (1-2) of and a unidirectional grammaticalization path (3) from: spatial locative (LOC) to possessive (POSS) relations (Aristar, 1996; Koch, 2012; Deo, 2015) suggesting a conceptual connection between LOC and POSS (Jackendoff, 2012; Lyons, 1967; Pinker, 1989).

(1)   *Le livre, c'est **à moi**. / Le livre, cest **à la bibliothèque**.*
      'The book, it's mine.' / 'The book, it's at the library.'

(2)   *Nà běn shū **zài** wǒ zhè'er* / *Nà běn shu **zài**
      that CL book AT 1.SG here   vs. that CL book AT
      túshūguǎn*
      library
      'That book is with me.' / 'That book is at the library.'

(3)   Marathi *kade*: incidental-LOC → non-incidental-LOC
      → temporary control/ownership → alienable-POSS
      → inalienable-POSS

Proposal

We propose that such a conceptual connection serves as the cognitive pathway fsor the synchronic meaning variation and consequent diachronic meaning change that we observe cross-linguistically. While a unified conceptual infrastructure lays the foundation for meaning variation and ultimately meaning change, individual speaker differences in language comprehension and usage are what drive linguistic markers to express different meanings along a given conceptual pathway. Through location-possession meaning phenomena, the present study seeks to illustrate how conceptually-principled linguistic variability can be mediated by variability in cognitive attributes of the producer/comprehender, ultimately leading to diachronic meaning change.

Approach

We test this proposal by investigating the lexical item *have*, English's canonical POSS meaning device (4).

(4)   *John **has** a bike.*

In line with the cross-linguistic conflations, however, corpus analyses show that despite usage asymmetries, *have* also conveys incidental LOC meanings (5).

(5)   *The oak tree **has** a bike near it.*

Some proposals in the literature argue that the LOC meaning comes from only the prepositional phrase (Myler, 2014; Harley & Jung, 2015). In contrast, based on the cross-linguistic observations and a unified conceptual structure analysis, we argue that the lexical item *have* itself can express LOC meanings due to the underlying conceptual connection. In English, however, these LOC meanings are less frequent and more ambiguous, leading to a general dispreference of LOC *have*-sentences compared to POSS *have*-sentences. Accordingly, we hypothesize that a supportive context can facilitate the dispreferred, yet possible LOC meaning. Furthermore, we propose that inter-comprehender variability in the ability to use supportive contextual information in downstream

processing (CONTEXT-SENSITIVITY) is systematically quantifiable with domain-general cognitive processing style measures.

Conceptual analysis for LOC-POSS

In this unifying conceptual semantics analysis,[1] the most fundamental LOC relation represents an inherently transient situation of an EVENT-type (Fig. 1).
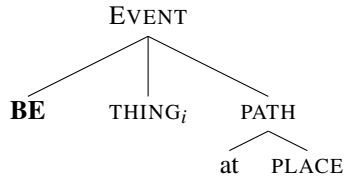
Figure 1: Conceptual representation of incidental location.

POSS is then built by nesting LOC in the standard CAUSE frame, creating a unified structure where the possessor is the EVENT$_1$ (causal) actor and a possessee is the EVENT$_2$ actor (Fig. 2).
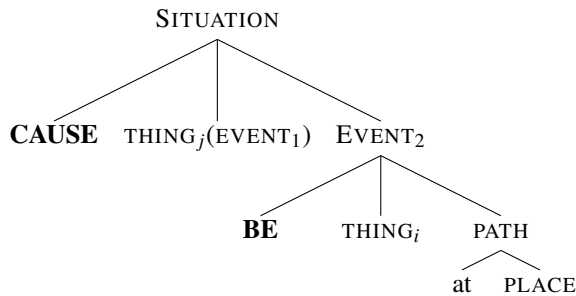
Figure 2: Conceptual representation of possession

Thus (a) what defines POSS is not only LOC, but the obligatory control of possessor over possessee; (b) retrieving *have* entails retrieving this lexico-semantic conceptual structure (CS). Hence, *have* should express the wide variety of LOC-POSS meanings observed.

However, while LOC-POSS meanings are part of *have*'s underlying CS, LOC readings seem to be dispreferred for bare *have*-sentences apparently due to lower informativity value and higher ambiguity potential. If so, to be preferred for bare *have*-sentences, LOC meanings should require stronger contextual support.

Individual differences in CONTEXT-SENSITIVITY

In addition to the cognitive pathway laid out by a unified conceptual structure, the other condition for meaning change is variation produced by different speakers' strategies within a speech community. The synthesis and proliferation of such linguistic variants has been studied largely within the sociolinguistic variationist tradition: Lakoff (1972), McConnell-Ginet (2014), and Kendall and Tannen (2015) find **gender**

---

[1]Formalisms à la (Pinker, 1989; Jackendoff, 1990)

group-level differences in a variety of English phenomena and suggest that females are more accepting of others' language, more subtle in their expressions, and more socially aware of the way they are required to use language, given the context of their interlocutor. By contrast, males, free from such strict sociolinguistic conventions, are allowed to remain less sensitive to context, more independent in their produced language, and paradoxically, more inflexible with respect to (socio-)linguistic rules. Labov (1990) applies these socio-culturally-based generalizations to linguistic change phenomena, suggesting that the social and linguistic flexibility in female language, due to increased necessity of contextualization, establishes women as linguistic innovators, particularly in cases where speakers are not conscious of change.

The cognitive neuroscience literature has found neuroanatomical correlates of the generalizations made in the sociolinguistic literature. In one case, Clements et al. (2006) find a gender difference in phonological and visuospatial processing: males show more bilateral activation in the visuospatial task and more lateralized activation in the phonological task, while females show the opposite distribution. Kramer, Ellenberg, Leonard, and Share (1996) replicated this pattern in children between the ages of four and 12. Kaiser, Kuenzli, Zappatore, and Nitsch (2007), however, find a conflicting pattern in which males, as a group, showed more bilateral activation in a language production task–though the differences were not observed at the individual level. In more generalized cognitive tasks, Abraham, Thybusch, Pieritz, and Hermann (2014) report that male participants did show preferential engagement of cortical regions underlying non-linguistic semantic cognition, rule learning, and decision making, while females showed preferential engagement in speech processing and "social perception" areas. Tanner and Van Hell (2014) find a large degree of individual variance within monolingual English participants in the biphasic LAN-P600 response to morphosyntactic violations and conclude that comprehenders take different neurocognitive routes to successful comprehension, though they do not quantify these differences using gender or other measures of CONTEXT-SENSITIVITY, instead focusing on working memory, lexical processing speed, and sinistrality. These sociolinguistic and neuroscientific proposals, taken together, provide a solid basis for the hypothesis of gender, as one component of cognitive processing style, as a reliable predictor of linguistic processing differences, and of women as drivers of linguistic innovation.

Yu (2010) extends this framework to sound change and quantifies linguistic innovators as individuals whose cognitive processing styles, indexed by gender and Autism Quotient (AQ), are the most CONTEXT-SENSITIVE. Yu reports specifically that low-AQ women (as the most CONTEXT-SENSITIVE speaker/comprehenders) under-compensate for coarticulatory effects, allowing these context-induced phonetic variations to percolate through the speech community, thus introducing variation and ultimately change. These re-

sults are the first to link the ability to "mine" relevant linguistic context to an individual's cognitive processing style, suggesting that individual differences in language processing are systematic, predictable from domain-general cognitive factors, and potential seeds of variation and change.

Thus, the convergence of synchronic and diachronic linguistic patterns lead us to hypothesize that the process of change not only operates in real-time over underlying conceptual foundations or pathways but also is actively driven by individuals' CONTEXT-SENSITIVITY during comprehension, a process of incremental disambiguation using context (Swinney, 1979; Altmann & Steedman, 1988, a.o.).

Hypotheses

The linguistic observations and the CS model lead to these hypotheses: (a) LOC and POSS meanings are part of the same conceptual representation associated with the lexical item *have*, consequently (b) LOC readings of locative *have*-sentences can be made salient and thus more acceptable with relevant linguistic context, and given independent cognitive predispositions, (c) the degree of increased acceptance is predicted by an individual's CONTEXT-SENSITIVITY, indexed by gender and Autism Quotient (Labov, 1990; Lakoff, 1972; McConnell-Ginet, 2014; Yu, 2010). We measured the degree to which comprehenders obtain the LOC meaning using a contextual facilitation paradigm (presenting ambiguous *have*-sentences after differing contexts).

Predictions

We predicted higher acceptability ratings and lower reading times for ambiguous sentences (e.g. *The maple tree has a car.*) after LOC vs. (less plausible) POSS contexts, as speakers will be able to recover the less-canonical LOC meaning given the appropriate context; we expect more CONTEXT-SENSITIVE speakers (women/low-AQ speakers) to show larger effects, as the critical psycholinguistic operation is contextualization-based.

Our unified conceptual structure (CS) model, which proposes that LOC/POSS meanings are part of the same CS retrieved through *have*, predicts a late-positivity ERP (Piñango et al., 2016; Weiland, Bambini, & Schumacher, 2014) at the complement of *have* for LOC contexts (a) indexing the context-modulation effort needed to facilitate LOC meanings and (b) interacting with individual CONTEXT-SENSITIVITY levels. That is, the process of contextually supporting the less frequent LOC meaning of *have* is a matter of context-integration, which is variable across comprehenders. Specifically, performing this context-modulation effort will result in a late-positivity; the individual differences therein will correlate with our indices of context-sensitivity (gender + AQ), in that more context-sensitive comprehenders (women/low-AQ) should show a greater amplitude during the late-positivity window than less context-sensitive comprehenders (men/high-AQ), in line with predictions from Yu (2010, a.o.).

Alternatively, if the syntax-dependent polysemy approach (Harley & Jung, 2015; Myler, 2014, a.o.), which claims that the LOC meaning of *have* is sourced entirely to a LOC-PP, were correct, a P600, indexing the syntactic repair of LOC-PP insertion, would be observed with no individual differences. Both accounts predict an N400, as an index of word-level semantic unexpectedness, after the contextually non-facilitating POSS context.

Observing N400 and late-positivity components that are correlated with individual CONTEXT-SENSITIVITY (as indexed by gender + AQ) would support the unified LOC-POSS conceptual structure account, while observing N400 and P600 components with no correlation with CONTEXT-SENSITIVITY measures would support a syntactic repair/insertion analysis.

Study 1: Acceptability ratings

We showed six target sentences with four context-types (Tab. 1) in addition to 86 filler sentences for a total of 120 experimental items to two subject populations: 48 Yale University students (26 female, ages 18-29, mean age 20;10) and 91 individuals recruited through the Amazon Mechanical Turk platform (48 female, ages 18-30, mean age 24;8).

Each target sentence was a *have*-sentence expressing an incidental proximity relation (LOC). The two entities in each sentence were selected to prevent bias toward a construal of possession and to block any plausible containment reading. The locative context-type provided a similar incidental proximity relation to facilitate the dispreferred LOC interpretation of the target *have*-sentence, while the possessive context-type provided an inalienable part-whole relation–a canonical possession relation expressed by *have*. Two experimental control context-types served as baseline measures: the no-context condition provided the target sentence alone to rule out mere presence of context as facilitatory and the nonsensical context-type provided the locative context but with a nonsensical conjunction to illustrate a categorical distinction between the dispreference of a LOC interpretation of a *have*-sentence and the true semantic unacceptability of the nonsensical conjunction.

Subjects first saw the context alone and were asked to rate it on a scale from 1-7, and then saw the whole experimental sentence, and were asked to provide a rating, again, on a scale from 1-7. Each participant saw all sentences in a unique, pseudo-randomized order.

Mixed-effects models with the acceptability ratings show that only the LOC contexts significantly facilitated target interpretation ($p < .001$). Moreover, in line with the predicted gender differences in CONTEXT-SENSITIVITY, females (shown to be more CONTEXT-SENSITIVE) are responsible for the main effect (Fig. 3).

These results suggest that LOC meanings are part of the unified conceptual structure retrieved through *have*, and that comprehenders, especially the more CONTEXT-SENSITIVE female comprehenders, are sensitive to the contextual con-

Table 1: Study 1 stimuli

Context-type	Context	Conj.	Target
Locative	The motorcycle is under the pine tree	and	the maple tree has a car.
Possessive	The pine tree has a big branches	and	the maple tree has a car.
No-context	The maple tree has a car	and	the motorcycle is under the pine tree.
Nonsensical	The motorcycle is under the pine tree	or	the maple tree has a car.

Table 2: Study 2 stimuli

Context-type	Context	Target
LOC-*have*	The pine tree *has* a silver motorcycle under it	
LOC-*be*	The silver motorcycle *is* under the pine tree	and the maple tree has a **car** that is red.
Inalienable-POSS	The pine tree has big branches	

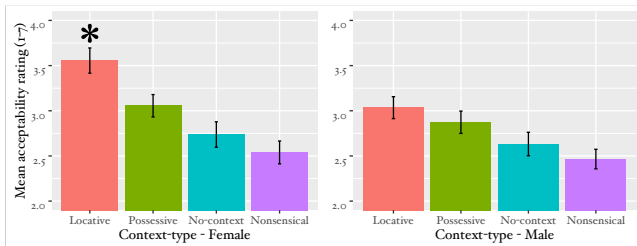Note: boldface indicates time-locked segment for ERPs.

Figure 3: Acceptability ratings by context-type and gender.

ditions that support the LOC meaning of a *have*-sentence.

Study 2: Self-paced reading

A similar target as in Study 1 was shown to 65 Yale University students (37 female, ages 18-27, mean age 20;8) after 3 context-types (Tab. 2). A total of 50 sentence sets, comprising 150 experimental sentences, with an additional 50 filler sentences, for a total of 200 stimulus items, were shown to each participant in a unique, pseudo-randomized order.

A relative clause containing a copular predicate was added to the end of each target sentence to act as a spill-over buffer–a series of cost-free windows that isolate delayed sentence-processing effects from the sentence-final "wrap-up" effect. The additional descriptive detail was matched by adding corresponding adjectives to the contexts.

Reading times were residualized for window length and each subject's individual reading speed (Gibson & Warren, 2004, a.o.). Mixed-effects models of the residualized reading times (Fig. 4) show that only the LOC-*have* context significantly facilitated the target at the complement of have (p's < 0.01), but that this effect was present in both gender groups.

The timecourse of processing demonstrates that the contextualization effort, significant only in the window containing the noun-complement of *have*, is part of the standard processing of *have*, suggesting that LOC meanings are in-
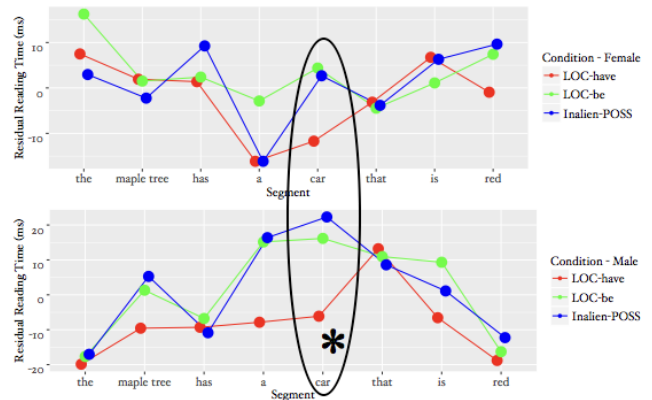

Figure 4: Self-paced reading times by context-type and gender.

trinsically represented by the conceptual structure underlying *have*. Syntactic repairs, specifically LOC-PP insertion, would have manifested as processing cost delays in the following segment, where the parser would have discovered the lack of LOC-PP. Furthermore, the semantically equivalent LOC-*be* context showed just as much of a slow-down as the implausible POSS context, suggesting that the joint LOC-POSS structure is indeed retrieved through the lexical item *have*.

While the gender groups showed significant differences in the conscious evaluation of LOC *have*-sentences, they did not show differences in the locus or magnitude of the contextualization effort, suggesting that introspection alone may not reflect the entirety of the underlying real-time processing infrastructure.

Study 3: Event-related potentials

The LOC-*have* and Inalienable-POSS context-types from Study 2 were shown to 20 Yale University students (12 female, ages 18-24, mean age 20;5) while undergoing EEG

recording. Electrophysiological measures were recorded using Neuroscan Synamps2 amplifiers and a 64-channel Quik-Cap 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 kΩs for each electrode and ERPs were time-locked to the onset of the noun-complement of *have*, following the self-paced reading processing timecourse. Stimulus sentences were presented one word at a time in the center of the screen; each word was displayed for 500 ms.

The EEG waveforms were first visually inspected for artifact rejection, and then were filtered (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.

Linear mixed-effects models were created using the fixed effects of context-type, gender, scalp location (9 levels: left anterior, middle anterior, right anterior, left central, middle central, right central, left posterior, middle posterior, right posterior), and the continuous individual CONTEXT-SENSITIVITY (AQ) measures. The random effects included random intercepts for participants and items as well as by-participant random slopes for the effect of context-type. Mean amplitudes were calculated over windows based on semantic context-modulation ERP studies in the literature (e.g., 400-500 ms post-onset for N400; 600-850 ms post-onset for P600; and 850-1000 ms post-onset for late-positivity; (Piñango et al., 2016, a.o.)), and adjusted based on visual inspection (Schumacher, 2014).
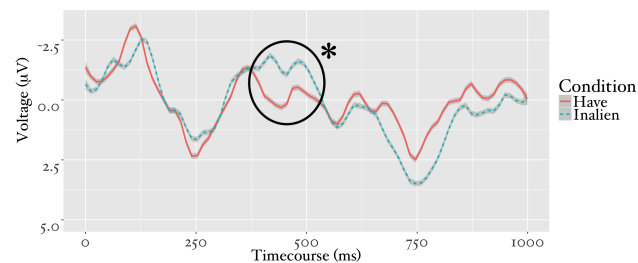
a. Men - N400 effect
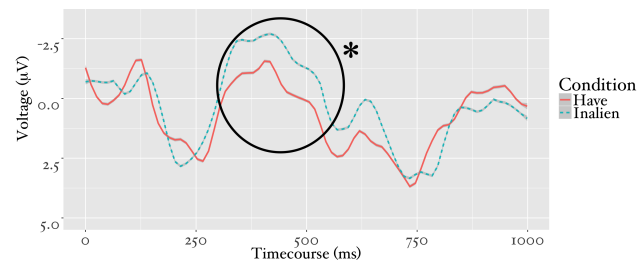
b. Women - larger N400 effect

Figure 5: Locative vs. possessive–center-parietal electrodes.

An N400 was observed for the Inalienable-POSS context (Fig. 5) relative to the LOC-*have* for all participants in the

400-500 ms window in the centro-parietal region; females, however, showed a longer (400-600 ms) effect, which spread to frontal electrode regions in the 500-600 ms part of the window. Mixed-effects models show a context-type-gender-AQ interaction for the LOC-*have* context in the late-positivity window (850-1000 ms post-onset), revealing that low-AQ women, as the most CONTEXT-SENSITIVE comprehenders showed significantly higher amplitudes than low-AQ women as well as both high- and low-AQ men (p's $< .05$, Fig. 6). No differences between gender + AQ groups was observed in the Inalienable-POSS context-type, as no context-modulation is expected. These gender-group differences in duration, area, and magnitude are consistent with the previous findings that females, and especially low-AQ females, show greatest sensitivity to contextual modulation.
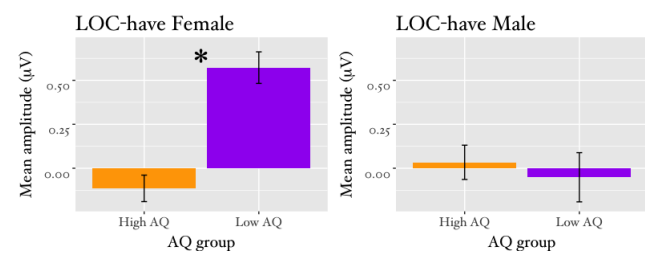

Figure 6: CONTEXT-SENSITIVITY indices of gender + AQ predict magnitude of context-modulation effort (Amplitude of the late-positivity ERP component.

These results help nuance the self-paced reading time data, and give more support to the unified LOC-POSS conceptual structure analysis: facilitating the less canonical LOC meaning of a *have*-sentence is a matter of standard context-integration, as shown by the late-positivity component, and consequently, varies across individual comprehenders based on their degree of CONTEXT-SENSITIVITY as indexed by gender + AQ. There were no significant differences observed in the P600 window, suggesting that no syntactic repair mechanism, such as LOC-PP insertion, took place in the processing of the *have*-sentence. Such a process, had it been observed, would not be predicted to demonstrate inter-comprehender differences, as it would be an invariant, reflexive response across all comprehenders.

Summary

The converging results from the three studies detailed above suggest that normally dispreferred LOC meanings are an intrinsic component of the lexico-conceptual structure retrieved by the lexical item *have* and can be facilitated by relevant context. Such a finding connects English *have* to the cross-linguistic location-possession patterns, strengthening the argument that these pathways of change are underlain by a unified conceptual infrastructure; in English, location and possession meanings are retrieved through the lexical item *have* in a gradient contextualization effect, and not a categorical ungrammaticality repair. Furthermore, the degree of contextual facilitation interacts with cognitive processing

style (indexed here by gender + AQ), pointing to CONTEXT-SENSITIVITY as an critical cognitive component in meaning composition, and the differentiation of speakers in a speech community, some of whom (the innovators) will lead consequent change.

Conclusion

Our results suggest that the linguistic distribution of *have* is inherently principled due to a unified CS that allows us to quantify systematic inter-comprehender variation along a CONTEXT-SENSITIVITY gradient. The underlying CS and relevant context cooperate in guiding comprehension by increasing the salience of otherwise infrequent but plausible underlying meanings, as comprehension unfolds. We propose that these linguistic and cognitive factors together form *the core of normal language processing* and, with a flexible unified CS, the minimal infrastructure for synchronic variation and diachronic meaning change.

Acknowledgments

References

Abraham, A., Thybusch, K., Pieritz, K., & Hermann, C. (2014). Gender differences in creative thinking: Behavioral and fMRI findings. *Brain Imaging and Behavior*, *8*, 39–51. doi: 10.1007/s11682-013-9241-4

Altmann, G., & Steedman, M. (1988). Interaction with context during human sentence processing. *Cognition*, *30*(3), 191–238. doi: 10.1016/0010-0277(88)90020-0

Aristar, A. R. (1996). The Relationship Between Dative and Locative: Kurylowicz's Argument from a Typological Perspective. *Diachronica*, *13*(2), 207–224. doi: 10.1075/dia.13.2.02ari

Clements, A. M., Rimrodt, S. L., Abel, J. R., Blankner, J. G., Mostofsky, S. H., Pekar, J. J., . . . Cutting, L. E. (2006). Sex differences in cerebral laterality of language and visuospatial processing. *Brain and Language*, *98*, 150–158. doi: 10.1016/j.bandl.2006.04.007

Deo, A. (2015). The semantic and pragmatic underpinnings of grammaticalization paths : The progressive to imperfective shift. *Semantics and Pragmatics*, *8*, 1–52.

Gibson, E., & Warren, T. (2004). Reading-Time Evidence for Intermediate Linguistic Structure in Long-Distance Dependencies. *Syntax*, *7*(1), 55–78.

Harley, H., & Jung, H. K. (2015). In support of the PHAVE analysis of the double object construction. *Linguistic Inquiry*, *46*(4), 703–730. doi: 10.1162/ling

Jackendoff, R. (1990). *Semantic structures*. MIT Press.

Jackendoff, R. (2012). *A User's Guide to Thought and Meaning*. Oxford University Press.

Kaiser, A., Kuenzli, E., Zappatore, D., & Nitsch, C. (2007). On females' lateral and males' bilateral activation during language production: A fMRI study. *International Journal of Psychophysiology*, *63*, 192–198. doi: 10.1016/j.ijpsycho.2006.03.008

Kendall, S., & Tannen, D. (2015). Discourse and Gender. In D. Tannen, H. E. Hamilton, & D. Scriffin (Eds.), *The handbook of disocurse analysis* (2nd ed., pp. 639–660). John Wiley & Sons. doi: 10.1002/9781118584194.ch21

Koch, P. (2012). Location, existence, and possession: A constructional-typological exploration. *Linguistics*, *50*(3), 533–603. doi: 10.1515/ling-2012-0018

Kramer, J. H., Ellenberg, L., Leonard, J., & Share, L. J. (1996). Developmental sex differences in global-local perceptual bias. *Neuropsychology*, *10*(3), 402–407.

Labov, W. (1990). The intersection of sex and social class in the course of linguistic change. *Language Variation and Change*, *2*, 205–254. doi: 10.1017/S0954394500000338

Lakoff, R. (1972). English Language in Context. *Language*, *48*(4), 907–927.

Lyons, J. (1967). A Note on Possessive, Existential and Locative Sentences. *Foundations of Language*, *3*(4), 390–396.

McConnell-Ginet, S. (2014). Meaning-making and ideologies of gender and sexuality. In S. Elrich, M. Meyerhoff, & J. Holmes (Eds.), *The handbook of language, gender, and sexuality* (pp. 316–334). John Wiley & Sons.

Myler, N. J. (2014). *Building and Interpreting Possession Sentences*. Dissertation, New York University.

Piñango, M. M., Zhang, M., Foster-Hanson, E., Negishi, M., Lacadie, C., & Constable, R. T. (2016). Metonymy as Referential Dependency: Psycholinguistic and Neurolinguistic Arguments for a Unified Linguistic Treatment. *Cognitive Science*, *41*(S2), 351–378. doi: 10.1111/cogs.12341

Pinker, S. (1989). *Learnability and Cognition: The Acquisition of Argument Structure*. MIT Press.

Schumacher, P. B. (2014). Content and context in incremental processing : the ham sandwich " revisited. *Philosophical Studies*, *168*, 151–165.

Swinney, D. A. (1979). Lexical access during sentence comprehension: (Re)consideration of context effects. *Journal of Verbal Learning and Verbal Behavior*, *18*, 645–659. doi: 10.1016/S0022-5371(79)90355-4

Tanner, D., & Van Hell, J. G. (2014). ERPs reveal individual differences in morphosyntactic processing. *Neuropsychologia*, *56*(1), 289–301. doi: 10.1016/j.neuropsychologia.2014.02.002

Weiland, H., Bambini, V., & Schumacher, P. (2014). The role of literal meaning in figurative language comprehension: Evidence from masked priming ERP. *Frontiers in Human Neuroscience*, *8*(August), 1–17. doi: 10.3389/fnhum.2014.00583

Yu, A. C. L. (2010). Perceptual Compensation Is Correlated with Individuals' Autistic" Traits : Implications for Models of Sound Change. *PLoS ONE*, *5*(8). doi: 10.1371/journal.pone.0011950