

## **Chapter 1: The Historical Emergence and Current Study of Semantics in Acquisition**

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A child acquiring language – be it English, German, Tamil, Japanese, Mandarin Chinese, Navajo, American Sign Language, or any other of the thousands of languages in the world – is faced with the task of mastering multiple components of that language. Some of the most basic components may be rapidly picked up from the language to which the child is exposed: word order or mappings of certain phonological forms to possible meanings. Other components, such as the constraints or rules that guide the language acquisition process – some of which appear to apply universally across languages, and some of which are language-specific – may be part of an innately endowed language-specific system, or constructed by abstracting over multiple occurrences of patterns. The challenges faced by the young language learner, and the strategies and timeline according to which children meet these challenges, have been the focus of language acquisition research by linguists and developmental psychologists for decades now.

A major inspiration for research programs in this vein were the proposals set forth in Chomsky's foundational book *Aspects on the Theory of Syntax* (1965). In *Aspects*, Chomsky put research on language acquisition at the forefront, making it a major goal for linguistic theory to be rich enough to account for how rapidly and effortlessly the young child seems to acquire language universally and at the same time allow for cross-linguistic diversity. It was here that Chomsky proposed that children are guided by an innate *language acquisition device* (a biologically-endowed mental capacity to acquire language), a concept that later evolved into a set of universal principles to be called *Universal Grammar* (UG). The idea of a Universal Grammar was simple and compelling, because it helped to explain a great deal of both the universality and diversity of languages: every child was said to be equipped with similar

assumptions and expectations about the processes and principles that govern language, but every child must also discover how these processes and principles are instantiated in the language(s) they are acquiring. In this way, there was an interplay between the innate components of grammar present from the very beginning, and the ones dependent upon experience and linguistic input from the caregiver. The very concept of UG changed the way that researchers approached the study of language and language acquisition, but it would also become a matter of fierce debate in years to come.

Chomsky proposed a fundamental distinction between *competence* and *performance* – a distinction between what a language user knows about their language (without even knowing they know it) and how they actually use language. This competence/performance distinction carries clear implications for research on language acquisition and our ability to extrapolate what a child *knows* from what a child *does* when using language or performing in an experimental study. We cannot (and should not) assume that children’s early linguistic production – such as the single and telegraphic multi-word utterances carefully documented in Brown (1973), Bloom (1970), and elsewhere – adequately captures their full and always developing linguistic capacity.

Around the same time that *Aspects* was published, Ross’s (1967) dissertation *Constraints on variables in syntax* appeared, and served as a rich source of syntactic phenomena (identified with creative and now-standard terminology) to be studied for years to come, including islands, sluicing, pruning, scrambling, and other constraints and conditions on movement. Subsequent publications in the field of linguistics brought to light the challenges and appeal of investigating phenomena such as *wh*-movement (Chomsky 1977), case, anaphora and binding constraints involving pronouns, reflexives, and names (Chomsky 1980; Reinhart 1983), null subjects/objects, pro, PRO, raising and control (Bresnan 1982, Rizzi 1986, Williams 1980).

Years later, in *Lectures on Government and Binding* (1981) Chomsky proposed a system of principles and parameters that constrained linguistic representations, and set forth X-bar theory, a theory governing syntactic phrase structure.

The overall result was that during this time, linguistic theory was highlighting specific structural (syntax-specific) aspects of language that every child needed to acquire, along with specific features that children acquiring certain languages would need to master. A common goal of researchers was to take linguistic theory as a starting point for targeting specific aspects of children's language acquisition process, and to arrive at a linguistic theory with explanatory adequacy that could formally account for behavioral data collected from children and children's frequent deviation from adult production, and reveal their underlying competence at various stages in development. Research in language acquisition was therefore focused on syntax during this period of time, because it was in this subfield of linguistics that Chomsky's proposals could be tested, and researchers could gather evidence that spoke directly to the cross-linguistic universals that may or may not govern the structure of language, the cross-linguistic variation that it was possible to observe, and the processes by which children might acquire syntax, be it through an innate capacity or by generalizations over patterns in the input.

Over a number of years, a convincing and powerful argument was being made that formal semantics had a firm place in the growing field of cognitive science, and that the investigation of meaning was built upon an understanding of lexical and compositional semantics, syntactic structures, conceptual representations, and an understanding of the link between language and cognition. This move had started years before. Because in *Aspects*, Chomsky talked of linguistic theory as being concerned with the mental or psychological reality underlying behavior, linguistics not only found itself firmly established in the cognitive sciences,

but empirical behavioral data and introspective judgments were becoming a window into more abstract linguistic representations and mechanisms. Fodor's *The Language of Thought* (1975) made an explicit link between the syntax of linguistics and mental representations in thought, both inspiring future lines of work and sparking further debate. Jackendoff's *Semantics and Cognition* (1983) and *Semantic Structures* (1990) emphasized this connection clearly, as did Barbara Partee's (1995) chapter 'Lexical semantics and compositionality' in Gleitman, Liberman, & Osherson's *An Invitation to Cognitive Science*. Adele Goldberg's *Constructions* (1995), too, reinforced this link with the novel proposal that constructions themselves conveyed meaning beyond individual words and their composition, offering an alternative to generative approaches of language acquisition and learning, which would inspire lines of research investigating how children could acquire abstract constructions and generalize over patterns via similarity and analogy.

As attention to the subfield of semantics in new areas grew, so did research in word learning. Again, this was by no means a new phenomenon. To take one well-known example, hundreds of years prior, in the 17<sup>th</sup> century, John Locke (1690/1894) had highlighted the challenges of word learning in discussions about the relation between a word, an idea, and reference. But researchers were now equipped with sophisticated linguistic and cognitive theory, data, and methodologies to move beyond Locke's early form of an associationist account of word learning and make more specific proposals about the process of acquiring meaning based on recent advances in lexical semantics and the mapping between syntactic structure, conceptual structure, and semantic representations. In the 1970s and 1980s, semantic feature theory, and the connection between linguistic and conceptual categories, played a prominent role in discussions of the acquisition of the lexicon, and the progression through stages of lexical understanding in

language development (see e.g., Clark, 1973; Bowerman 1978).

In the 1990s, the syntax-semantics interface in language acquisition had attained a central position in the field. Landau & Gleitman (1985) and Gleitman (1990) capitalized on this tight linking between syntax and semantics – specifically that the structures in which verbs appear are projections of the meaning of these verbs – to propose a theory of syntactic bootstrapping: that children could deduce something about the meaning of words (verbs specifically) by paying attention to the syntactic environments in which they appear in the input. Support for this hypothesis came from their (1985) analysis of interactions between a mother and her blind child prior to the point in development when the child was producing vision-related words. A close examination of the patterns that surfaced in this corpus revealed that it was not just the proximity of the object to be explored that distinguished lexical meaning between verbs like *look* and *see*, but rather, that the subcategorization frames and linguistic environments in which these words appeared seemed to provide reliable cues to the learner about differences in meaning – and that attention to extralinguistic information could be modulated by sensitivity to linguistic information. That such a strategy could account for how even a blind child without the ability to perceive visual events could differentiate between *look* and *see* is compelling evidence that perception need not be at the forefront of word learning, and that children recruit structural patterns that can be abstracted from caregiver input.

In a complementary vein, Pinker (1989, 1994b) suggested how this connection between syntax/semantics could allow the learner to acquire argument structure: the learner pays attention to the situations in which a verb is used, and maps event participants onto arguments with thematic roles projected from the verb meaning. Gleitman and Landau brought together a number of prominent linguists, psychologists, and developmentalists for contributions to the

volume *Acquisition of the Lexicon* (1994), which laid out the conceptual and linguistic issues inherent to word learning, and verbs in particular. But many of the same concerns – the relation between conceptual and linguistic categories, for example – apply equally to other predicates, such as adjectives, as Kamp & Partee (1995) showed quite clearly.

Also in the 1990s, textbooks appeared that made it easier for students and researchers of linguistics to become acquainted with the tools of formal logic and semantics and to apply them to issues relevant to cognitive science, including language acquisition and psycholinguistics. These included the two-volume (1991) *Logic, Language, and Meaning* published by notable logicians and semanticists under the pseudonym L. T. F. Gamut, Chierchia & McConnell-Ginet's (1993) *Meaning and Grammar*, and Heim & Kratzer's (1998) *Semantics in Generative Grammar*. These texts continue to be standard textbooks used in graduate semantics courses, because they draw upon decades of theoretical advances such as Montague grammar (Montague 1973, 1974; see Partee 2006), and not only make such formalism accessible to students of semantics, but illustrate its relevance to capturing and investigating a range of natural language phenomena.

Montague grammar served as a main starting point of formal semantics because of the merger of the techniques of logic with natural language and its own “Universal Grammar,” which highlighted the mathematical foundations of language, the truth conditional components of semantics, entailment relations, the Fregean-inspired principle of compositionality, and the homomorphism between syntax and semantics. In subsequent years, key theoretical publications would come to shape the way researchers accounted for the interpretations that were available (or not) in natural language expressions, and the kinds of sentences they targeted in their research. These included, for example, May's (1977, 1985) proposal of Quantifier Raising – that

a quantificational phrase moves covertly through the structure, allowing for scopal interaction; Ladusaw's (1979) appeal to downward entailing environments as licensors for Negative Polarity Items (NPI) (e.g., *any*); Barwise & Cooper's (1981) work on generalized quantifiers and monotonicity; and Heim's (1982) idea of partitioning sentences into a tripartite structure (quantifier, restrictor, and nuclear scope) and her account of 'donkey' sentences (*Every farmer who owns a donkey feeds it*) that appealed to quantifier binding.

As a result, in the mid-nineties to early 2000s, and research on children's knowledge of quantifier meaning had begun to surge. Certainly, this was not the first time quantification had drawn interest in the area of language development; Inhelder and Piaget (1958, 1964) had documented children's interpretations of sentences involving universal quantifiers long before this, and quantifiers continued to be of interest to developmentalists for years afterwards (see, for example, Smith 1980; Freeman, Sinha, & Stedman 1980). But during this period of time, key publications on children's knowledge of quantifier meaning began to appear. What distinguished these works from earlier ones, and what fostered the move towards investigations in semantics, was that, now, acquisition researchers were equipped with the theoretical linguistic machinery and formalism that earlier developmentalists lacked. Some research focused on how children interpret universal quantifiers such as *every*, *each*, and *all* vis-à-vis quantifier spreading and entailment relations (Brooks & Braine 1996; Brooks et al 2001; Crain et al. 1996; Crain, Meroni, & Minai 2004; Drozd 2001; Philip 1995). Other research focused on the scopal interaction between quantifiers and negation or indefinite expressions (Gualmini 2003; Lidz & Musolino 2002; Musolino 1998). Both lines continue to have a profound impact on the topics and cross-linguistic range of research conducted in the field of acquisition.

Around this same time, two other instructional books were published, which contributed

to the rise of acquisition work in semantics in another way. The first, McDaniel, McKee, & Smith Cairns's *Methods for Assessing Children's Syntax* (1996) featured chapters written by experts in the field, detailing in clear, step-by-step fashion how to implement both established and growing methodologies in language acquisition and development, one of which was the Truth Value Judgment Task (TVJT), which was also subsequently widely applied to the acquisition of semantics and pragmatics. This methodology was first introduced in Crain & McKee (1986), but was introduced at length with multiple illustrative and entertaining examples in Crain & Thornton's (1998) *Investigations in Universal Grammar*. Research on semantics in language acquisition continued to flourish throughout the early 2000s, with the topics under investigation broadening to include not only quantification, but also phenomena such as negation and disjunction (Goro & Akiba 2004; Gualmini & Crain 2005a, b), the scope of *only* (Gualmini & Schwarz 2009), and gradable adjectives (Barner & Snedeker, 2008; Syrett 2007, Syrett, Kennedy, & Lidz 2010).

But this period of time also saw the surge of another area of language acquisition beyond syntax: pragmatics. If semantics is the study of lexical and truth-conditional meaning, pragmatics is the study of meaning in context. Semantic meaning arises from the meaning of words and phrases, and propositional content determined compositionally, whereas pragmatics moves beyond what is said to the meaning that a speaker intends or a listener retrieves when language is used. It may not be so surprising, then, that a great deal of pragmatic meaning takes a long time to acquire.

A number of publications in the seventies served as the impetus for the study of formal pragmatics, beginning with Horn's (1972) dissertation, *On the Semantic Properties of Logical Operators in English*, which served as a springboard. Around this same time, work in semantics

and pragmatics by Robert Stalnaker, Lauri Karttunen, and Stanley Peters formalized the notions of presuppositions and how they are triggered by specific lexical expressions and calculated in complex sentences (Karttunen 1974; Karttunen & Peters 1979; Stalnaker 1974). David Lewis illustrated how a speaker and hearer negotiate meaning and truth conditions, and make accommodations in a context as a conversation unfolds (Lewis 1979). Grice's *Logic and Conversation* first appeared in 1975, but began to gain influence when his writings were published posthumously in 1989, the same year that Horn's *A Natural History of Negation* was published. Soon afterwards, more linguists were appealing to the Gricean maxims of quantity, quality, relation, and manner, and the Cooperative Principle. Much later, however, neo-Griceans (Horn 2004) and Relevance theorists (Wilson and Sperber 2004) would propose alternative principles to the Gricean Maxims. These theoretical proposals brought presupposition triggers, conversational implicatures – and specifically scalar implicatures – to the foreground, paving the way for work in acquisition and psycholinguistics to pick up on these phenomena as topics of investigation. Clark and Amaral (2010) highlight a number of ways in which lexical acquisition capitalizes upon pragmatic sources of information, including gesture and eye gaze, common ground between speaker and hearer, relevance, and discourse context.

Noveck's seminal (2001) article was perhaps the first paper in acquisition to investigate how older children and adults calculated scalar implicatures on so-called 'Horn scales' with words like *might* and *some*. He showed that children, but not adults, generally accept statements such as *There might be a parrot in the box* when there is a probability of 1.0 that there is a parrot in the box (and it is therefore more felicitous and informative to say that there *must* be a parrot in the box). Likewise, children accept statements such as *Some giraffes have long necks* when our experience in the real world tells us that *all* giraffes have long necks. Papafragou & Musolino

(2003) then showed that much younger children (preschoolers) also accept such underinformative statements, but become more adult-like with training that emphasizes conventional descriptions. Soon afterwards, there was an explosion of acquisition research on monolingual – and later, bilingual – children’s offline and online comprehension of scalar implicatures, as well as on whether and how methodological revisions could improve performance, shed light on the nature of the implicature, or access children’s more fine-grained judgments (see, for example, Katsos & Bishop (2011)).

Well into the 2000s, then, acquisition researchers had increasingly taken up semantic and pragmatic issues in language acquisition, taking as a starting point theoretical linguistic formalism, with the goal of illuminating the process of acquisition and development, and at the same time obtaining empirical data that could bear on the aforementioned theoretical proposals. And a number of researchers who were initially trained as theoretical semanticists rather than developmentalists have turned to acquisition experiments to further probe the limits of meaning and test hypotheses that propose that some aspect of meaning depends on a particular component being present in the grammar or a particular ability to make certain kinds of inferences. Thus, whereas early investigations in acquisition and development were centered on syntactic phenomena, the field of language acquisition now has a more widespread focus, extending to investigations of semantic and pragmatic meaning.

This brings us to the current date and this volume on *Semantics in Acquisition*. We have invited established and leading researchers in language acquisition and development, along with scholars newer to the field, to contribute to this volume. Together, their work collectively represents both novel and classic investigations of semantics in acquisition that are firmly grounded in semantic theoretical traditions while advancing the field of acquisition forward into

new territory.

We have divided the volume into five sections, which not only represent the research interests of these respective researchers, but also capture the major areas of investigation within this growing subfield in acquisition: the acquisition of word meaning and the structure of the lexicon, the acquisition of verb meaning and event semantics, the mapping between syntactic structure and semantic meaning and its role in the acquisition of word meaning, logical interpretations and abstract operations, and the relation between semantics and pragmatics in a speaker's meaning. The sections are sequenced in a way that roughly mirrors language development – a progression from the early acquisition of word meaning and the link between concepts and linguistic forms, to a more complex mapping between syntax and semantics and the interpretation of logical expressions, and finally to the relation between semantics and pragmatics in speaker meaning.

In each section, researchers highlight the basic learning and interpretational problems the young language learner faces – some universal across languages and some specific to a particular language, some universal across lexical and grammatical categories and some specific to particular expressions. These researchers also present experimental investigations, evidence from spoken language corpora, and/or data from previous studies that bear on this issue in order to make a proposal about children's developing linguistic capacity with respect to semantics, and in some cases its relation to syntax and/or pragmatics.

In **Section 1 (Lexical meaning)**, we begin with lexical semantics and the semantic features and domains present as children build their early lexicons. Eve Clark's chapter "Word meanings and semantic domains in acquisition" starts us off on the initial mapping between sound and meaning, and the gradual building up of semantic domains in the lexicon, which rely

upon the link between words and concepts, and similar words to each other. Over the years, Clark has beautifully and skillfully drawn our attention to the semantic and pragmatic force of seemingly mundane daily interactions between children and their caregivers, documenting the development of these interactions over time, and describing in detail the semantic and pragmatic challenges inherent to acquiring words describing concepts such as space, relations, and properties. In this chapter, Clark highlights the conceptual sources for word meaning and the social and linguistic support provided to children about the meaning of words and the structure of a semantic domain by their caregivers in their interactions. Thus, Clark introduces us to the young language learner who is rapidly transforming into a young conversationalist.

One might be tempted to think that young children iron out the details of word meaning in the first two to three years of language acquisition, and from then on, it is semantic composition and more complex sentence structures that pose the challenge. However, this is not the case. Fast forward a number of years into language development, and children as old as five years of age are still struggling to pin down the meaning of certain words, even seemingly simple ones such as those mapping on to periods of time or temporal ordering. (We return to the struggles that five- and six-year-olds experience when trying to pin down the meanings of certain words in our last chapter on semantics and pragmatics.) In her chapter “The influence of linguistic temporal organization on children’s understanding of temporal terms and concepts,” Laura Wagner presents the results of two experiments in which children age five to eight were asked to order events on a timeline, given descriptions of the events and/or explicit linguistic temporal terminology. In doing so, she tests the hypothesis that if a particular semantic element is typologically prevalent across the world’s languages, then it will be comparatively easy for children to learn (because concepts that humans are predisposed to learn will shape learning and

will be grammaticized). While Wagner finds limited support for this hypothesis, the results highlight the role of a ‘deictic center’ in relative temporal ordering and lend potential support to a “thinking for speaking” position (Slobin 1987, 1996), which holds that our grammar shapes the way that we perceive and think about events in the world and the way in which we speak about them.

Among the words and grammatical categories every child acquires are verbs. Investigations of how the child acquires verb meaning have played a central role in the field of language acquisition, because of the relative delay of the appearance of verbs in the lexicons of many languages relative to nouns (Gentner 1978, 1982) and the tight relation between syntax and semantics in verb meaning due to the semantic roles linked to argument structure and event representation (Gleitman 1990; Grimshaw 1981; Pinker 1994a). In their chapter “Semantic features of early verb vocabularies,” Sabrina Horvath, Leslie Rescorla, and Sudha Arunachalam take this long-standing observation about the acquisition of verbs as a starting point for their comprehensive survey addressing *which* kinds of verbs are difficult to acquire initially, and why. Horvath et al. examined parental reports in a vocabulary checklist for toddlers acquiring Greek, Italian, Korean, and Portuguese, and coded verbs for a subset of key semantic dimensions tied to event representation: manner or result, durative or punctual events, and the number of event participants encoded in the verb’s denotation. They find that both durativity and the number of event participants are predictors of order of acquisition.

We dig further into the link between event representation and verb meaning in **Section 2 (Event Semantics)**, in which the two chapters target one aspect of verbs in particular: telicity (event completion, from the Greek *telos* ‘goal’). This aspect of verb meaning and events was most notably brought to light by Dowty (1979) and Vendler (1957). The two chapters in this

section outline the learning problem and relevant experimental findings to date on the acquisition of telicity. Angeliek van Hout's chapter "On the acquisition of event culmination" presents the linguistic sources of telicity and perfectivity located in the lexical semantics of the verb, verb phrases, and aspectual morphology. She reviews in exceptional detail previous studies covering the acquisition of verb meaning as it relates to manner and endstates, and children's acceptance of telic sentences in events without culmination, incorporating a range of linguistic features and methodologies across a number of languages, including English, Dutch, German, and Spanish. Van Hout concludes by offering a proposal about why children consistently accept non-culminating interpretations of telic-perfective sentences.

Petra Schulz turns our focus specifically to German in her chapter, "Telicity in typical and impaired acquisition." Beginning with a concise and crisp presentation of the semantics of telicity in language in general, she then transitions to the encoding of telicity in German verb particles and the lexical semantics of verbs, highlighting the contribution of both semantics and pragmatics. How does a child learning to speak German acquire telicity in verb meaning? Schulz proposes an *Event Structural Bootstrapping* account in which the child focuses on a verb's event structure rather than on its core meaning or its argument selection, and demonstrate an *Endstate Orientation* in which they focus on expressions that encode an endstate. She presents empirical support for this position from previous studies of typically developing children in German, but contrasts this with findings from children who exhibit Specific Language Impairment (SLI) (Developmental Language Disorder). Atypically developing children appear to have an unstable *Endstate Orientation* (or lack an endstate orientation) and do not reliably understand that the endstate is entailed by telic verbs. The findings from German may be easily generalized to make predictions about the acquisition of telic verbs by typically and atypically developing children in other languages.

Given the complexity that arises in verb meaning – even with the simplest of verbs and event expressions – a question that naturally arises is what strategies children use to acquire verb meaning. **Section 3 (Syntactic Structure and Semantic Meaning)** presents four chapters that address the role that the relation between syntax/constructions and semantic meaning plays in this process. In their chapter “Not all subjects are agents: Transitivity and meaning in early language comprehension,” Rose Scott, Yael Gertner, and Cynthia Fisher present two preferential-looking experiments with novel verbs to test the hypothesis that young language learners approximately two years of age take transitive syntax to indicate an asymmetric expression of the subject corresponding to the agent and the object corresponding to the patient (or proto-agent and proto-patient in the sense of Dowty (1991)) and not merely a causal interpretation. Their findings strongly suggest that young children at this age link transitive word order with semantic roles that extend beyond prototypical agents and patients, demonstrating a more abstract representation of meaning early in acquisition than was previously thought.

Ben Ambridge, Micah Goldwater, and Elena Lieven in their chapter “Analogical structure mapping and the formation of abstract constructions: A novel construction learning study” also capitalize on the value of incorporating novel language into an experimental design with a forced choice pointing paradigm to test the power of the link between syntax and semantics in verb learning. Instead of novel verbs, however, their experiment tests novel constructions in order to test Tomasello’s (2003) proposal that children perform an analogical structure mapping across specific slot-and-frame patterns, and use this information to form abstract constructions. The premise of the experiment is that particular constructions may reliably express relations between event participants (e.g., the transitive expressing a relation between an agent and patient, or the ditransitive expression transfer of an object between

possessors). Whether an overlap among constructions is sufficient for children to generalize to an abstract argument structure construction is another question, and one that they probe in their experiments with four- to six-year-olds and non-English OSV and VOS constructions. The null results raise a number of interesting questions about the viability of Tomasello's proposal and the support needed and strategies enlisted for analogical learning.

Aaron White, Valentine Hacquard, and Jeffrey Lidz move us beyond verbs denoting perceivable events of manner, motion, transfer of possession, and enabling or preventing an action to verbs that have more abstract meanings tied to belief and desire (so-called 'propositional attitude verbs'). In their chapter, "The labeling problem in syntactic bootstrapping: Main clause syntax in the acquisition of propositional attitude verbs," White et al. consider how a learner might use cues in a syntactic bootstrapping framework to identify 'clusters' of verbs that share either a belief or a desire component and to 'label' them as such. Like the previous chapters, they depend on a tight connection between syntax and semantics. However, they observe that while the syntactic frame in which verbs like *think*, *believe*, *know*, and *want* appear in English may display regularities with respect to  $\pm$ tense, this correlation is not robust cross-linguistically. Their solution is to invoke abstract projection rules in which the semantic meaning maps onto not one syntactic feature, but a set of such features (a 'featural anchor'). They then go further to formalize their proposal in a probabilistic model, which depends on an incremental learner that observes pairings of such verbs and syntactic features and makes subsequent inferences about the verbs' semantic representation. This model is then applied to child-directed speech data.

Jill de Villiers' chapter "Perspectives on truth: The case of language and false belief reasoning" is also concerned with the information that an embedded clause conveys, and how

children come to understand propositional attitude verbs. De Villiers has carefully highlighted how the language learner must eventually come to appreciate the force of linguistic devices such as pronouns, deixis, and evidentials in expressing another speaker's perspective. But at the same time, the child must understand that another speaker may share a different perspective than their own, and be able to take on that perspective. That is, the child must have a 'Theory of Mind'. Preschoolers' Theory of Mind abilities are often tested in 'false belief' tasks. De Villiers advances the thesis, supported by findings that she reviews in detail, that four-year-olds who pass such a task are able to do so because of their acquisition of sentential complement structures, which enables false belief reasoning. Specifically, they have come to recognize that the tensed complements that verbs such as *believe* and *think* take convey *realis*, or truth, assertion, and point of view.

Of course, the language acquisition process is not limited to the grammatical categories indicated above. Especially vexing are words that function as logical operators, or which undergo covert movement, or which are not present at all in the surface string. In **Section 4 (Logical Interpretations)**, we turn to how children age four to six interpret sentences involving such expressions, and evaluate what the experimental findings presented in these chapters says about children's abstract semantic representations. The work presented in this section follows an approach in language acquisition shaped in many ways by one of the section authors, Crain, of demonstrating that preschoolers not only possess abstract representations involving logical operations, but that their interpretations are also often adult-like, presumably reflecting continuity in language development.

In their chapter, "The meaning of question words in statements in child Mandarin," Crain

and Zhou present two experiments using the question/statement task, a derivative of the Truth Value Judgment Task (TVJT) originally pioneered by Crain (Crain & Thornton 1998), and show that Mandarin-speaking preschoolers appreciate the existential force of a question word (*shenme* ‘what’) appearing in declarative contexts, but treat it as a question word in interrogative, information-seeking contexts (that is in the scope of different expressions).

In the second chapter in this section, “Overt, covert, and clandestine operations: Ambiguity and ellipsis in acquisition,” Kristen Syrett reviews experimental evidence from a series of studies, some of which employ Crain’s TVJT, testing young children’s comprehension of ambiguous sentences involving overt movement (*wh*- questions) or covert movement (quantifier raising), and the interpretation of elided material in verb phrase ellipsis or comparatives. The three main sentence types under investigation involve the interaction of *wh*-phrases and universal quantifiers, antecedent-contained deletion, and comparative constructions involving pronominal reference in the elided material. The experimental findings not only clearly demonstrate that children as young as age four have access to abstract representations and operations at the syntax-semantics interface (even when they do not arrive at the intended adult-like interpretation), but also highlight the path of language development, provide a test of linguistic theory, and help us to better understand the endstate of the adult grammar.

As research on semantics in acquisition has burgeoned, so too has research on pragmatics and the relation between semantics and pragmatics in language development. The three chapters in the final section, **Section 5 (The Relation between Semantics and Pragmatics)** cover children’s knowledge of different linguistic phenomena related to the calculation of semantic and pragmatic meaning. Lyn Tieu, Cory Bill, Jérémy Zehr, Jacopo Romoli, and Florian Schwarz start the section off with their chapter, “Developmental insights into gappy phenomena: Comparing

presupposition, implicature, homogeneity, and vagueness.” This chapter introduces a range of phenomena that have been debated as being handled either by the semantics or pragmatics, all of which involve so-called ‘gappy’ interpretations. These phenomena include presupposition failure when a presupposition is triggered under conditions that do not support it, the calculation of scalar implicatures when the literal meaning of the target expression is considered, statements that are not clearly true or false because they violate homogeneity, and instances of vagueness that involve borderline cases in fuzzy regions. Tieu et al. present a clear and concise review of the theoretical background on these topics, paired predictions for the path of acquisition and a review of a series of experimental studies directly comparing them and revealing their differences. The results of the studies not only provide insight into language development, but speak directly to the merits of the theoretical approaches that attempt to capture these phenomena.

In their chapter, “Four-year-old children compute scalar implicatures in absence of epistemic reasoning,” David Barner, Lara Hochstein, Miriam Rubenson, and Alan Bale home in on children’s calculation of ‘ad hoc’ scalar implicatures – those that are not based on strength by entailment relations – and compare this capacity to children’s ability to make epistemic inferences at the same age. They show that the ability to compute ad hoc implicatures precedes the ability to compute ignorance implicatures. Here, too, in this chapter, Barner et al. offer a simple methodology that gets at a core understanding of the nature of children’s ability to compute pragmatic inferences. Children were shown two dolls and provided with a statement with either a central *or* or *and*, and were asked to determine which of the puppets (the silly or straight faced one, or the seeing or blindfolded one) said it. The findings speak directly to neo-Gricean approaches to pragmatic meaning that implicate reasoning about another speaker’s

knowledge (or lack thereof).

Closing the volume is the chapter “The acquisition path of near-reflexivity” by Valentina Brunetto and Thomas Roeper, which tackles ‘near reflexive’ interpretations (Jackendoff 1992, Lidz 2001) – interpretations illustrated by a scenario in which Ringo sees a statue of himself in a museum, and the situation is described by saying that ‘Ringo saw *himself*.’ Brunetto and Roeper test children’s interpretation of English ‘self’ and Italian *se* and show that English children allow for near-reflexivity with *himself* while Italian children tend not to do so with *se*. Brunetto and Roeper propose that near-reflexivity involves a mapping between sets of individuals (the real people and the statues), and that there is a pragmatic partition of the sets into subsets, giving rise to reciprocal and near-reflexive readings. They argue that at age four, children have difficulty computing multiple partitions, and therefore overaccept near-reflexives. Thus, an interface between syntax, semantics, and pragmatics explains the acquisition path of this linguistic phenomenon.

It is our hope that the collection of chapters in this volume on *Semantics in Acquisition* will not only showcase the range of linguistic phenomena that can be investigated in this subfield of language acquisition, but also highlight the tight connections between semantics and the other subfields of syntax and pragmatics but also between language, concepts, and cognition. In addition, the clear explication of theoretical underpinnings and the diversity of methodologies represented will help current and future researchers conduct further investigations of these topics. We are confident that the clarity of exposition in the chapters, the expertise and enthusiasm of the authors, and the inherent beauty and intrigue of the semantic topics investigated in the experimental research presented in this volume will draw future students to the study of semantics in language acquisition for years to come.

## References

- Barner, David, & Snedeker, Jesse. (2008). Compositionality and statistics in adjective acquisition: 4-year-olds interpret *tall* and *short* based on the size distributions of novel noun referents. *Child Development*, *79*, 594-608
- Barwise, Jon, & Cooper, Robin. (1981). Generalized quantifiers and natural language. *Linguistics and Philosophy*, *4*, 159-219.
- Bloom, Lois. (1970). *Language development: Form and function in emerging grammars*. Cambridge, Mass: MIT Press.
- Bowerman, Melissa. (1978). The acquisition of word meaning: An investigation into some current conflicts. In Natalie Waterson & Catherine Snow (Eds.), *The development of communication* (pp. 263-287). New York: Wiley.
- Bowerman, Melissa. (1980). The structure and origin of semantic categories in the language learning child. In Mary L. Foster & Stanley H. Brandes (Eds.), *Symbol as sense* (pp. 277-299). New York: Academic Press.
- Brooks, Patricia J., & Braine, Martin D. S. (1996). What do children know about the universal quantifiers *all* and *each*? *Cognition*, *60*, 235-268.
- Brooks, Patricia J., Braine, Martin D. S., Jia, Gisela, & Dias, Marcia da Graca. (2001). Early representations for *all*, *each*, and their counterparts in Mandarin Chinese and Portuguese. In S. C. Levinson (eds.), *Language acquisition and conceptual development* (pp. 316-339). Cambridge: Cambridge University Press.
- Brown, Roger. (1973). *A first language*. Cambridge, Mass: Harvard University Press.
- Chierchia, Gennaro, & McConnell-Ginet, Sally. (1993). *Meaning and grammar*. Cambridge,

Mass: MIT Press.

Chomsky, Noam. (1965). *Aspects on the Theory of Syntax*.

Chomsky, Noam. (1981). *Lectures on Government and Binding*.

Clark, Eve V. (1973). What's in a word? On the child's acquisition of semantics in his first language. In T. E. Moore (Ed.), *Cognitive development and the acquisition of language*. New York: Academic Press.

Clark, Eve V., & Amaral, Patricia. (2010). Children build on pragmatic information in language acquisition. *Language and Linguistics Compass*, 4, 445-457.

Crain, Stephen, & McKee, Cecile. (1986). The acquisition of structural restrictions on anaphora. In Stephen Berman, Jae-Wong Choe, and Joyce McDonough (Eds.), *Proceedings of 16 Annual Meeting of the North East Linguistic Society* (pp. 94-111). Amherst, Mass: GLSA Publications, University of Massachusetts.

Crain, Stephen, Meroni, Luisa, & Minai, Utako. (2004). If everybody knows, then every child knows. In J. van Kampen and S. Baauw (eds.), *Proceedings of the Conference on Generative Approaches to Language Acquisition 3* (pp. 127-138). Utrecht: LOT.

Crain, Stephen, & Thornton, Rosalind. (1998). *Investigations in Universal Grammar: A guide to research on the acquisition of syntax and semantics*. Cambridge, Mass: MIT Press.

Crain, Stephen, Thornton, Rosalind, Boster, Carrol, Conway, Laura, Lillo-Martin, Diane, & Woodams, Ellen. (1996). Quantification without qualification. *Language Acquisition*, 5, 83-153.

Dowty, David R. (1979). *Word meaning and Montague grammar*. Dordrecht, The Netherlands: D. Reidel.

Dowty, David R. (1991). Thematic proto-roles and argument selection. *Language*, 67, 547-619.

- Droz, Kenneth F. (2001). Children's weak interpretations of universally quantified questions. In M. Bowerman and S. C. Levinson (eds.), *Language acquisition and conceptual development* (pp. 340-376). Cambridge: Cambridge University Press.
- Fodor, Jerry A. (1975). *The language of thought*. Cambridge, Mass: Harvard University Press.
- Freeman, Norman H., Sinha, Christopher G. & Stedmon, Jacqueline A. (1982). All the cars— which cars? From word meaning to discourse meaning to discourse analysis. In M. Beveridge (ed.), *Children thinking through language* (pp. 52-74). London: Edward Arnold.
- Gamut, L. T. F. (1991). *Logic, language, and meaning. Volume I: Introduction to logic, Volume II: Intensional logic and logical grammar*. Chicago, IL: University of Chicago Press.
- Gentner, Dedre. (1978). On relational meaning: The acquisition of verb meaning. *Child Development, 49*, 988-998.
- Gentner, Dedre. (1982). Why nouns are learned before verbs: Linguistic relativity versus natural partitioning. In Stan A. Kuczaj (Ed.), *Language development: Vol. 2. Language, thought, and culture* (pp. 301-334). Hillsdale, NJ: Erlbaum.
- Gleitman, Lila R. (1990). The structural sources of verb meanings. *Language Acquisition, 1*, 3-55.
- Gleitman, Lila R., & Landau, Barbara. (1994). *Acquisition of the lexicon*. Cambridge, Mass: MIT Press.
- Goldberg, Adele. (1995). *Constructions: A construction grammar approach to argument structure. Cognitive theory of language and culture series*. Chicago, IL: University of Chicago Press.
- Goro, Takuya, & Akiba, Sachie. (2004). The acquisition of acquisition of disjunction and

- positive polarity in Japanese. In V. Chand, A. Kelleher, A. J. Rodríguez, and B. Schmeiser (Eds.), *Proceedings of the 23<sup>rd</sup> West Coast Conference on Formal Linguistics (WCCFL)* (pp. 251-264). Somerville, MA: Cascadilla Press.
- Grice, H. Paul. (1975). Logic and conversation. In Peter Cole and James Morgan (Eds.), *Syntax and semantics, Vol.3*, Academic Press. Reprinted in Grice (1989) (pp. 22-40).
- Grice, H. Paul. (1989). *Studies in the way of words*. Cambridge, Mass: Harvard University Press.
- Grice, H. Paul. (1989). *Studies in the way of words*. Cambridge, Mass: Harvard University Press.
- Grimshaw, Jane. (1981). Form, function, and the language acquisition device. In C. L. Baker and J. J. McCarthy (Eds.), *The logical problem of language acquisition* (pp. 183-210). Cambridge, Mass: MIT Press.
- Gualmini, Andrea, & Crain, Stephen. (2005a). Operator conditioning. In Alejna Brugos, Linnea Micciulla, & Christine E. Smith (eds.), *Boston University Conference on Language Development (BUCLD) 28 Proceedings* (pp. 232-243). Somerville, MA: Cascadilla Press.
- Gualmini, Andrea, & Crain, Stephen. (2005b). The structure of children's linguistic knowledge. *Linguistic Inquiry*, 36, 463-474.
- Gualmini, Andrea, & Schwarz, Bernhard. (2009). Solving learnability problems in the acquisition of semantics. *Journal of Semantics*, 26, 185-215.
- Heim, Irene. (1982). The semantics of definite and indefinite NPs. Doctoral dissertation, University of Massachusetts – Amherst. Amherst, Mass: GLSA Publications, University of Massachusetts.
- Heim, Irene, & Kratzer, Angelika. (1998). *Semantics in generative grammar*. Malden, Mass: Wiley-Blackwell.

- Horn, Laurence R. (1972). *On the semantic properties of the logical operators in English*.  
 Doctoral dissertation, UCLA, Los Angeles, CA. Distributed by the Indiana University  
 Linguistics Club (1976). Bloomington, IN: Indiana University.
- Horn, Laurence R. (1989). *A natural history of negation*. Chicago, IL: University of Chicago  
 Press.
- Horn, Laurence R. (2004). Implicature. In Laurence R. Horn & Gregory Ward (Eds.), *The  
 handbook of pragmatics* (pp. 3-28). Oxford: Blackwell Publishing.
- Inhelder, Bärbel, & Piaget, Jean. (1958). *The growth of logical thinking from childhood to  
 adolescence*. New York: Basic Books.
- Inhelder, Bärbel, & Piaget, Jean. (1964). *The early growth of logic in the child: Classification  
 and seriation*. London: Routledge and Kegan Paul.
- Jackendoff, Ray. (1983). *Semantics and cognition*. Cambridge, Mass: MIT Press.
- Jackendoff, Ray. (1990). *Semantic structures*. Cambridge, Mass: MIT Press.
- Jackendoff, Ray. (1992). Mme. Tussaud meets the binding theory. *Natural Language and  
 Linguistic Theory*, 10, 1-31.
- Kamp, Hans, & Partee, Barbara. (1995). Prototype theory and compositionality. *Cognition*, 57,  
 129-191.
- Karttunen, Lauri. (1974). Presuppositions of compound sentences. *Linguistic Inquiry*, 4, 169-  
 193.
- Karttunen, Lauri, & Peters, Stanley. (1979). Conventional implicature. *Syntax and Semantics*,  
*Vol. 11: Presupposition* (pp. 1-56). New York: Academic Press.
- Katsos, Napoleon, & Bishop, Dorothy. (2011). Pragmatic tolerance: Implications for the  
 acquisition of informativeness and implicature. *Cognition*, 120, 67-81).

- Ladusaw, William. (1979). Polarity sensitivity as inherent scope relations. Doctoral dissertation, University of Texas – Austin. Republished in (1980) in the series *Outstanding dissertations in Linguistics*. New York: Garland.
- Landau, Barbara, & Gleitman, Lila R. (1985). *Language and experience: Evidence from the blind child*. Cambridge, Mass: Harvard University Press.
- Lewis, David. (1979). Scorekeeping in a language game. *Journal of Philosophical Logic*, 8, 339-359.
- Locke, John. (1690/1894). An essay concerning human understanding. Ed. by Alexander Campbell Fraser. 2 vols. Oxford: Clarendon Press.
- Lidz, Jeffrey. (2001). Condition R. *Linguistic Inquiry*, 32, 123-140.
- Lidz, Jeffrey, & Musolino, Julien. (2002). Children's command of quantification. *Cognition*, 84, 113-154.
- May, Robert. (1985). *Logical Form*. Cambridge, Mass: MIT Press.
- McDaniel, Dana, McKee, Cecile, & Smith Cairns, Helen. (1996). *Methods for assessing children's syntax*. Cambridge, MA: MIT Press.
- Montague, Richard. (1973). The proper treatment of quantification in ordinary English. In K. J. J. Hintikka, J. M. E. Moravcsik, and P. Suppes (Eds.), *Approaches to natural language* (pp. 221-242). Dordrecht: Reidel.
- Montague, Richard. (1974). *Formal philosophy: Selected papers of Richard Montague*. Ed. by Richmond H. Thomason. New Haven: Yale University Press.
- Musolino, Julien. (1998). *Universal Grammar and the acquisition of semantic knowledge: An experimental investigation into the acquisition of quantifier-negation interaction in English*. Doctoral dissertation, University of Maryland, College Park.

- Noveck, Ira. (2001). When children are more logical than adults: Experimental investigations of scalar implicature. *Cognition*, 78, 165-188.
- Papafragou, Anna, & Musolino, Julien. (2003). Scalar implicatures: experiments at the semantics-pragmatics interface. *Cognition*, 86, 253-282.
- Partee, Barbara. (1995). Lexical semantics and compositionality. In Lila Gleitman, Mark Liberman, and Daniel Osherson (Eds.), *An invitation to cognitive science, Part I: Language* (pp. 311-360). Cambridge, Mass: MIT Press.
- Partee, Barbara. (2006). Montague, Richard (1930-1971). In Keith Brown (Ed.), *Encyclopedia of Language and Linguistics* (pp. 255-257). Oxford: Elsevier.
- Philip, William. (1995). *Event quantification in the acquisition of universal quantification*. Doctoral dissertation, University of Massachusetts–Amherst.
- Pinker, Steven. (1989). *Learnability and cognition: The acquisition of argument structure*. Cambridge, Mass: MIT Press.
- Pinker, Steven. (1994a). How could a child use verb syntax to learn verb semantics? *Lingua*, 92, 377-410.
- Pinker, Steven. (1994b). *The language instinct: How the mind creates language*. New York, NY: Harper Perennial Modern Classics.
- Reinhart, Tanya. (1983). Coreference and bound anaphora: A restatement of the anaphora questions. *Linguistics and Philosophy*, 6, 47-88.
- Rizzi, Luigi. (1986). Null Objects in Italian and the Theory of pro, *Linguistic Inquiry*, 17, 501-557.
- Ross, John Robert. (1967). *Constraints on variables in syntax*. Doctoral dissertation, MIT, Cambridge, Mass.

- Slobin, Daniel I. (1987). Thinking for speaking. In the Proceedings of the Thirteenth Annual Meeting of the Berkeley Linguistics Society (pp. 435-445). Available at <https://journals.linguisticsociety.org/proceedings/index.php/BLS/article/view/1826/1598>.
- Slobin, Daniel I. (1996). From “thought and language” to “thinking for speaking.”. In John J. Gumperz & Stephen C. Levinson (Eds.), *Rethinking linguistic relativity* (pp. 70- 96). Cambridge: Cambridge University Press.
- Smith, Carol L. (1980). Quantifiers and question answering in young children. *Journal of Experimental Child Psychology*, 30, 191-205.
- Stalnaker, Robert. (1974). Pragmatic presuppositions. In Robert Stalnaker (Ed.), *Context and Content* (pp. 47-62). Oxford: Oxford University Press.
- Syrett, Kristen. (2007). *Learning about the structure of scales: Adverbial modification and the acquisition of the semantics of gradable adjectives*. Doctoral dissertation, Northwestern University.
- Syrett, Kristen, Kennedy, Christopher, & Lidz, Jeffrey. (2010). Meaning and context in children’s understanding of gradable adjectives. *Journal of Semantics*, 27, 1-35.
- Tomasello, Michael. (2003). *Constructing a language: A usage-based theory of language acquisition*. Cambridge, Mass: Harvard University Press.
- Vendler, Zeno. (1957). Verbs and times. *The Philosophical Review*, 66, 143-160.
- Wilson, Deirdre, & Sperber, Dan. (2004). Relevance theory. In Laurence R. Horn & Gregory Ward (Eds.), *The handbook of pragmatics* (pp. 607-632). Oxford: Blackwell Publishing.