Daniel Altshuler
Jessica Rett  *Editors*

# The Semantics of Plurals, Focus, Degrees, and Times

## Essays in Honor of Roger Schwarzschild

Springer

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# Preface

**Daniel Altshuler and Jessica Rett**

**Abstract**  In this preface, we introduce Roger Schwarzschild's body of work, as well as the papers in this volume. Because Roger's work is so diverse and comprehensive, the book is divided into four categories: papers that address the semantics of nouns and plurals; papers on focus semantics; papers on degree semantics; and papers addressing the semantics of tense and aspect. We end with compelling arguments that Roger is the best.

**Keywords**  Plurals · Focus · Degrees · Space · Tense · Aspect

This book is lovingly dedicated to Roger Schwarzschild on the occasion of his 60th birthday.

Whenever Roger is brought up in conversation—any conversation—the words are shaded with the warmest pastels. Shared experiences are often familiar because he has been a guiding angel for so many. For those lucky enough to get to know Roger, their thoughts and experiences have forever become Rogeresque. As the editors of this volume, we are honored to aid a celebration of Roger's accomplishments as a scholar, colleague, teacher, friend, and mentor.

Roger's contribution to semantics has been formative. As noted by Roger's Doktormutter, Angelika Kratzer, Roger is not satisfied until he gets to the truth of the matter. This is not only painstaking, but it takes a long time. Roger, however, has been a successful perfectionist, even from early on in his career. Every one of his publications has made a vital contribution to the field. Roger has inspired generations of scholars to rethink their own work in a new light, regardless of the framework employed, regardless of the kind of research being pursued. After all, the truth of the matter is not tied to a particular framework or a particular research question. Once discovered, it lives on as the core of semantic theorizing.

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# 1 Roger's Contributions to Formal Semantics

Roger's contributions to formal semantics is unusually varied. As the title of this volume reflects, he has made lasting impacts on the semantics of plurals, focus, degrees, and tense; areas that seem quite diverse on the face of things. But the creative approaches he has used in this work—cross-linguistic, undogmatic, and phenomenon-general—have also helped address broader questions, including the question of what sorts of entities can be represented in natural language, and what the properties and structures of those entities can and must be.

## 1.1 *The Semantics of Nouns and Plurals*

Roger's earliest impact on the field of natural language semantics was one of his biggest. In his dissertation (Schwarzschild 1991), Roger advanced an empirically comprehensive treatment of plurals as set-denoting. While it has historical prece- dence (see Winter and Scha 2015, for a recent overview), the proposal was made in direct contrast to Link's (1983) suggestion that plurals denote individuals qua join semi-lattices. To account for the symmetric interpretations of complex plu- rals (e.g., *Mary and John were separated*), Roger proposed that plural denotations include a context-sensitive parameter defining their cover, allowing for the plural to be associated with different subsets of its referential denotation. This view was further developed in a series of papers (Schwarzschild 1992, 1994) and in his book (Schwarzschild 1996), prompting future generations of scholars to research how con- textual effects should be incorporated into the analysis of plural phenomena, across theoretical frameworks.

In later work, culminating in a very influential *Journal of Semantics* article (Schwarzschild 2002), Roger argued that specific indefinites take exceptional scope because of their semantic properties, as opposed to their syntactic properties. In particular, he argued that a specific indefinite is any indefinite with a singleton in its extension, in which case the scope of the indefinite is neutralized with respect to other quantifiers, giving the appearance of wide scope. To a large extent, it is this idea that has made the treatment of specific indefinites a hot topic in formal semantics. Roger's theory is still firmly in place as part of the canon, in linguistic semantics as well as the philosophy of language.

In 2006, Roger taught a graduate seminar at Rutgers on the mass/count distinc- tion. While recent work had been done to address the apparent semantic differences between mass and count nouns (Chierchia 1998a, b), Roger remained frustrated by the distinction, as well as a potentially related distinction between cumulative and distributive interpretations of plurals. In a series of paradigm-shifting papers (Schwarzschild 2011, 2015), Roger advanced the proposal (inspired by Higgin- botham and Schein (1989); Parsons (1990)) that the count/mass distinction and the cumulative/distributive distinction are both best accounted for in a semantics in which

nouns are principally associated with eventualities, not individuals. Single count nouns are predicates of eventualities that require single participants; plural count nouns and some mass nouns (like *traffic*) are predicates of eventualities that require multiple participants; other mass nouns (like *furniture*) are underspecified in this respect. Currently, Roger is working on his magnum opus, which looks at numerical reports (*4000 ships passed through the lock*, Krifka 1990), in addition to count/mass nouns, and proposes new, striking formal similarities between the nominal and verbal domains.

## 1.2 The Semantics of Focus

Roger often jokes that he could not, in his wildest dreams, have imagined contributing to research on focus because he is "tone-deaf". And yet, it is difficult to find work on focus in the 21st century that doesn't mention Roger's seminal research (Schwarzschild 1997, 1999, 2004a).

His article in *Natural Language Semantics* (Schwarzschild 1999) is arguably his most important contribution. Besides being widely cited, it is considered to pioneer research in Optimality Theoretic Pragmatics (Blutner and Zeevat 2003), in part due to the proposed, violable constraints which are ranked with respect to one another: GIVENness, Avoid F, FOC, and HeadArg. The GIVENness Constraint requires constituents that are unfocused-marked to be GIVEN—a notion with a complex history that Roger redefines by synthesizing insight from the literature on focus semantics with views on information structure. AvoidF requires speakers to economize on focus-marking, while FOC requires a subset of focus-markers to dominate accents; HeadArg requires a head to be less prominent than its internal argument. Roger shows how deaccenting and various kinds of prominence patterns arise from a particular ranking of the constraints. Moreover, Roger shows that head/argument asymmetries that are well-known in the literature on focus projection (e.g., Selkirk 1984, 1995) are placed in the phonology-syntax interface, independent of discourse conditions.

Roger's most recent work on focus (Schwarzschild 2018) considers what happens when an expression is both focused and GIVEN. He considers three conflicting results: reduced prominence, increased prominence and infelicity. Building on (Schwarzschild 1999's) definition of GIVENness, as well work on associated foci and exhaustivity operators (Fox 2007; Beck and Vasishht 2009; Chierchia 2013; Katzir 2013), the paper proposes several hypotheses that negotiate a path out of the conflict. (i) GIVENness and focus coexist in the grammar; each is represented with its own syntactic marker associated with its own phonological consequence. (ii) GIVENness status is determined relative to the discourse context and the immediate syntactic context in which an expression is found in a way that minimizes the amount of material deemed novel. (iii) Every focus associates with a focus-sensitive operator. (iv) There are silent exhaustivity operators that associate with focus. And (v) Structures containing nested focus-sensitive operators in which all the associated foci are in the scope of the inner operator are problematic.

Roger's proposed analysis is driven, to a large extent, by the widely cited *crêpes* example, involving second occurrence focus. Roger argues that such an example is problematic due to nested focus-sensitive operators—an explanation that is crucially independent of focus phonology. Moreover, he argues that second occurrence focus results from the confluence of independently derived focus and GIVENness marking simultaneously implemented in the phonology (Féry and Ishihara 2009). This conclusion is important because it goes against the predominant view that second occurrence focus is the result of a competition among foci or anaphora-to-focus (Selkirk 2008; Krifka 2004).

## 1.3   The Semantics of Degree and Space

Roger's work on degree semantics began in a foundational article on the semantics of comparatives he coauthored with Karina Wilkinson (Schwarzschild and Wilkinson 2002). Based on earlier investigations of the role of quantifiers in comparatives (e.g., *Roger is shorter than every student*; Larson 1988), Roger and Karina proposed that the comparative morpheme is best analyzed as a quantifier over intervals – a semantic primitive—rather than sets of degrees. The theory was explicitly extended to cover an impressive array of phenomena, including comparative differentials, equative constructions, and measure phrases. It was amended in Schwarzschild (2004b) and, along with related proposals (e.g., Heim 2000, 2006), and it remains part of the canonical theory of quantifiers and NPIs in comparative constructions today.

Roger's interest in the comparative and other degree constructions led him to a very thorough examination of the distribution and semantic behavior of measure phrases (MPs), as in *This table is 3 feet tall* (Schwarzschild 2005). He argues that the class of measure adjectives—adjectives that can be modified by MPs—is linguistically specified, not metaphysically specified, as some have assumed. His discussion parallels quite nicely the argumentation in his work on the mass/count and collective/distributive distinctions, and remains the authority on the topic, as does his (Schwarzschild 2008) *Language and Linguistics Compass* article on the semantics of degree constructions broadly construed.

Arguably, Roger's most influential contribution to degree semantics is his *Syntax* article "The role of dimensions in the syntax of noun phrases" (Schwarzschild 2006). In it, he offers a semantic explanation for a long-standing syntactic puzzle regarding differences between attributive and partitive measure constructions (e.g. *six ounces of cherries/gold* but *(a) six-ounce cherry/*gold*). His observation, defended with characteristic care, was that partitives must encode dimensions of measurement that are monotonic on the relevant part-whole structure of the measured individual, while attributives must encode dimensions of measurement that are non-monotonic in this respect. While this explanation has not gone unchallenged, it has clearly inspired a resurgent interest in the semantics of mereology (e.g., Champollion 2017).

Roger's most recent degree-semantic work is notable for its cross-linguistic and cross-domain innovations. In Schwarzschild (2010), he draws on data from Hebrew

and Navajo comparatives to argue for a semantic analysis of comparative standard markers like the English *than* that addresses long-standing syntactic and semantic puzzles about the behavior of comparatives. In two subsequent papers (Schwarzschild 2012, 2013), Roger extends his semantics of the comparative standard marker in these languages to the use of the same morphemes in postpositions in spatial constructions (like *from* or *out of*). This analysis highlights a startling parallel between the structure of two semantic domains—degrees and spatial segments, or vectors—which is characteristic of Roger's creativity.

## 1.4   The Semantics of Tense and Aspect

Roger's latest impact on the field can be traced back to his generals paper at the University of Massachusetts, Amherst, on the semantics of attitude reports and cases of temporal confusion. Roger continued to be interested in the topic, but it was not until 2009 that he decided to teach a graduate seminar on tense and aspect at Rutgers.

In that seminar, Roger questioned the leading assumption for analyses of Sequence of Tense (SOT), namely that a sentence like *At 9:00 am, Jack believed that the server was down* is truth-conditionally ambiguous between a past-shifted and a simultaneous reading. Roger began to develop an argument showing that ambiguity analyses of SOT were committed to problematic metaphysical commitments about states. This argument led to a coauthored paper (Altshuler and Schwarzschild 2012) which advanced a hypothesis about the truth of a stative clause and showed how this hypothesis underwrites the entailment from Present $\phi$ to Past $\phi$.

This innovation allows for a straightforward analysis of *cessation* (the inference that no state of the kind described currently holds) in matrix clauses and in clauses embedded under attitude predicates. Crucially, an explanation emerged as to why previous analysts of SOT perceived an ambiguity (and built their analyses around this seeming ambiguity) that is actually nonexistent: it is the perception of the absence of cessation that is reported as the putative simultaneous reading. This conjecture led to a subsequent paper (Altshuler and Schwarzschild 2013), which provides a novel analysis of the thorny Double Access reading (found in a sentence like *Roger said that prior analyses of SOT are misguided*). A key innovation of the paper is the proposal that the present tense in English involves universal quantification and is an amalgam of both a relative and an absolute present. The paper also shows how one can derive Double Access readings without resorting to *de re* movement or the Upper Limit Constraint—something that had been assumed in prior work on embedded tense (see Grønn and von Stechow 2016 for a recent overview). These innovative ideas have lead researchers to reassess the semantics and pragmatics of tense, leading to many new and exciting analyses in a wide variety of languages.

### 1.5    *Impacting the Research of His Colleagues and Students*

In addition to his significant contributions to research, Roger has been an incredible colleague, teacher, and mentor. After getting his Ph.D. at the University of Massachusetts, Amherst, Roger has held positions at Bar Ilan University, Hebrew University of Jerusalem, Rutgers University, and MIT. The 14 papers in this festschrift are written by a small sample of Roger's colleagues and students whose research has been shaped—in one way or another—by Roger.

## 2    This Book's Contributions

Natural language semantics has, over the course of its history (and often following work in the philosophy of language), uncovered justification for the incorporation of different types of entities into the formal systems that model meaning. The semantic ontology has been argued to include individuals, canonically, but also possible worlds (Kripke 1959); events (Davidson 1969); times (Partee 1973); kinds (Carlson 1977); degrees (Cresswell 1977); situations (Barwise 1981); and even vectors (Zwarts 1995).

Semantic research has also revealed parallels across ontological domains, suggesting that natural language often treats entities that have traditionally been considered distinct as being similar, particularly in how these elements are structured. For example, Link (1983) united the treatment of plural individuals and mass individuals; following his line of thinking, Bach (1986) and Krifka (1989) argued for the unification of the treatment of atelic events with plural and mass individuals, based on similarities in their internal structure. Events are clearly semantically related to their run times (Link 1987); Partee (1973, 1984) revealed strong similarities between the treatment of times and individuals in natural language; and Stone (1997) revealed the same parallels between the way languages treat times and possible worlds.

As highlighted above, Roger's work has contributed significantly to these studies of cross-domain parallels, in particular in the context of elements with internal structure, like plural sets, alternative sets, degree intervals, temporal intervals, and vectors. The work in this volume is intended as a paean to Roger's immense contributions, in this vein, in the formal semantics of nouns, focus, degrees and space, and tense and aspect.

### 2.1    *The Semantics of Nouns and Plurals*

In her paper, "A Chapter in the History of Formal Semantics in the 20th Century: Plurals", **Barbara Partee** provides a historical overview of how plurals were researched by linguists and philosophers in the twentieth century. Partee begins with a discussion of how plurals were studied before formal semantics and, subsequently, how work on plurals in Montague Grammar gave rise to exciting work in the 1980s,

which significantly changed the landscape. The paper continues with a discussion of work on plurals in the 1990s, culminating with Roger's seminal work described above.

Also offering a historical perspective on formal semantics is **Ede Zimmermann**'s contribution "Intentions, Types, and Models: Remarks on some developments in formal semantics." Zimmermann describes and evaluates a number of Montague-inspired treatments of intensionality and possible worlds, regarding the interpretation of nouns like *unicorn* in intensional contexts (e.g., Montague's famous *John seeks a unicorn*) as well as attitude verbs. Zimmermann also discusses the ways in which compositional, Montagovian semantic theories vary with respect to the number of types and ontological primitives they assume.

In her paper, "Singleton Indefinites and the Privacy Principle: Certain Puzzles," **Veneeta Dayal** continues Roger's work on specific indefinites by closely examining the "Privacy Principle," the explanation in Schwarzschild (2002) of the semantic differences between singleton indefinites and definite descriptions. She draws in part on epistemic indefinites, and in part on data from Hindi, in which bare singulars are reliably singleton definites, but are never singleton indefinites. Dayal suggests that, to account for the broader scope of English and Hindi data, the Privacy Principle should be supplemented with some notion of (in)definiteness and specificity.

In turn, **Katy McKinney-Bock** and **Roumyana Pancheva** extend Roger's theories of the collective/distributive distinction and of the non-monotonicity requirement on attributive predication ("Why is attributive 'heavy' distributive?"). In particular, they present a strong argument that the non-monotonicity of attributive predication noted in Schwarzschild (2006) is a consequence of the distributivity of adjectives like *heavy*, addressed in Schwarzschild (2011). They extend this explanation to other sorts of adjectives, like *pretty* (whose collective interpretation is non-monotonic) and "non-local" adjectives like *noisy* (which, unlike *pretty*, can be interpreted collectively in attributive position).

**Gennaro Chierchia** and Roger co-taught a seminar on the semantics of plural and mass nouns in the fall of 2015 at Harvard University. Chierchia describes his contribution to the volume, "Factivity meets polarity: On two differences between Italian verus English factives," as "an unexpected, almost subconscious byproduct" of that collaboration with Roger, a familiar experience for many of us who have interacted with him. The paper contrasts factive verbs in English and Italian: the former license NPIs, but the latter do not. Chierchia argues that the contrast is due to differences in the languages' complementizer systems, which he likens to differences between singular and plural definite determiners, with intringuing resulting conclusions about the licensing of NPIs (or lack thereof).

## 2.2   The Semantics of Focus

In "Topless and Salient—Convertibles in the Theory of Focus", **Daniel Büring** traces the influential history of so-called "convertible examples" (e.g., *He drove her BLUE convertible*), which were first published in Schwarzschild (1999). Büring first illus-

trates how these examples were used to challenge Selkirk's theory of focus projection (Selkirk 1984, 1995), showing that focus projection from adjuncts is possible, and then discusses how the examples motivated Roger's seminal GIVENness theory. Subsequently, Büring considers Wagner's (2006, 2012) modified convertible examples, which challenge Roger's GIVENness theory, showing that givenness alone is not sufficient to license deaccenting; contrastive focusing is also necessary. Finally, based on further modifications to the convertible examples, Büring argues that we should maintain Wagner's conclusion, while giving up the widely held view that focusing is anaphoric. Büring ends the paper by going full circle, suggesting to make deaccenting—but not backgrounding in general—subject to a givenness condition.

In their squib, "New versus Given", **Angelika Kratzer** & **Lisa Selkirk** consider analyses which posit two features to distinguish focused phrases that are merely new and those that introduce alternatives and might or might not be new (Selkirk 2002, 2007, 2008 versus Beaver and Velleman 2011). They propose a novel research strategy to discriminate between these analyses in light of Schwarzschild (1999, 2018).

## *2.3   The Semantics of Degree*

Like Roger, **Luka Crnič** and **Danny Fox** investigate the semantics of comparision constructions; their focus is on the semantics of equative constructions ("Equatives and Maximality"). They argue that equatives in Slovenian differ from their English counterparts in that they do not encode maximality, which explains why they can license downward-entailing operators in their standard clause. Crnič and Fox conclude that any semantic characterization of the equative must decouple equation and maximality; they draw additional conclusions regarding the density of degree intervals.

In their paper, "The perils of interpreting comparatives with pronouns for children and adults," **Kristen Syrett** and **Vera Gor** build on work on the acquisition of degree constructions (including Syrett and Schwarzschild 2009). Through a series of experiments, they show that neither adults nor children behave as Principle C would predict when interpreting comparatives (given the syntactic analysis in Bhatt and Takahashi 2011): children seem to interpret pronouns functionally, not strictly; and adults obey or ignore Principle C depending on prosodic focus or structural considerations (like the difference between subject and object comparatives). To account for these novel and unexpected findings, Syrett and Gor argue that, in addition to their complicated syntax and semantics, natural language imposes different constraints on the processing of subject and object comparatives.

In their paper, "Differentials crosslinguistically," **Rajesh Bhatt** and **Vincent Homer** examine the semantics of differential comparatives, e.g. *Karina read three more books than Roger*. Like much of Roger's work, their approach is cross-linguistic: their paper draws on data from French and Hindi as well as English and other languages. Its goal is an account of differential measure phrases that explains

their novel typological generalization: every language that allows *three books more than* also allows *three more books than*, but not vice-versa. Their innovative analysis of these data invoke a homomorphism proposed by Roger's student, Xiao Li (2015).

**Xiao Li**'s own contribution to this volume, "Subjectivity and Gradability: on the semantics of the possessive property concept construction in Mandarin Chinese", explores the possessive Property Concept construal of the *you* ("have") construction in Mandarin Chinese. In this construction, when the object noun is abstract, the construction receives a gradable interpretation, and is interpreted subjectively. To account for these observations, Li uses measure theory to posit a sophisticated treatment of the difference between concrete and abstract nouns: the former are associated with a ratio scale that includes a zero point, while the latter are associated with an interval scale that does not. This theory strongly recalls Roger's work on the count/mass distinction and on the monotonicity restriction in partitive constructions.

## 2.4 The Semantics of Tense and Aspect

In "Did Socrates die? A note on the moment of change", **Sandro Zucchi** considers the *moment of change problem*, going back to Plato's *Parmenides*: when an event occurs which involves a change from a state $\phi$ to a state not-$\phi$, when does the change occur? Zucchi first considers Sextus' Empiricus' argument exemplifying the moment of change problem and offers a way of rejecting it, based on Aristotle's solution to the problem. Subsequently, Zucchi raises various problems with an Aristotilean solution and considers an alternative, based on Hans Kamp's logic of change (Kamp 1980). Finally, Zucchi provides a revised Aristotilean solution which he argues is superior to the Kampian one. This solution presents challenges to Altshuler and Schwarzschild's analysis of cessation described above and their proposed temporal profile of statives in particular (Altshuler and Schwarzschild 2012; Altshuler 2016). The paper ends with an outline of an alternative way of accounting for cessation, which is compatible with Zucchi's proposed solution to the moment of change problem.

In "Adverbs of Change", **Todor Koev** also explores the notion of change, though instead of considering the problem that it gives rise to for stative predication, he explores how it is helpful in characterizing the semantics and pragmatics of adverbs like *quickly, fast, sluggishly, instantaneously, immediately* and *gradually*. Building on insight by Cresswell (1978) and Rawlins (2013), Koev argues that such adverbs should not be classified as *manner*, as has often been done since (Jackendoff 1972); they constitute a class of their own, adding some dimension to the change explicitly or implicitly implied by the sentence. Focusing on the adverbs *quickly* and *slowly*, Koev builds on proposes that that these adverbs measure the temporal distance between a point of change and either the speech event or some other prominent event previously mentioned in the discourse. The main consequence of this proposal is that the many readings that result from the use of *quickly* and *slowly* are accounted for by an underspecfied, yet uniform semantics that interacts with aspectual and discourse structure.

In "Since ~~since~~", **Kai von Fintel** & **Sabine Iatridou** address an intriguing puzzle about the interaction of the perfect and *since*. To appreciate the puzzle, von Fintel and Iatridou first show how a Perfect Time Span (PTS) analysis (Iatridou et al. 2001) accounts for the various uses of the perfect: the perfect encodes a PTS; the tense establishes the right boundary (RB) of the PTS and *since* is used to convey that the left boundary (LB) is contained in the interval described by its complement; viewpoint aspect determines how the run time of the described eventuality is related to the PTS. For example, in *Tony has been happy since he has been taking Prozac*, Tony's happiness extends throughout the PTS, in which the RB is the speech time. The puzzle concerns the LB, which intuitively is the time when Tony started taking Prozac. The problem is that this is not what the complement of *since* means in this sentence. To deal with this problem, von Fintel and Iatridou extend an analysis of elided prepositions by Larson (1987) to *since*, predicting that a sentence with one overt *since* could in principle be hiding a second identical one. They end the paper by providing some outstanding issues with their proposed analysis.

## 3   Concluding Remarks

Together, the papers in this volume investigate the nature of structured elements with the goal of learning about existing parallels between them, and understanding the nature of these similarities. This research suggests that the structure of an entity could inform the semantic behavior of that entity just as much (if not more) than its semantic type or lexical category. And because these structures dictate the formation of semantic alternatives, it can help inform focus semantics and scalar implicature as well.

But above all, these papers have in common that they were written by people whose lives and scholarship have been deeply affected by Roger's brilliant influence. In some cases, that means that Roger offered comments on ideas or proposals that began or became these papers. In others, as we know from experience, the authors wrote the papers as they do all their papers: constantly asking themselves, *What would Roger say to this?*, with the knowledge that the answer—however hard fought—will inevitably, always, improve the project.

There is no one on Earth like Roger Schwarzschild. Which is not to say that there is only one Roger Schwarzschild on Earth: After Roger befriended and supported a Ghanaian refugee detained in New Jersey, the man wrote Roger to say that his wife had given birth to a son, who they decided to name in his honor. "Oh, you named your son Roger?," Roger asked. "No," the man replied,"We named him Roger Schwarzschild."

And while we, as his students, colleagues, and friends have no plans to change our names—at the very least, it would make citation too complicated—we understand the sentiment perfectly. Thank you, Roger, for your wisdom, your generosity, your Biblical quotes in Hebrew, your guidance, your sense of humor, your critiques, your kind-heartedness, your collaboration, and your infectious dance moves. We and the entire field are immensely better because of you.

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# Part I
# The Semantics of Nouns and Plurals

# A Chapter in the History of Formal Semantics in the Twentieth Century: Plurals

**Barbara H. Partee**

**Abstract** Plurals had a slow start in the history of formal semantics; a significant explosion of innovations didn't come until the 1980s. In this paper, I offer a picture of developments by noting not only important achievements but also reflecting on the state of thinking about plurals at various periods—what issues or phenomena were not even noticed, what puzzles had started to get attention, and what innovations made the biggest changes in how people thought about plurals. I divide the epochs roughly into decades: before formal semantics (before about 1970); the first decade of formal semantics—the 1970s, with early work by Montague and Bennett and landmark work on bare plurals by Carlson; the 1980s, when work by Link, Scha, Krifka, Landman, Roberts, and others significantly changed the landscape; and the 1990s, where I mention some key work by Lasersohn and Schwarzschild and stop there, although there was much more work in the 1990s. I don't discuss the twenty-first century at all because it's not very historical yet.

**Keywords** Plurals · Mass · Count · Collective readings · Distributive readings Cumulative readings · Conjoined NPs · Bare plurals · Dependent plurals Mereology

## 1 Introduction

Plurals had a slow start in the history of formal semantics; a significant explosion of innovations didn't come until the 1980s. This is partly because plurals hadn't loomed large as presenting serious puzzles to be solved before that, although of course there was already important work done before the beginnings of formal semantics. In this paper, I'll try to capture a picture of developments by noting not only important achievements but also reflecting on the state of thinking about plurals at various

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periods—what issues or phenomena were not even noticed, what puzzles had started to get attention, and what innovations made the biggest changes in how people thought about plurals.

Of course, I will oversimplify somewhat, because "what people were thinking" was never uniform, not across place nor across theoretical outlooks. My default for "people" will be the circles I was part of, though I'll try not to be too parochial.

I'm dividing the epochs roughly into decades: before formal semantics (before about 1970); the first decade of formal semantics—the 1970s, with early work by Montague and Bennett and landmark work on bare plurals by Carlson; the 1980s, when work by Link, Scha, Krifka, Landman, Roberts, and others significantly changed the landscape; and the 1990s, where I'll mention some key work by Lasersohn and Schwarzschild and stop there, although there was much more work in the 1990s. I won't discuss the twenty-first century at all, because it's not very historical yet.

## 2   Plurals in Syntax and Semantics Before Formal Semantics

"Plurals" was not a big topic in linguistics, philosophy, or logic before the beginnings of formal semantics. There was some work on plurals, but not nearly as much as came later. And indeed it's possible to get along without thinking too much about plurals,[1] and some languages don't mark plurality at all. But probably more importantly, plurality was generally not seen to pose any crucial or interesting problems for syntactic theory or for logic or philosophy of language.

In philosophy of language, there was interest in the problem of the distinction between mass and count; a special double issue of *Synthèse* in 1975 devoted to mass terms includes a comprehensive bibliography by (Pelletier 1975). And there's a history chapter in Oliver and Smiley (2013), a book on plural logic, that goes back to Plato and Socrates—but they agree that there's little systematic work on plurals in the period before 1980.

In linguistics, there was much more work in syntax than in semantics before 1970, and plurals came up here and there but with little focused attention on them. One issue that was raised early on was the issue of collective versus distributive readings of plural subjects, not described with that terminology, but focused on the proper syntactic derivation of sentences with conjoined subjects—by conjunction reduction from conjoined sentences or by phrasal conjunction of NPs. There was no explicit semantic terminology in the discussion, but there was attention to whether a sentence

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[1] As an anecdotal aside, I learned Czech in 1989 with the help of a monolingual Czech-for-foreigners textbook, *Čeština pro cizince* (Šara et al. 1969), which didn't introduce plurals until week 14, partly because Czech plural morphology is quite daunting. That forced me into quite awkward paraphrases like "I have a son, and I have another son, and I have another son," but it was possible to muddle along. Thanks to Rineke Verbrugge (p.c. on Facebook) for finding and filling in the details about that book for me.

with surface phrasal conjunction was or was not paraphrased by a corresponding sentence conjunction, as it would be in the case of a distributive reading (assuming the NPs were simple referential terms, as they generally were in all early grammatical discussions.) Lila Gleitman wrestled with that topic, especially with sentences containing symmetrical predicates, in a series of papers (Gleitman 1960, 1961a, b, 1963, 1965), arguing that phrasal conjunction should in general be derived from sentential conjunction, but sometimes by way of reciprocal constructions, and her fellow graduate student Carlota Smith also published a short piece on ambiguities of conjunction (Smith 1965). Lakoff and Peters (1966) argued against Gleitman's claim that all conjunction should be derived from sentential conjunction,[2] they may have been the first to explicitly advocate that some conjoined NPs must be base generated.

The relatively comprehensive review and synthesis of work done on transformational grammar of English up until about 1970 (Stockwell et al. 1973) mentions issues concerning plurals most prominently in the chapter on conjunction, with related issues raised in the chapters on anaphora and on determiners. In that project, we were trying (with difficulty) to stick to syntax only, but we faced problems with plurals in connection with various transformations—how to state them, and how they relate to interpretation.

In the case of conjunction, we tried to take seriously the syntactically optional "NP plural collapsing" that occurs among the "conjunction reduction rules." Conjunction reduction of NPs was taken to require formal identity apart from number; but then from a source like (1a), one could derive either (1b) or (1c), with the (free) choice correlated with an interpretive choice: interpreting the two source NPs as coreferential (1b) or referentially distinct (1c). (In order for our syntax to reflect the majority of the work done in syntax up to 1970, we had to assume that transformations could affect the interpretation.)

(1)   a.   That man sang and that man danced [284a, p. 392].
      b.   That man sang and danced [286a, p. 393].
      c.   Those men sang and danced (respectively)[3] [283a, p. 392].

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[2]Their arguments do not centrally concern plurality. The paper is interesting in part as representing an intermediate stage between transformational grammar in the *Aspects* tradition and generative semantics: the arguments are syntactic, but the authors have the implicit goal of finding common deep structures for sentences that are synonymous, and some of the judgments of ungrammaticality might be argued to concern semantic or pragmatic anomaly. The argument against Gleitman rests on a prior argument that a sentence like *John met with Bill* is to be derived from *John and Bill met.* On Gleitman's analysis, *John and Bill met* is derived from *John and Bill met with each other,* which in turn is derived from two sentences. Lakoff and Peters present *John and Bill killed Harry* (*together*) as a counterexample to Gleitman, arguing that the putative but ungrammatical intermediate source *John and Bill killed Harry with each other* would have to have a *with*-phrase in deep structure, which they earlier argued to be impossible because of the complex conditions on its occurrence, stable transformationally but not at deep structure. I don't see any discussion of predicates like *are a happy couple,* with which it's much easier to argue against a sentential conjunction source.

[3]Sentence (1c) ((283a)) can also be derived from three other sources, ones like (1a) ((284a)) except that one or both NPs is *those men* rather than *that man*.

There are five pages on the "plural collapsing" rule; the difficulties one gets into can provide some arguments against deriving phrasal conjunction from sentential conjunction, if more are needed.

One of the issues about plurals that arose in the chapter on determiners was that the "quantifier movement rule" - sometimes referred to as the *each*-hopping rule and applying to *all, both, each* - had problems with number, even though number agreement was ordered after it to ensure that the verb would end up plural even in the case of *each*-movement, whose source sentence is singular, as in (2).

(2)  a.  Each of the girls was dancing.
     b.  The girls were each dancing.

The main problem was that sometimes it's not only the verb that should be changed to plural—we noted that the rule had no way to handle cases like (3). And sometimes the output of the transformation is ungrammatical and can't be fixed by any choice of number, as in our (4).

(3)  a.  Each of the boys examined himself for ticks (302), p. 152.
     b.  The boys each examined themselves for ticks.
(4)  a.  Each of the mountains is taller than the one to its south (303), p. 152.
     b.  The mountains are each taller than the one to *its/*their south.

The problems connected with anaphora were largely derivative from the problems connected with conjunction: we had rules to derive *John and I helped ourselves* from *John helped himself and I helped myself* (pp. 224–225), but we could not manage to derive *John and Bill each promised himself a vacation*: our rules would force the reflexive to be *themselves*, which would actually be correct, we believed, only with plural *vacations.*

More radical problems about plurals came from Postal's "Linguistic Anarchy Notes", written and circulated from 1967 to 1970. Some were published later as (Postal 1976) in McCawley's subversive collection (McCawley 1976), including (5).

(5)  Harry and Thmug married seven women (between them) (28), p. 220.

He remarks that to give these all and only their possible analyses, deriving them from conjoined sentences, the grammar has to know some arithmetic. He was assuming the Katz-Postal hypothesis, that transformations preserve meaning; he was also making the assumption that all the different ways that (5) could be true constituted separate "readings" and should correspond to different deep structures.

I recall another of the early Linguistic Anarchy Notes in which Postal gives an example like (6a). He argued that it is infinitely many ways ambiguous, since not only does it have a distributive reading and a group (single event, joint carrying) reading, it could also have as a source the sentential conjunction (6b), among infinitely many others. (The idea of a "cumulative" reading, which would replace those infinitely many readings by a single cumulative reading, did not come onto the stage until later.)

(6)  a.  Jack and Jill carried six buckets of water up the hill.
     b.  Jack carried 2½ buckets of water up the hill and Jill carried 3½ buckets of water up the hill.

Postal's Linguistic Anarchy Notes came around the same time that some Generative Semanticists were suggesting that the grammar of English would have to include the rules of tennis in order to distinguish grammatical from ungrammatical sentences reporting tennis scores. The "sane" reaction, or some might say the "conservative" reaction, to the tennis examples was to more carefully distinguish syntactic ill-formedness from other sorts of anomaly, and in the case Postal's examples to distinguish genuine ambiguity from underspecification (Zwicky and Sadock 1975). So discussions of sentences like (6a) have generally revolved around more limited possibilities of ambiguity, distinguishing at most among distributive, collective, and cumulative readings, but sometimes still veering toward Postalian multiplication, as discussed by (Link 1997) in a section on "groups and the problem of over-representation", where he talks about examples like (7) and the problem of what kind of structure has to be assigned to the conjoined subject in order to have the information needed for each of the different conjoined VPs, which are respectively groupwise distributive, collective, and individually distributive.

(7)  The boys and the girls had to sleep in different dorms, met in the morning at breakfast, and were then wearing their blue uniforms (Landman 1989).

Overall, it seems that what linguists were most conscious of before the start of formal semantics were some puzzles concerning the proper derivation of conjoined NPs, puzzles about symmetric predicates with conjoined subjects, and some of the syntactic difficulties with any transformations that would require converting a singular predicate or NP to a plural one. The "semantics of plurals" was not itself a topic of investigation.

## 3  Plurals in the First Decade of Formal Semantics

In the first decade of work on formal semantics, roughly the 1970s, there began to be serious semantic work on plurals, and more awareness of the puzzles and problems they presented, but apart from the important work by Greg Carlson on bare plurals (Carlson 1977b), the biggest breakthroughs started coming in the 1980s. Montague began to worry about plurals but didn't talk about them or publish anything, because he didn't find solutions to the problems he had noticed (Sect. 3.1). But some of the earliest published work in "Montague grammar" made headway on the analysis of plurals (Sect. 3.2), and later in the decade, Greg Carlson made a landmark innovation in analyzing English bare plurals not as ambiguous quantifiers but as names of kinds, with a concomitant distinction between stage-level and individual-level predicates, a distinction that turned out to have far-reaching applications (Sect. 3.3). In the same period, Chomsky noticed the problem later known as "dependent plurals" and used

it to challenge the prospect of compositionality for natural language; Partee had a rebuttal for Chomsky's own suggested solution to the problem but failed to find a compositional alternative (Sect. 3.4).

## 3.1 Montague's Unpublished Notes on Plurals[4]

Montague did not treat plurals in any of his published papers. Class handouts and notes that he made while working on PTQ (Montague 1973) show that he had intended to include plural quantifiers and conjoined term phrases, but that adding plurals to his fragments was turning out to pose problems he didn't see how to solve. So he just left them out.

It has often been noted that although Montague in PTQ analyzed *every man, a man, the man* as term phrases, interpreted as generalized quantifiers, he did not put *every, the, a* into any category, but treated them syncategorematically. As subsequent work made clear, there is no obstacle to putting them into a category of determiners, categorially representable as T/CNP in the notation of PTQ. Montague evidently thought about that but didn't bother as long as he had only three determiners and was treating each of them as having a logical meaning, not as constants to be assigned interpretations in a model. But it does seem slightly odd to give the title "The proper treatment of quantifiers in ordinary English" to a paper that treats only the definite and indefinite articles and the one quantifier *every*, and indeed we see notes in which he was considering expanding the set of determiners, and then giving them a category. The student-written notes from Philosophy 260 in Winter 1968 include two pages of "An example of Prof. M's grammar: English"—just the syntax, in very formal form, but it includes *a, all, every, some, no, two, three, any, a certain, the.*

Later in Philosophy 262A in Fall 1968 (the first seminar of his that I sat in on, together with David Lewis and Frank Heny), he was evidently working on polishing EFL for publication, but also discussed ideas which didn't go into EFL. In one set of notes (Box 11, Folder 7, pp. 22–27)[5] from late in the quarter, there is a discussion of two "possible extensions" (of the EFL fragment, I believe), each of which requires some supplementary defined syntactic notions. One is "modern negation" (EFL had just used sentence-final *not* for syntactic simplicity), for which we "need to be able to single out *main occurrence* of *main verb* of a formula." And then there come some more notes about quantifiers. "To do 'all', need to single out *main noun occurrence* in order to pluralize correctly." Montague clearly had in mind to derive plural common noun phrases from singular ones. And then the notes report him as going on to say, "Cardinals should be easy once we can do plurals. Since there are infinitely many, we would probably want to introduce Quantifiers as a syntactic category." In another

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[4]Much of the material in this section comes from Partee (2013).

[5]References to notes of Montague's found in Box n, Folder m are to materials in the UCLA Library's Department of Special Collections, where the Richard Montague papers have been curated and stored.

folder among notes that seem to be related to EFL, we find a handwritten page with an early idea about including a category Q of quantifiers, including lexical "basic quantifiers": "BQ = {*every, no, the, a, only the, ~~all, 1, 2, …~~* }". As well as striking out the last ones, he added a marginal note "Probably no category." (Box 3, Folder 2. "Logical analysis in ordinary language").

In fall 1969 and spring 1970, he was still worrying about plurals. I think he had definitely hoped to include various plural expressions in PTQ, but in the end he did not; he even had to spoil the symmetry of his treatment of *and* and *or* as connectives that can conjoin sentences, verb phrases, or term phrases by omitting *and* as a term-phrase connective, clearly in order to avoid plurality.

Box 1, Folder 5, "misc phil of lg research notes 1969—" from fall 1969 and into summer 1970, is full of interesting examples he was thinking about and includes more musings about plurals. We find notes dated "22 October 69" and "March 70" where he is worrying about "committee" and about whether plurals designate sets and plural verbs sets of sets; in an update March 70, he notes that he still thinks so, and thinks "committee" also designates a set of sets and that "numerous" is a higher order predicate (since it can apply to "committee"). This strategy, which he did not implement anywhere, was later followed by Michael Bennett in his work on plurals (Bennett 1974). The idea that plurals demanded a higher order treatment was not seriously challenged until the mereology-based work of Sharvy (1978, 1980) and Link (1983).

The following notes from the same folder, from September 1970, may surprise Montague grammarians who used Montague's analysis of quantifiers and relative clauses to argue against Generative Semantics, since these proposed "indirect derivations" look rather generative semantics-like:

'two men love a woman who loves them' perhaps get this from: two men love a woman and she loves them. (How get THAT??)

*A woman who loves them kills two men/Women who love them kill two men*

perhaps get the first from: *a woman kills two men and she loves them*. (Box 1, Folder 5)

But he didn't put anything like that in any of his fragments; he evidently knew that he hadn't figured out everything about plurals and plural anaphora, and he evidently didn't like to put anything really speculative into published fragments.

## *3.2 Earliest Work on Plurals in Montague Grammar*

Some of the earliest work in Montague Grammar took on the project of extending Montague's fragments to include plurals. In the first seminar on Montague grammar, which I taught at UCLA in the winter and spring quarters of 1972, both Michael Bennett and Renate Bartsch (a visiting scholar then) worked out treatments of plurals which were revised and included in a UCLA Occasional Papers volume of papers

in Montague Grammar[6] (Rodman 1972; Bartsch 1972; Bennett 1972). Bartsch then published a further revision of her paper in the second volume in the *Syntax and Semantics* book series (Bartsch 1973), and Bennett developed his ideas further in his dissertation (Bennett 1974). Around the same time, Roland Hausser published a treatment of plurals in Montague grammar (Hausser 1974). Those early works on plurals in the Montague tradition took plural common noun phrases to be predicates of sets, and thus of a higher type than singular common noun phrases.[7]

As noted by Winter and Scha (2015), McCawley had even earlier (McCawley 1968, p. 142) "noted that 'a plural noun phrase usually refers not to an individual but to a set of individuals'. Further, McCawley maintains [p. 146] that English does not distinguish between an individual x and the collection {x} consisting of that individual. To model this property, he suggests to use a nonstandard set theory."

### 3.3   Carlson on Bare Plurals

One major advance in the first decade of formal semantics was Greg Carlson's work on bare plurals (Carlson 1977a, b, 1980). Before Carlson, linguists who thought about bare plurals in sentences like (8) generally assumed that bare plurals were ambiguous between two or possibly three readings—the reading in (8a) existential, something like the plural of the indefinite article, and the reading in (8b) perhaps universal, perhaps generic, or perhaps those were two different readings. The reading in (8c) was not noticed; Carlson noticed that in such a sentence a property is really predicated of the kind, not of any individual raccoons or raccoon stages.

(8)  a.   Raccoons were stealing my corn.
     b.   Raccoons are sneaky.
     c.   Raccoons are widespread.

Carlson observed that very few sentences with bare plural subjects are actually ambiguous: what reading you get is generally predictable from the predicate. Carlson's radical new idea was that bare plurals are not quantificational at all, and not ambiguous: bare plurals are always the name of a kind, and the different readings in (8a), (8b), and (8c) arise predictably from differences in the predicate. His distinction between "stage-level predicates" as in (8a) and "individual-level predicates" as in (8b) turned out to have many applications beyond accounting for the distribution of readings of bare plurals—it also turned out to be key to accounting for what "coda-predicates" are possible in existential sentences (9), for the interpretation of

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[6]The Oxford English Dictionary cites that volume as containing the first occurrence(s) of the expression 'Montague grammar'.

[7]The higher type for plural nouns, plural common noun phrases, and plural terms had a cascading effect through the grammar, leading to additional higher types for adjectives, verbs, and many other categories. One solution was to make singular nouns be predicates of singleton sets of entities rather than of entities: then all the relevant categories were uniformly of those higher types.