THE ACQUISITION OF SYNTACTIC CATEGORIES: THE CASE OF THE COUNT/MASS DISTINCTION.

by

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This thesis is dedicated to my parents and to Betsy Connors.

Author's Biography

The author was born on October 1st 1956 in Bangkok, Thailand. From the age of 2, he was living in London and later in Henley-on-Thames, England. His undergraduate education was at the University of Stirling in Scotland where he received his Bachelor's degree in Psychology in 1978. There he worked on his honor's project with Robin Campbell on the semantic development of the comparative terms: *more* and *less*. After Stirling, he went to M.I.T. to enter the graduate program in Psychology. There his advisor was Susan Carey with whom he worked on language and conceptual development.

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ABSTRACT

A number of empirical studies were carried out in order to examine the process by which young children are able to form syntactic categories and consequently assign words to their appropriate categories. The focus was on the count/mass distinction, a subcategorization of the noun class. This subcategorization essentially differentiates nouns by certain distributional properties with respect to determiners (c.f., *a car* vs. **some car*; **a water* vs. *some water*) and plurals (c.f., *cars* vs. **waters*). An initial study of longitudinal speech samples from two children examined when one could attribute categorical status to Determiners and Count and Mass subcategories. This analysis revealed that there were early distinctions present in the children's speech showing evidence of the presence of these categories in their grammars. However, certain reservations were made concerning whether some of these distinctions might have arisen independent of category development per se.

A second question concerned the process by which children are able to generalize use of words on the basis of category assignment. In particular, it was proposed that initially, restrictions on the use of quantifiers with respect to the count/mass distinction would not emerge until much later in development. This was supported by experimental findings in which errors such as: **several soup* and **too much chairs* were found.

In the final section, the hypothesis was tested that children initially acquire count/mass categories semantically as: object vs. substance rather than as more formally defined entities. While it was found that children were able to subcategorize on the basis of semantic properties of referents, they did not choose these properties in preference to formal cues such as determiner type. This was further corroborated in finding that children did not seem to have problems subcategorizing nouns that did not exhibit the appropriate semantic properties (e.g., *furniture*). A final reanalysis of the longitudinal data in general supported the experimental findings. It is concluded that children's induction and representation of count/mass subcategories is essentially of a formal nature.

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General Introduction

One of the foremost problems faced by a child in learning the grammar of a language is that of inducing the appropriate set of categories for that language. Having learned a set of lexical items and their meanings, the child is faced with the task of assigning each of these items to their respective categories in order to employ the generalized rules of syntax. In the present thesis, this induction procedure will be examined in some detail for one subcategory of the noun class, the count/mass distinction. While we are approaching the issues of category acquisition by isolating a very small piece of the language, it is hoped that this will provide a more complete account of the process than a general survey would allow.

We may initially define a syntactic category as a set of lexical items whose membership is determined on the basis of the role shared by those items in syntactic constructions. That is to say, the rules of grammar are written over syntactic categories in their structural configurations. If a particular lexical item is generated into a position specifying a particular category, then the item is considered to be a member of that category. The problem for the child is that he does not start out with a prearranged set of rules. He must not only determine what the rules are, but also what the categories are that the rules are written over.

In delimiting the members of a category, the child is essentially grouping together a set of words that correlate along some dimension or set of dimensions. These dimensions could potentially involve any pertinent property whether it be phonological, semantic, distributional, syntactic or whatever. Having established the criteria for category membership, the child is also required to determine what role the category plays in the syntax (i.e., which particular rules invoke the category). We shall take the count/mass distinction to be an exemplary case in which the child could choose to employ either semantics or syntax as an

evidential base for induction of the appropriate categories. One of the functions of this thesis will be to explicate the conditions for either of these strategies and empirically test the competing hypotheses.

Linguistic Properties of the Count/Mass Distinction

The count/mass distinction can essentially be characterized in terms of quantificational differences between noun-types. Count nouns such as *table, shirt, car* etc. are discretely quantified as individuals and pluralities (e.g., *a car, two shirts, many tables*). Mass nouns, on the other hand, do not denote individuals when quantified (e.g., *some water, much sand*). As a natural consequence, mass nouns may not be pluralized, counted or individuated (c.f., **two waters, *a sand*). Notice that the property of non-individuation does not necessarily fall out from the nature of the entity being denoted by the mass noun. For example, *furniture* is a mass noun by dint of the fact that it does not get quantified by individuation (c.f., **a furniture*). However, furniture itself does constitute a class of individual objects such as chairs and tables.

Notice that when we speak of a noun not being quantified over individuals, the assertion is made with respect to the syntactic possibilities within the language in question. For example, there are ways of denoting individuated instances of mass noun referents by means of "classifier" constructions. That is, one can speak of *three pieces of furniture*, thus semantically quantifying over individuals. However, syntactically, it is the word *piece* that is being quantified not *furniture*. In certain classifier languages such as Thai and Japanese, all nouns require such classifier constructions in order to be quantified. Thus, for example in Thai, **saam to?* (= three table(s)) is ungrammatical, the correct construction being: *to? saam tua* (= table three CLASSIFIER). Conversely, in languages such as Hopi, there is no count/mass distinction and all nouns may be directly quantified over individuals (see Greenberg 1972).

We see then that the count/mass distinction for a particular language (if it has one) is defined not just by the manner in which the noun classes are quantified, but, more precisely, by how the language syntactically realizes that difference. For English, one can characterize the differences in terms of syntactic constructions that allow only count nouns vs those that allow only mass nouns. For present purposes we shall restrict our attention to simple noun phrases of the form [Det (Adj) N]. [1] Specifically, we are interested in two kinds of rules: (i) Those that specify whether the noun type requires a determiner and (ii) Those that specify co-occurrence restrictions of particular determiners with either singular count, plural count or mass nouns. We shall refer to the former as subcategorization rules (on a par with complement selection in verb subcategorization) and the latter as selection rules (see Chomsky 1965). Nothing particular hangs on maintaining the "Aspects" nomenclature or formalism, so long as the relevant system expresses the appropriate distributional properties in a reasonably well-motivated manner. [2]

Subcategorization rules may be invoked to express the facts that singular count nouns require a determiner whereas plural count and mass nouns do not. These rules account for the relevant grammaticality judgements for the following sentences:

0.1) Get me the table/s

0.2) Get me tables

0.3) *Get me table

---

[1] As far as I know, the only other context that clearly distinguishes count from mass nouns is the use of pronominal *one* (c.f., Bill has a car and John has *one* too vs. *Bill has furniture and John has *one* too) (see Baker 1979). Such restrictions would presumably be handled by agreement rules.

[2] We shall take "well-motivated" to mean something like, attaining at least descriptive adequacy.

0.4) Get me the water

0.5) Get me water

That is, the ungrammaticality of (0.3) is due to the fact that *table* is a singular count noun and requires a determiner. We may wish the subcategorization rules to further specify that mass nouns may not be pluralized (as noted previously). The following two rules capture the above facts:[3]

$$(0.6)\ N[+\ count] \rightarrow / \begin{cases} Det \_\_ [-pl] \\ (Det) \_\_ [+pl] \end{cases}$$

$$(0.7)\ N[+\ mass] \rightarrow / (Det) \_\_ [-pl]$$

Selection rules may be used to specify the selectional properties of determiners as to whether they require count or mass nouns, and if count, whether such nouns must be in the singular or plural form. Thus we are specifying the rules over such determiners as *many* which requires plural count nouns to follow them (c.f., *many chairs*, but not: **many chair* or **many sand*). Notice that in stating these properties in a purely formal manner does not serve to negate the claim that such restrictions may be motivated by semantic (viz quantificational) functions. Rather, we are simply attempting to account for the distributional properties, at least in a descriptively adequate manner. [4] Table 0.1 lists most of the major determiners checked against occurrence in one of the following three possible NP patterns:

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[3] These rules should be read: Count or Mass noun is rewritten (→) in the environment (/): Determiner (parentheses mark optionality) - insert noun - plus or minus plural (see Chomsky 1965).

[4] It is likely that a more motivated account would be axiomatically derived from a formal semantic system such as Montague (1974).

Table 0.1 Selectional Properties of Determiner Classes

Determiner	Det N [+count] [-pl]	Det N [+count] [+ pl]	Det N [+mass]
Articles:			
the	x	x	x
a	x		
Quantifiers			
Unrestrictive (UR)			
Some	(x)	x	x
Any	(x)	x	x
All (the)		x	x
Enough		x	x
More		x	x
Less		x	x
Most		x	x
Plenty (of)		x	x
A lot of		x	x
Restrictive Count (R-C):			
Several		x	
Many		x	
Few		x	
Both		x	
E-Quantifiers:			
Each	x		
Every	x		
Either	x		
Neither	x		
Restrictive Mass (R-M):			
Much			x
(A) little			x
Numerals:			
one	x		
2,3,4 ...		x	

[i] Det N [+ count] [-pl] (= first column)

[ii] Det N [+ count] [+ pl] (= second column)

[iii] Det N [+ mass] (= third column)

Selection for each of these three patterns constitute the column headings in the table. Determiners are classified into a number of groupings. The first level distinguishes between articles, quantifiers and numerals. For articles, *the* is unrestrictive whereas *a* selects for singular count nouns. Within the quantifiers, there are three main groupings as follows:

Unrestrictive (UR)

This group includes quantifiers that do not exclusively select for either count or mass nouns:

c.f.,

Some cars	Some water
A lot of cars	A lot of water

Count and mass subcategories are differentiated for most of these quantifiers by the presence or absence of the plural. That is, count nouns agree in the plural and mass nouns in the non-plural form. *Some* and *any* do occasionally take singular count nouns although such use tends to be idiosyncratic and may involve separate lexicalization. [5]

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[5] This postulation is supported by the fact that there is also different intonation for expressions such as: *sóme cát* vs. *some cáts* and *ány cát* vs. *any cáts*. This difference does not occur with, say, *the cát* vs. *the cáts*.

Restrictive Count (R-C)

R-C quantifiers include those that exclusively select for count nouns:

c.f.,

Several cars	*Several water
Many cars	*Many water

A subgroup of the R-C quantifiers, called here: "E-Quantifiers" is distinguished by the fact that singular rather than plural forms are selected for:

E-Quantifiers

Each car	*Each cars
Every car	*Every cars

A further semantic property of this group is that they actually quantify over plural sets (or at least over individuals within plural sets). For example, an expression such as:

0.8) Every ball is in the hole

denotes a plural set of objects. Note that this semantic criterion precludes inclusion of *a, one* or *another* which, although they have the same selectional restrictions, do not have the semantic property of quantifying over plural sets. [6]

Restrictive Mass (R-M)

Very few quantifiers select for mass nouns only. Table 0.1 includes *much* and *(a) little* in this class:

c.f.,

---

[6] It may be that *either* also does not belong in this class for although an expression such as: *either car* quantifies over a plural (or rather, dual) set, it does pick out an individual from that duality.

Too much water	*Too much car/s
A little water	*A little car/s

Although, strictly speaking, *less* should be restricted to mass nouns, colloquially, it tends to be used with count nouns as well (e.g., *less cars*) and is therefore included in the Unrestrictive (UR) class.

Numerals

Numerals are fairly straightforward. All select for count nouns, plural agreement is a direct function of quantity: *one* takes singular forms, *2,3,4* ... take plurals.

Not included in the table is *another* which selects for singular count nouns with singular reference. Unfortunately there is no quantifier class that fits such a pattern. *Another* is perhaps most closely related to *a* being a morphological derivation. Nothing crucial hangs on the incompleteness of the present schema. The reason for choosing these particular divisions will become apparent in Chapters I and II.

Also not included are other determiners such as possessive pronouns (e.g, *his, her, your, my*), possessive nouns (e.g., *Joe's, The man's*) and demonstratives (*this, that, these, those*). For the most part, these determiners are unselective although demonstratives do require plural agreement (and hence count noun selection for *these* and *those*).

Acquisition

In choosing the scope of the present thesis, the choices were guided largely by considerations of what appear to be major themes or controversies involved in accounting for language acquisition. This is not intended to be an all-around look at the count/mass distinction in ontogeny. Consequently, many issues are not addressed, especially quite

interesting issues to do with quantification, part-whole structure, ontology and so on. [7] Our main concern will be with developing the notion of a grammatical category and its consequences in considering the problem of acquisition.

In the first chapter, the theme involves the descriptive problem of when one should attribute categorial status to a set of words in the child's lexicon. That is, the child may have, what we take in the adult language to be determiners, adjectives, count nouns and mass nouns. Giving categorial status to these in the adult language is, in general, well motivated since we have evidence from distributional differences and structural properties that they play differing roles in the grammar. If there were no such differences one would not be justified in assuming categorial distinctions. Thus, for example, in certain aboriginal languages such as Walpiri (Hale 1981) and Ngyamba (Klavans 1982), "adjectives" are not distributionally distinguished from nouns and are thus assigned the same categorial status (i.e., they are both nouns).

We shall therefore be concerned with the problem of determining the relevant criteria for deciding whether the child's grammar contains certain categorial distinctions (specifically: determiner vs adjective and count vs mass noun). This investigation will be conducted within the context of an analysis of longitudinal speech samples from two children. The analysis will also allow for a determination of how the count/mass distinction is initially manifested with respect to the various constructions outlined previously.

In the second chapter, we consider the nature of the induction of the appropriate restrictions for determiners and plurals. A proposal is tested whereby it is claimed that initially such functors are unrestricted, coming in at the most general level (equivalent to the UR class in table 0.1). That is, we propose that restrictive quantifiers such as *many* are initially

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[7] For philosophical discussions see Quine (1960), Pelletier (1979). For an examination of the relation of mass noun superordinates to conceptual structure in development see Markman (unpub).

acquired as unrestrictive thus predicting errors of the kind: **many water*. It is further suggested that such unrestrictiveness reflects the generalising property of categories, that they exist in grammars in order to generalize use of lexical items beyond what occurs in the input to the learner.

A further issue to be considered in chapter II concerns whether the child's restrictions on the use of plurals to count nouns is, in fact motivated by the categorial status of the noun (in the syntactic sense), or whether the motivation is derived from something like "discreteness" or "countability" of the referent. For example, if we have evidence that the child does not pluralize mass nouns such as *soup*, is this because *soup* is de facto a mass noun, or is it because the referent is unbounded and hence uncountable?

In chapters III and IV we address what has become one of the most interesting and controversial issues in category development. The debate hinges on whether the child's categories are initially induced in an equivalence relation to pre-existing conceptual distinctions or whether the child's induction of categories is over their formal or distributional properties. For the sake of tradition we shall refer to the former position as the "Semantic Account" and the latter as the "Syntactic" or "Distributional Account". Employing the term "Semantic" in the former case unfortunately has the consequence of causing serious confusions and misconceptions regarding the claims being made. The term is retained simply as a matter of expedience for lack of an appropriate substitute. However, I shall attempt to be clear about the distinguished sense in which it is claimed that early categories are semantic, and contrast that with the other sense in which not only might the child's categories be "semantic" but also the adult's. I would urge the reader to take careful note of the relevant distinctions.

Perhaps the most familiar context in which it has been proposed that categories are semantic for the young child has been in the discussion of major categories such as Noun,

Verb, Adjective etc. In general, the claim amounts to a proposal that when the child acquires, say, the Noun category, he initially equates it with something like: *Person, Place or Thing*; Verbs are equated with *Actions* and so on (c.f., Pinker 1983, Grimshaw 1982, Roeper 1983, Macnamara 1982). Of course, none are so naive as to propose that such schoolbook definitions survive into the adult grammar since they are clearly inadequate. Rather, semantic induction of this sort is proposed as a way of bootstrapping one's way into abstract (syntactically defined) categories via pre-existing conceptual distinctions.

Notice a number of things about this account. First, it presupposes a reorganization of the categories from ones that are parasitic on the child's conceptual typology, derived from non-linguistic experience, to ones that are constrained by purely linguistic functions. This discontinuous view of the acquisition process thus proposes that the epistemological status of the child's categories is very different in kind from that of the adult. [8] This is an important point, since it is often claimed that showing certain semantic functions for the child's categories provides prima facie evidence for the claim that they are semantic (c.f., Grimshaw 1982 p.176). However, if those same functions exist for the adult, then there is no evidence that the child is any different from that adult in this respect. For example, one may demonstrate that the child expects a new verb (e.g., *to sib*) to name an action rather than an object (c.f., Brown 1957). However, since an adult presumably has the same reflexes and we know a priori that adults' categories are not semantic, one cannot deduce that such results, interesting as they are, tell us anything about the defining criteria for the categories of the child.

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[8] Pinker (1983) has claimed that while his theory does rely on using semantic properties to determine category membership, the categories are themselves syntactic (i.e., defined by structural properties). However, any model that claims to have categories (semantic or syntactic) is going to require that those categories play a role in sentence structure in a formal sense, otherwise there would simply not be any categories at all. Thus, the degree of being syntactic in Pinker's sense is unavoidable. However, if category assignment to, say, the noun-class is on the basis of naming a concrete object, then what one has written in one's rules are semantic types not formal categories. Whether or not one calls them nouns seems to be a matter of notational preference (see Chapter III for an elaboration).

A second point to notice is that the semantic account is very specific in claiming that the induction is over intrinsic semantic properties of lexical items (roughly, what kind of thing it denotes). In considering the count/mass distinction, an equivalent proposal would be that the semantic induction was over *objects* vs *substances*, the prototypical realizations of these subcategories. Note however, that this is a very different claim from that invoking, say, individuated vs non-individuated quantification - a distinction that is a proper semantic function of the count/mass distinction and one that survives into the adult grammar. The difference here turns on the fact that intrinsic semantic properties (i.e., being an object or substance) do not determine the mode of quantification; that being a function of the syntactic assignment of the noun to a particular syntactic subcategory. In support of this contention, consider the following facts:

[I] Certain superordinates such as *furniture, silverware, jewelry, equipment* etc. are mass nouns (c.f., *some equipment* vs **an equipment*) yet they denote classes of objects. If categories were semantically determined, such terms should be count nouns as are other superordinates such as: *toy, vehicle, flower* etc.

[II] Certain count nouns denote substances such as: *solution, substance, (blood-) sample, drink.* Again, their semantic properties lend themselves to mass rather than count subcategorization.

[III] Many food terms are ambiguous as to whether they should be construed as objects or substances. This is principally because, although the items tend to be object-like (i.e., are bounded and have characteristic form), in functional use they tend to be ground up (or chewed) and are no longer discrete. Consequently, the subcategorization of such terms tends to be somewhat arbitrary and therefore underdetermined with respect to semantic properties. Compare, for example, *carrot* and *celery* which are very similar with respect to the relevant semantic dimensions, yet *carrot* is a count noun and *celery* a mass noun (c.f., *a*

carrot vs. **a celery*). Other terms with perceptually similar referents but that are opposed in subcategorization include: *vegetable* vs. *fruit*, *beans* vs. *rice*, *lettuce* vs. *onion*.

[IV] The semantic characterization of the count/mass distinction is given in terms of concrete properties. For example, Macnamara (1982) argues that:

> "... the (count/mass) distinction is mainly semantic, that count nouns name things that have characteristic form, and mass nouns do not ... when substances are named that usually coalesce when placed together, the name is a mass noun".

Notions such as coalescence are reminiscent of Pelletier's (1979) "Universal Grinder" test for mass nouns: If an entity is ground up into small pieces yet remains the same entity (e.g., ground-up sand = sand) then the name is a mass noun. Otherwise the name is a count noun (e.g., a ground-up chair $\neq$ a chair).

Unfortunately, such concrete definitions are simply not applicable in the case of abstract nouns which must also be subcategorized as either count or mass. Thus, *advice* is a mass noun, yet there seems to be nothing in the intrinsic semantic properties of the term that make is uncountable (c.f., *pieces of advice* but not **advices*). Similarly, *example* is a count noun yet nothing semantically precludes examples, like advice, being considered non-discretely.

[V] For languages that have a count/mass distinction, there is considerable cross-linguistic variation in terms of how a particular word is subcategorized. For example, *spaghetti* is a mass nouns in English and a (plural) count noun in Italian, *hair (cheveux)* is a count noun in French as is *furniture (meuble)*. Such examples are legion and are evidenced in the many categorization errors made by even well tutored foreign speakers. If subcategorization were a direct consequence of semantic properties, one would not expect such a large amount of

cross-linguistic variation, since such properties do not vary from country to country. [9]

Such facts conspire only to demonstrate that the count/mass distinction, like other categories, is not semantically based for the adult in the sense of exhibiting a direct correspondence to objects and substances. The interesting question is whether the child is unlike the adult in this respect and does initially induce semantic categories.

The semantic account as stated here is probably one of the most widely held beliefs in the field. It is held not only by those who believe semantics to be the basis for syntax in general (e.g., Bates & MacWhinney 1983), but also those who espouse the strictly autonomous view of syntax (at least in the adult) (e.g., Roeper 1983, Grimshaw 1982). One major exception is Maratsos & Chalkley (1981) who propose an alternative account whereby categories are induced on the basis of distributional regularities and not on the basis of intrinsic semantic properties. Thus a category is induced by correlating the priveleges of occurrence of lexical items in sentential schemas of the form:

(0.9) ## Arg + *Rel* + ed + Arg ## = Past Occurrence of Relation

e.g., John frightened Fred

That is to say, categories are defined over sets of such schemas. Having acquired a category, generalization is then allowed into all contexts specifying the category.

While such contexts are given a semantic interpretation, the interpretation is restricted to specifying function-argument relations, tense, aspect and so on. What is not employed is any reference to semantic properties such as *object, action* and so on. This is a principled distinction between the proper semantic function of syntactic constructions as

[9] This is not to say that languages would not divide their semantic domains differently (since they clearly do). Rather, when one is comparing cross-linguistic generalized categories whose memberships should be mutually exclusive, such differences should not occur if the criterial properties are constant.

above, vs. a purely semantic generalization not motivated by the syntax. (Notice that this is equivalent, in many ways to the distinction between individuated quantification and object vs. substance for the count/mass distinction).

In many ways the Maratsos & Chalkley (M&C) model is both underconstrained and more constrained than the authors admit. Their proposal is for an induction procedure of the most general kind, with little or no innate specification. It is conceptualized in much the same way that the structuralists conceived of discovery procedures for determining the structure of languages (c.f., Bloomfield 1933, Harris 1970). History has proved such methods to be rather unfruitful (see Fodor, Bever and Garrett 1974 for a discussion). However, the M&C model does have certain built-in presuppositions that could possibly serve to make the procedure somewhat more successful. First, it assumes a distinction in the manner in which the closed-class vocabulary (function words and affixes) is represented (i.e., functors such as *-ed, is, -ing* are treated as uncategorized forms, unlike Nouns (Arg) and Verbs (Rel)). The existence of such a distinction could clearly benefit the learning process by differentiating sentential components and indicating structural relations. However, M&C do not attempt to explain how this distinction comes about and, given the general principles of the model, there should be no motivation to make such a distinction. A second way in which the M&C model differs from general discovery procedures is that there is a semantic interpretation over the context. This, for example, serves to differentiate cases of homonymity, disambiguate structure and so on.

While many things are unaccounted for in the M&C model and there are valid criticisms of it (c.f., Pinker 1979, 1983, Wanner & Gleitman unpub.), at some level there is justification for proposing that children are able to learn categories in the absence of semantic properties since they do acquire such distinctions as gender where there is little or no semantic support for the induction procedure. That is, in languages with extensive gender systems, children do learn that such things as chairs and gates are denoted by either

masculine, feminine or neuter nouns.

Karmiloff-Smith (1979) has studied the development of gender distinctions in French speaking children in a series of groundbreaking experiments. She showed quite conclusively that in learning new nouns, children only picked up on formal cues such as article type (*un* vs. *une*) or phonological properties of noun endings. Semantic cues (i.e., natural gender) were never employed as a basis for category assignment even when it was the only cue available. Such results are further corroborated by findings such as those of Suzman (1980) who found that in learning Zulu noun classes, the semantic coherence of the class was not a good predictor of order of acquisition. Thus semantically arbitrary classes were often acquired prior to those based on such things as animacy.

Thus, the M&C model may be correct, in principle a least, for some categories. What it lacks however, are constraints on what can count as common or distinguishing properties of distributions. Consider the contexts listed in table 0.1. for the count/mass distinction. If we assume that the child hears nouns in some of their possible contexts, but not others, then he will end up with a list of nouns that have various idiosyncratic distributions. Unfortunately, for the contexts that a noun does not occur in, the child has no way of knowing whether such lack of occurrence constitutes an "accidental" gap in the data, or whether it reflects an underlying categorical distinction. The M&C model does not explain how the child knows that there are only two subcategorizations nor how he knows which contexts to treat as distinguishing and which ones to treat as correlated. If the child were simply doing a blind correlation with no constraints then given 33 different contexts as in table 0.1, the child would have to consider $\sum_{n=1}^{33} \binom{33}{n}$ -over eight and a half billion possible subcategorizations.

It would seem then that there must be certain organizing properties that give coherence to the categories, above and beyond mere distributional coincidences. One way is to postulate semantically-based categories (e.g., count noun = object, mass noun = substance). An alternative would be if the child had picked up on the generalization that the the different contexts have common quantificational properties. This also would provide coherence to the relevant set of functors that serve to distinguish count from mass nouns. For example, if it was realized that *a* and *another* both quantified over individuals, then the child could be "prepared" (in a strong sense) to assume that to be a basis for correlation and thus restrict the set of possible hypotheses.

While it has been shown that subcategories such as gender must be induced in a non-semantic manner since there is no correlation with a semantic distinction,[10] there is very little evidence presently available concerning the development of categories for which the child might have a good basis for a semantic induction. The count/mass distinction does provide such a test case, since many of the early nouns that the child learns do conform to the semantic description of objects or substances. If the child's language learning procedure was one committed to initially representing categories as semantic types, one would expect this to be the case for the count/mass distinction. In the second half of this thesis we shall present evidence from both experimental and longitudinal studies of the count/mass distinction that should help to decide the issues for this particular case.

To summarize, Chapter I will examine longitudinal speech data and address the question of attributing categories to the child's grammar. Chapter II will examine the development of the relevant restrictions for determiners and plurals. The question of

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[10] One might wonder how children learning gender subcategories overcome the problem of 8 billion hypotheses. I suspect that the child must be innately endowed with some kind of agreement principle that causes him to be "on the lookout" for phonological coordination between phrasal constituents. The fact that adjectives exhibit a similar alternation to nouns (i.e., ± voicing of the final consonant) probably aids in making the appropriate generalization.

whether children's count/mass categories are semantically or formally based is addressed in Chapters III and IV.

Chapter I

Categorial Development: A Longitudinal Analysis

Introduction

In the present chapter we shall examine the development of formal rules invoking the count/mass distinction. We shall proceed by constructing an account of how count and mass nouns are distributionally distinguished from the analysis of longitudinal speech samples from two subjects. In terms of subcategorization and selection rules, count and mass nouns are distinguished by two factors: the determiner and the plural. In the introduction, determiners were classified as either unrestrictive (UR) or restricted to count nouns (R-C) or mass nouns (R-M). Determiners may further specify whether a count noun should be in the singular or plural form. In the first analysis we shall examine when these restrictions are enforced, treating separately, selection for count/mass features and plural features.

Because of the nature of the data, many of the lower frequency quantifiers are either never or seldom found in the spontaneous speech samples from young children. Therefore, much of the analysis will be restricted to the higher frequency determiners such as *a, another, some, more, one* etc. That is, we shall determine when the child restricts application of *a, another* and numerals to count nouns only, and for all determiners, whether plural agreement occurs for the relevant selection rules. Furthermore, with respect to plurals, we shall examine when these are restricted to count nouns only. In other words, do children make errors of the form: ***some waters***, and, if so, how frequent are they at different ages.

In examining the subcategorization rules, we are interested in when the child acquires the appropriate set of rules stating whether a determiner is obligatory or optional. It will be recalled that these rules stated that for singular count nouns determiners are obli-

gatory, whereas for plural count nouns and mass nouns determiners are optional. Therefore, if a singular count noun occurs without a determiner modifying it, the construction is ungrammatical:

(1.1) *I see car

However, if the noun is either a mass nouns or a plural, then the construction is grammatical:

(1.2) I see cars

(1.3) I see water

Notice that (1.1) is somewhat characteristic of early "telegraphic" speech in which children tend to omit grammatical function words and inflections or "closed-class items" (see Brown 1973). Therefore one would expect to find such errors in the early speech of children. However, as syntactic competence develops, the use of determiners should increase. In particular, such use should increase to a greater extent for singular count nouns that for the other categories (plural count and mass) as the child learns that such use is obligatory in the former but optional for the latter.

In all of the stated restrictions, a critical factor differentiating count and mass nouns is the determiner. For example, the selection rules are written over the different determiners (i.e., they are stored as part of the lexical representation of the determiner). Furthermore, for the subcategorization rules, one of the crucial factors involves whether a determiner is obligatory for the class of noun being used. Therefore, in attempting to provide an account of the subcategorization process, one must also take into consideration the development of the determiner category in providing the contextual differentiation of count and mass nouns. In the present analysis we will examine whether determiners are categorically distinguished

from adjectives. Because both categories are prenominal modifiers, it is possible that the child would not differentiate the two. As the subcategorization rules for count/mass specify determiners (and not adjectives),[11] we shall examine whether, in development, there is any tendency for adjectives to fulfill the role of determiners in these rules, thus showing a lack of differentiation at the categorial level.

In examining the differentiation of determiners and adjectives we shall be considering what exactly is involved in attributing categorial status to the set of determiners. Similarly, in investigating the initial distributional manifestations of the count/mass distinction, we shall also be concerned with the question of whether such distributional distinctions represent actual categorical distinctions. Again, we shall attempt to define when it is clear that we are seeing evidence of categories in the speech samples over time. To a large extent, the present analysis will be independent of considerations of semantic properties although the influence of semantics will be suggested in certain domains. What we shall not be considering is whether the distributional regularities indicate whether the categories are semantic or formal (as outlined in the introduction). This question will be addressed with respect to the longitudinal data in Chapter IV.

The Corpora

The speech corpora used in the present chapter were collected in the early 1960's by Wick Miller and Susan Ervin-Tripp and were kindly made available for the present analysis (see Miller & Ervin 1964 for discussions of the corpora). The two subjects we shall be examining were one female: SM, and one male: HS. SM was recorded from the age of 1;9 to 3;6

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[11] It is of interest that certain adjectives, particularly dimensional ones, tend to have semantic restrictions to something like objects but not substances. For example *?Big water* is semantically anomalous (see Keil 1979, for some properties of such predication restrictions). However, the mapping here is not onto the count/mass distinction since *Big furniture* does not exhibit the same unacceptability. In effect then, these adjectives appear to behave just as one would expect determiners to behave if the count/mass distinction were semantic.

and HS from 2;3 to 3;5. Samples were recorded at varying intervals. In the early stages, recordings were every 1 to 2 weeks combined into single transcripts over 1 to 2 month periods. Later, single recordings were made at anywhere from 1 to 4 months. Ages at which samples are available are shown in table 1.1. Concatenated samples are marked with an asterisk. Alongside each entry is the M.L.U. for that sample (see Brown 1973) and the number of count and mass nouns within that sample. In general M.L.U.'s for both subjects are comparable at equivalent ages with SM being slightly more advanced in this respect. Also noticeable is the fact that count nouns far outnumber mass nouns for all samples. This should be borne in mind when comparisons of the two categories are carried out (i.e., because of the relatively small number of mass nouns, generalizations may not be totally reliable).

Method of Analysis

The original transcripts for the corpora were filed in a computer-generated concordance text. For each word and inflection type, token occurrences were listed together. For each token there were about 2 to 4 sentences of context. There was almost no non-linguistic contextual information provided. From the concordance texts, all nouns were recorded along with the NP context in which it occurred (for errors, the whole sentence was recorded). NP's were coded for the following four factors:

(i) Noun

For present purposes, only clear cases of count and mass nouns are included (although all nouns were originally recorded from the concordance texts). Not included were nouns that were both count and mass in general use (e.g, *pie, cake, noise* etc.);[12] proper

[12] It is often not easy to decide whether a noun is both count and mass or if it switches categories a lot. For example, *a beer* occurs extensively, even though one's intuition suggests that it is a mass noun. On the whole, intuition was relied upon in the difficult cases and may therefore be a source of some error.

Table 1.1 Age, MLU and Number of Count and Mass Noun Tokens in Speech Samples

SM				HS			
AGE	MLU	Count	Mass	AGE	MLU	Count	Mass
1;9*	1.7	131	0				
1;11*	1.85	175	17				
2;2*	3.22	235	64				
				2;3*	2.94	276	56
2;5	3.53	249	50				
				2;6*	2.94	227	29
2;7	4.35	245	57				
2;9	3.96	309	53	2;9*	4.21	242	34
				2;11	4.32	308	55
3;1	5.13	431	88	3;1	4.64	220	88
				3;3	4.34	282	80
				3;5	4.7	174	25
3;6	4.73	507	68				
TOTAL		2282	397	TOTAL		1729	367

* *concatenated samples*

nouns (e.g., *Joe, Susan*) and other nouns with idiosyncratic distributional properties (e.g., *breakfast, upstairs, sun* etc.).

(ii) Determiner

The determiner was recorded in full. If there was no determiner, it was recorded as null (∅). Complex determiner constructions such as partitives (e.g., *some of the* N) and classifier phrases (e.g., *a piece of* N) were recorded as single determiner entries.

(iii) Adjective

Presence or absence of an adjective was coded as A or (∅) respectively.

(iv) Plural

The value of the plural feature was marked + or -. Pluralia tantum (e.g., *scissors, pants*, etc.) were not included in the analysis. Whether or not the morphological form of the plural was correctly produced was not considered relevant for present purposes.

A sample entry for e.g., "I see red cars" would be of the form:

NOUN	DET	ADJ	PLUR
CAR	∅	A	+

Entries in this form were put on file in a computer. For each age sample of each child there was one file for count nouns and one for mass nouns. A retrieval program was written that allowed probing for particular configurations. For example, one could probe for all occurrences of singular count nouns with no determiner. The program would then list all count noun tokens occurring in that context for each age sample. Also listed were the percentage of tokens for each noun type, plus the overall percentage of tokens and types appearing in a particular context for each age sample.

Examination of Distributional Distinctions:

Determiner Selection and Plural Restrictions for Count and Mass

The only determiners that occurred with any great frequency and were restricted to one subcategory were: *a, another* and numerals; all selecting for count nouns. In general, performance in selecting for the appropriate subcategory was very good from the earlest samples. The relative distributions of the three determiner types with count and mass nouns are shown in table 1.2a for SM and 1.2b for HS. Also shown are uses of count and mass nouns with plurals and the total number of count and mass noun tokens in the corpora. The bottom row indicates the proportion of errors in the use of these functors (i.e., use with mass nouns/use with count nouns) and in the bottom right entry, the overall proportion of mass nouns to count nouns. Thus, in assessing the error rate for a particular functor, one should compare values in the bottom row to the overall mass/count ratio (.17 for SM and .21 for HS).

For the most part, the error rates are extremely low, the highest rates being contributed by small (and thus unreliable) totals (e.g., *another* for SM has an error rate of .06, but is the result of a single error). An examination of these rates over age revealed very little clustering at particular samples although errors did tend to tail off in the later samples. For example, for *a* where there was an appreciable absolute number of errors, the error rate never exceeded .06 (= 1 error) for SM and .03 for HS.

The only possible evidence of some clustering occurred for plurals with SM which reached .1 (4/40) at 2;2 and .07 (3/43) at 2;7. While these rates are still well below the overall mass/count ratio of .17 one might want to suggest that SM was not completely restricting plurals to count nouns until perhaps age 2;9 or 3;1. One should however treat such results with caution due to the small absolute number of errors involved at each sample. Such an interpretation does agree with the results of Cazden (1968) who found that mass

Table 1.2a Frequency Usage of Count-Restrictive Determiners & Plurals with Mass and Count Nouns

	a	*another*	numerals	plurals	All Contexts
MASS	10	1	1	12	397
COUNT	540	17	34	484	2282
Mass/Count	.02	.06	.03	.02	.17

Table 1.2b Frequency Usage of Count-Restrictive Determiners & Plurals with Mass and Count Nouns

	a	*another*	numerals	plurals	All Contexts
MASS	6	0	3	0	367
COUNT	488	46	58	240	1729
Mass/Count	.01	0	.05	0	.21

plurals were a relatively frequent error noting 11 such examples. Unfortunately this number is not compared to the total number of plurals found in her corpora. What is perhaps the most striking finding in this analysis with respect to plurals, is that HS made no errors from a total of 240 used. It would seem that while the restrictions seem to come in very early, there is considerable variation between subjects.

The pattern for determiners, as noted previously, is quite consistent. The error rate is extremely low for even the earliest samples thus suggesting differentiation of noun classes, at least with respect to the particular high frequency forms examined (*a, another* and numerals). When one examines the pattern for less frequent determiners which are restricted to one subcategory, the picture is somewhat different. Of the 14 additional determiners (tokens) for which there was exclusive selection for count or mass there were 4 errors (35%). These are listed in table 1.3 along with correct uses of low frequency restrictive determiners. Thus, while there is very little data to go on, this result does suggest that restrictions might be somewhat delayed for these lower frequency forms. A more thorough examination of the development of these restrictions will be carried out in Chapter II.

Plural Agreement

It was noted previously that determiners may select not only for count or mass features but also for plural features (see table 0.1). For the high frequency determiners studied in the previous section (*a, another,* numerals) all except for numerals (greater than one) select for singular count nouns. We shall therefore initially examine errors of overpluralization with *a, another* and *one.* Once again, such errors were exceedingly rare. For SM there were three errors with *a* (2;9 and 3;1) and one error with *another* (3;1). For HS there was one error the *a* (2;3) and one error with *one* (2;9). Otherwise performance was perfect.

Table1.3 Use of Restrictive Determiners for SM and HS

Selection Errors:	**Correct Selection:**
SM	SM
*a piece - another toast	both babies
*too much - too many traffics	too many questions
HS	HS
*every bread	so many colors
*every candy (x2)	every day (x4)
	a little sugar (x2)

The other relevant class of determiners which require singular agreement with count nouns is the E-Quantifier class (*each, every* etc.). Of the four occurrence of *every* (the only E-Quantifier found) with a count noun, all were with singular forms. However, they were all occurrence of the phrase: *everyday* which could well be idiomatic and unanalyzed by the child. Later we shall predict that these quantifiers should cause much difficulty when used productively (see Chapt· II).

In general then, errors of overpluralization are, again very rare. In the case of under-pluralization where a singular form is produced when the determiner requires a plural, there were a total of 20 errors. The determiners for which such errors occurred are listed in table 1.4. Comparing error rates for underpluralization and overpluralization where the form is specified by the determiner (i.e., not including pragmatic requirements), the rates are much higher for underpluralization. For the determiners examined in the previous section (*a, another, one, every*) the proportion of use with plurals was only .003 (2/566) for SM and .005 (3/556) for HS. The data for underpluralization are: .14 (12/83) for SM and .13 (9/68) for HS.

In other words the subjects had a much stronger tendency to leave off plurals than to place them inappropriately. This is likely to be a reflection of some kind of "processing limitation" or such like generally invoked to account for the telegraphic nature of early speech where, typically, inflectional errors are of omission rather than proliferation. Thus apart from the influence of these factors, then did appear to have plural agreement quite well under control. That is, even for underpluralization, they were grammatical 96% of the time.

Table 1.4 Plural Agreement Errors: Underpluralization (SM + HS)

DETERMINER	# errors
some	4
some more	3
More	3
No more	1
Any	3
Numerals (>1)	6
Plenty of	1

Summary

On the whole, both subjects showed very early control of count/mass selection by determiners, plural agreement and restriction of plurals to count nouns. While there were a few areas where one or other of the subjects showed some problems, in general there were several other areas where they appear to have made clear distinctions from the earliest samples. Thus, if we are simply attempting to determine whether the subjects showed distributional evidence for a distinction between mass and count nouns, the answer would clearly be positive from the very earliest samples.

Obligatory vs. Optional Determiner

In the previous analysis we examined agreement phenomena between determiner, noun subcategorization and plural. In this section we shall be concerned with presence or absence of the determiner in the NP. Specifically, we are interested in the development of subcategorization rules stating that determiners are obligatory for singular count nouns but optional for plurals and mass nouns (see rules 0.8 and 0.9).

The method for examining the development of these rules will be to follow the rate of occurrence of the three noun types (sing-count, plur-count, mass) in "null-determiner contexts" (i.e., with no determiner: $[_{NP}\emptyset$ N]). [13] As previously mentioned, in early telegraphic speech, children generally tend to leave off function words, including determiners. Thus for all three noun types, the developmental trend should show a decrease in the rate of occurrence in null-det contexts with the concomitant increase in the use of determiners.

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[13] The null sign ($\emptyset$) is used here in the weakest sense. No claim is made that the position it occupies is the result of a deletion or any such process.

However, as the child learns that determiners are obligatory for sing-count nouns, the decrease of occurrence in null-det contexts should be more marked for that category. Plotting the rates for the three noun types, we are interested in two points: (1) The point at which the trend for sing-count nouns branches away from the other two noun types, and (2) the point at which a baseline level is reached for the singular count nouns. The baseline will be set at 10%, equivalent to Brown's (1973) 90% criterion of correct usage for the acquisition of grammatical morphemes.

The age trends for the three noun types are shown in fig 1.1a for SM and fig 1.1b for HS. The values are calculated as:

occurrence in null-det contexts/overall occurrence of the noun type.

For SM the picture is very clear. At 1;11 there is no real differentiation of the three noun types. Branching occurs at around 2;2 reaching the 10% criterion at 2;7. Plur-count and mass nouns, on the other hand, remain at around 40 to 50% across samples. The picture for HS is more erratic, but generally similar. Branching occurs at 2;9 reaching criterion at 3;1.

Spearman rank correlations revealed significant negative correlations with age for sing-count nouns (SM: $r = -.9$, $p > .005$; HS: $r = -.73$, $p = .05$). For the other noun types correlations were not significant although mass nouns did approach significance for SM (Plur-count: SM: $r = -.28$, HS: $r = +.3$; Mass: SM: $r = -.62$; HS: $r = +.2$).

To summarize, unlike the previous rules examined, differentiation for obligatory determiners with sing-count nouns does not occur until later with a somewhat protracted course of development.

Fig 1.1a. Proportion Use of Sing-Count, Plur-Count and Mass Nouns in Null-Det Contexts: SM

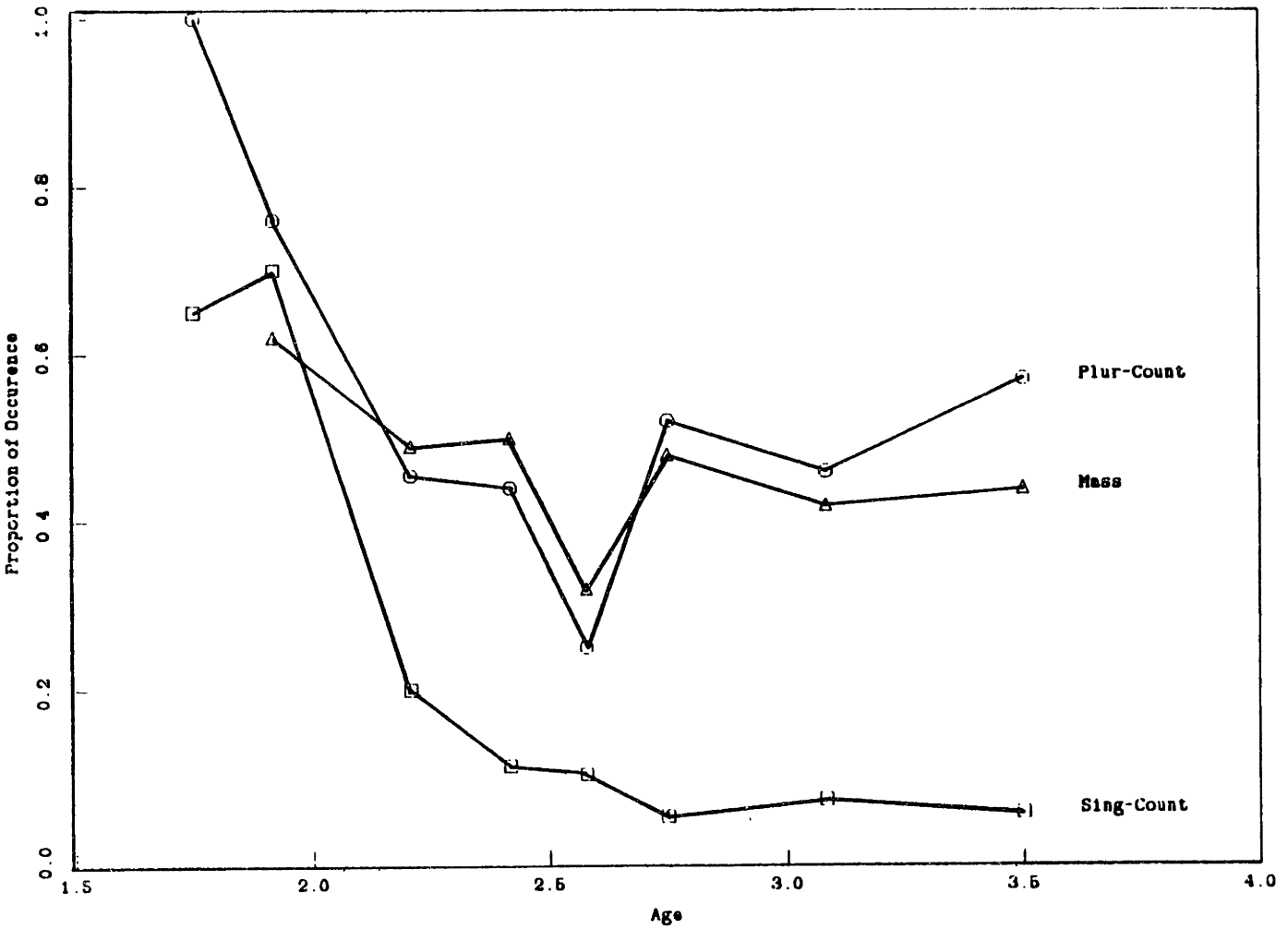
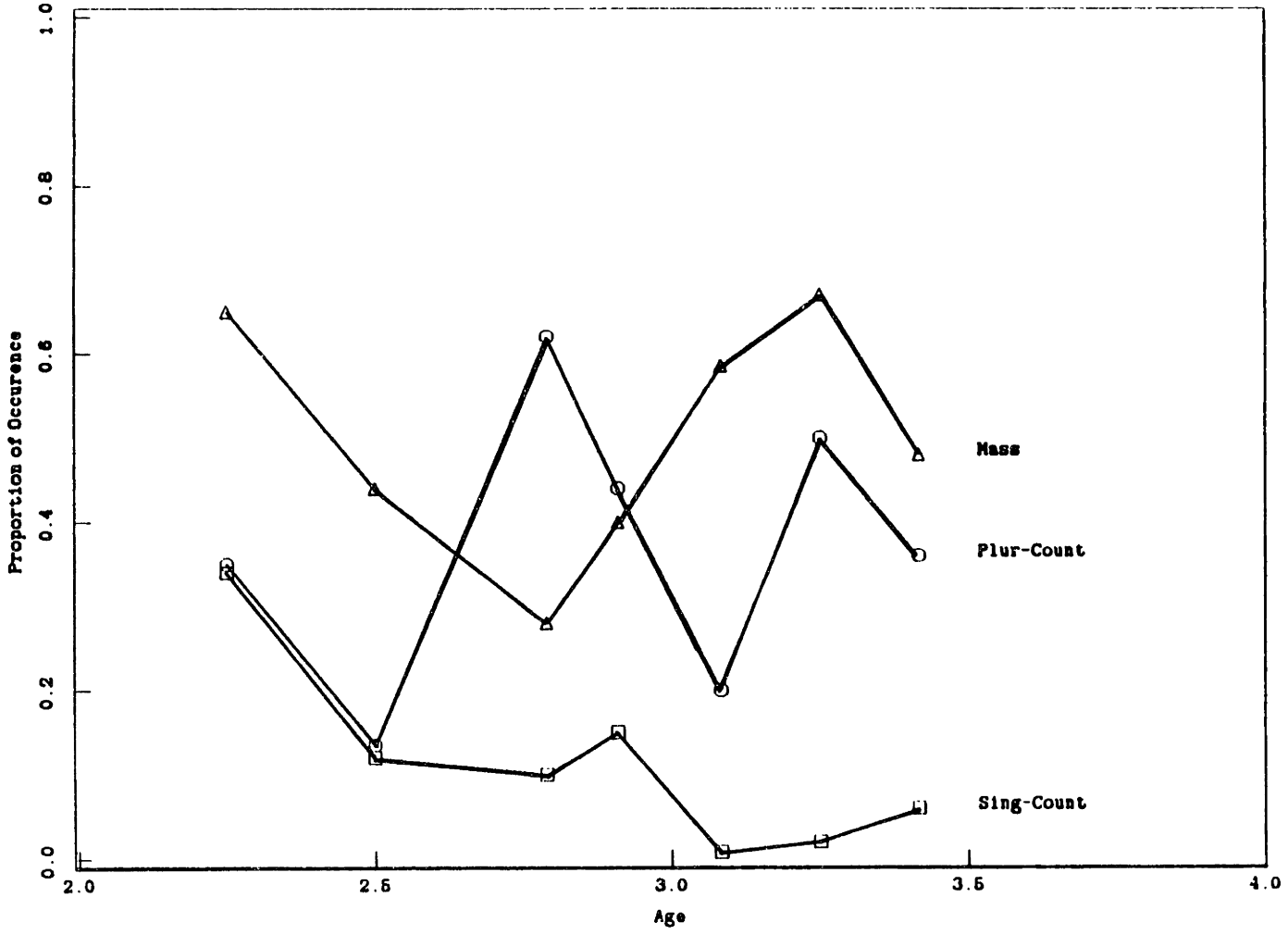


Fig 1.1b. Proportion Use of Sing-Count, Plur-Count and Mass Nouns in Null-Det Contexts: HS



The Determiner Category

An attempt to provide an account of the development of the count/mass distinction must not only consider the noun subcategories themselves, but also those categories that provide the context for differentiating count from mass nouns. In this instance, we must consider the development of the determiner category which plays such a crucial role in both the subcategorization and selection rules. In a recent study by Valian (unpub), the categories: Determiner, Adjective, Noun and Noun Phrase were examined for their emergence in longitudinal speech samples from six two-year-olds.

The Valian study represents a significant advance on previous studies in which grammars have been written for child speech samples. In the older studies, categories were either assumed without justification (e.g., Brown & Bellugi 1964, Bloom 1970) or else, the categories employed were radically different from the target categories with no account of how the child shifted to the adult categories (e.g., the pivot and open classes of Braine 1963; - see Brown 1973 for relevant criticisms). In Valian's study, for each of the categories examined, a number of distributional criteria were developed. If the criteria were met, then it was concluded that the categories were in existence for the subjects. For all categories except Adjective, the children studied met the required criteria by the age of 2 (MLU = 3), thus suggesting that such categories are in existence at a very early stage. For adjectives, many children were found to employ them in noun contexts, following a determiner but not modifying another noun (e.g., **a brown*).

Valian's criteria for the Determiner category were as follows:

[I] Must appear, if present, pre-adj or pre-Noun or pre-both.

[II] Must not stand alone as the sole content of an utterance.

[III] Must not be sequenced (exceptions: certain quantifiers).

The wording of [I] and [II] is somewhat misleading. For [I], Valian's evidence for criterion

passage was that when any *combination* of the three categories mentioned was present, children always produced them in the correct order: *Det-Adj-N.* Thus [I] does not incorporate [II], the case of the isolated determiner. For [II] there are further ambiguities. First, "utterance" should read: "utterance or noun phrase" as the counterexamples provided by Valian include uses of determiners without nouns, but not as the sole content of the utterance:

e.g.,

(1.4) "... and that's *a* -- what is that?"

The counterexamples were all found to be either false starts/hesitations (as above) or else the uses of determiners in isolation were legitimate such as: "that" or "two" as responses to questions. Notice that this introduces a weakening of the criterion in that the claim is no longer that determiners do not get used in isolation, but that they do not appear in isolation where such use is ungrammatical. A similar qualification must be added to the third criterion in that children did use determiners in sequence (e.g., *a few, some more, all the,* etc.) but again, such constructions were legitimate. The only exceptions were one use of *some the* and a number of cases of missing copulas with demonstratives (e.g., *that a horse*). While the latter example gives the appearance of sequencing, one can assume that the demonstrative is pronominal in such cases (i.e., dominated by a separate NP node) and therefore the criterion is not contravened.

There is a major problem with [I] and [II] in that they do not capture what is fundamental about the determiner category. That is, because there are grammatical exceptions both criteria, one cannot say that isolation and sequencing are distributional properties that exclude determiners by nature of the inherent properties of the category. For example, the one example of illegal sequencing given by Valian: **some the,* may have been an overgeneralization by analogy with *all the.* If this were the case, such an error would not constitute evidence for the lack of a determiner category, but rather, it would be evidence, par excellence,

for the existence of the category. That is, the purpose of a category is to allow generalization to occur across members of the category (see Chapter II). If a child overgeneralizes in such a manner, then one has good evidence for the internal coherence of the category. Given that overgeneralization is into a potential determiner position, the fact that it is ungrammatical merely adds strength to the argument that categorial generalization is productive beyond what occurs in the input to the child.

In fact, in the data for SM and HS, there were quite a few novel determiner sequences that were ungrammatical but can be seen to have been generated by analogy and substitution. Some examples are listed in table 1.5 along with comparable grammatical sequences that could possibly have served as the original analogues.

Unlike Valian's criteria [II] and [III], the first criterion pertaining to word order within NP's is fundamental and exceptionless. That is to say, a fundamental definitional characteristic of the determiner category is the sequence it appears in in the NP: [Det Adj N]. In the two corpora there was only one ordering error: ***other that sandwich*** (HS 2;11). In Valian's samples no ordering errors were found and in the language acquisition literature in general such errors are not often reported, at least by the three word stage.

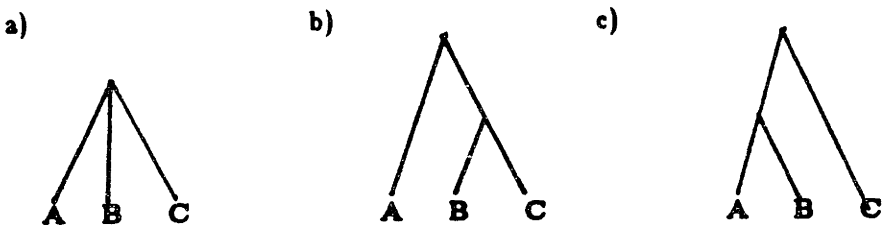
While correct sequencing does appear to be a fundamental criterion for the Determiner category in ***distributional*** terms, it does not necessarily provide evidence for structural differentiation. That is to say, a sequence of three categories:**A B C** could be related by a number of different structural configurations as in fig 1.2.

That particular aspect of structural differentiation that we shall be interested in in the present analysis concerns the differentiation of the Determiner category from the Adjective category. Consider the course of development of the noun phrase: The child acquires nouns and finds that there are other words modifying them (Determiners and Adjectives). On the basis of distributional evidence, it appears that determiners are distinguished from

Table 1.5 Possible Analogues to Erroneous Determiner Sequences (SM + HS)

Ungrammatical Sequence	Possible Analogue
*A more playdo	Some more N
*Another little sugar	A little N (was said in previus sentence)
*Somw lots of Playdo	A lot of N

Fig 1.2



adjectives at an early age. However, does the child correctly construe the distinction to be a major category difference and thus produce a tree configuration as in fig 1.3 or fig 1.4,[14] or rather, does he construe determiners and adjectives to be subcategories of a general "modifier" category as in fig 1.5. Proposing the possibility of an incorrect analysis is not at all absurd. In fact, the generalized *modifier* category incorporating both determiners and adjectives was exactly what was proposed in Brown & Bellugi's (1964) early grammar for Adam, Eve and Sarah.

The relevance of this issue for the count/mass distinction lies in the fact that the subcategorization rules are written over the determiner category with adjectives being essentially irrelevant. For example, the stipulation that determiners are obligatory for singular count nouns (see previous section) requires that determiners and not adjectives precede the noun:

c.f.,

(1.5) Look at *the* car

(1.6) *Look at car

(1.7) *Look at *red* car

If, as Brown & Bellugi suggest, both determiners and adjectives are incorporated into a single modifier category and are not structurally differentiated, then the relevant subcategorization rules would be written over the incorrect Modifier category rather than the structurally distinct Determiner category. In other words, the adjective could fulfill the role of the

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[14] The difference between fig 1.3 and 1.4 is basically that 1.3 represents an earlier formulation of NP structure (i.e., NP → Det (Adj) N). Structure 1.4 is superior for a number of reasons (see Radford 1981, chapt. 3) and is written in X-bar notation for theoretical niceties. Essentially, the reader may equate $\overline{\overline{N}}$ with NP and $\overline{N}$ with either NP or "nom". The present analysis does not address the question of which represents the child's structure since they both differentiate Det and Adj, that being the main concern.

Fig 1.3

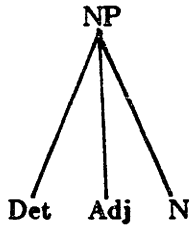


Fig 1.4

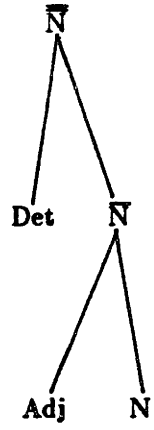
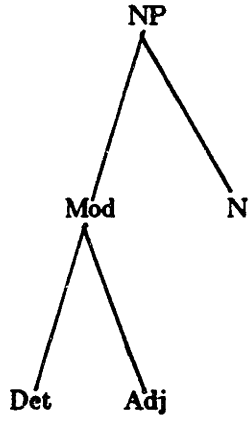


Fig 1.5



obligatory component in the subcategorization rule and thus constructions such as (1.7) would be generated by the grammar (i.e., they would be grammatical for the child).

Using the fact that we have data on the acquisition of the subcategorization rule making determiners obligatory for singular count nouns, it is possible to ascertain whether determiners and adjectives are structurally distinct in the child's grammar. That is, we can determine whether the child's NP looks something like the structurally distinguished form as in figs 1.3 or 1.4, or the incorrect form in fig 1.5. If the schema contains a generalized modifier category then one should find that adjectives fulfill the role of the obligatory component (i.e., the determiner in the correct form of the rule). As a consequence, NP's containing adjectives should have a disproportionately high number of null-det contexts with singular count nouns, as in (1.7). That is, assuming that the modifier category has attained obligatory status in the grammar, the presence of the adjective should fulfill the role of modifier, thus making the determiner unnecessary. On the other hand, if the subcategorization rule is written over the structurally distinct category of Determiner, then there should be no difference between NP's with or without adjectives.

If a difference were found in the occurrence of ungrammatical forms with null-det NP contexts depending on the presence of the adjective, then there could be an alternative account. The fact that determiners are not present when adjectives are present in NP's could be a consequence of limited processing capacity. That is, there could be a limit on the number of components in an NP. If an adjective is present, then the resulting increased complexity might lead to "bumping" some other constituent. The noun is clearly more important (semantically and structurally) than the determiner and therefore the determiner is left out.

This alternative account can be controlled for by examining whether or not the presence of an adjective in NP's in general causes omission of the determiner, or whether such

tendencies are restricted to singular count nouns. We shall therefore examine NP's containing plural count nouns and mass nouns. If the presence of an adjective leads to a high proportion of occurrence in null-det contexts for these other noun types, then one cannot explain the higher rate in terms of the adjective fulfilling the role of the obligatory determiner (as in the case of sing-count nouns) since the determiner is optional for these noun types. Therefore, if the rate is higher, the most likely explanation would be a processing limitation account.

To summarize, there are two conditions that must be met in order to demonstrate that determiners are not structurally distinct from adjectives and are subsumed under one general modifier category: (1) NP's with sing-count nouns and containing adjectives should have a disproportionately high occurrence rate in null-det contexts; (2) The high occurrence rate should be restricted to sing-count nouns and should not be high (relatively) for plur-count nouns and mass nouns with adjectives.

Results

The age trends for the relevant noun types are given figs 1.6-8 for SM and figs 1.9-11 for HS. For each of the three noun types, the proportion of occurrence in null-det contexts in general is shown in the unbroken line.. These trends are the same as those given in figs 1.1a and b. The broken lines represent the occurrence rates in null-det contexts for NP's containing adjectives. Thus, a higher rate for the unbroken line indicates omission of a determiner when the adjective is present. On average, NP's containing adjectives represented 7.5% of all NP's for SM and 11.5% for HS. The reader should bear in mind that in certain samples values become very small especially at early ages and for mass nouns or plurals with adjectives and no determiner. Therefore a certain amount of caution is warranted in interpreting the differences in occurrence rates.

Fig 1.6 Sing-Count Nouns in Null-Det Contexts: SM

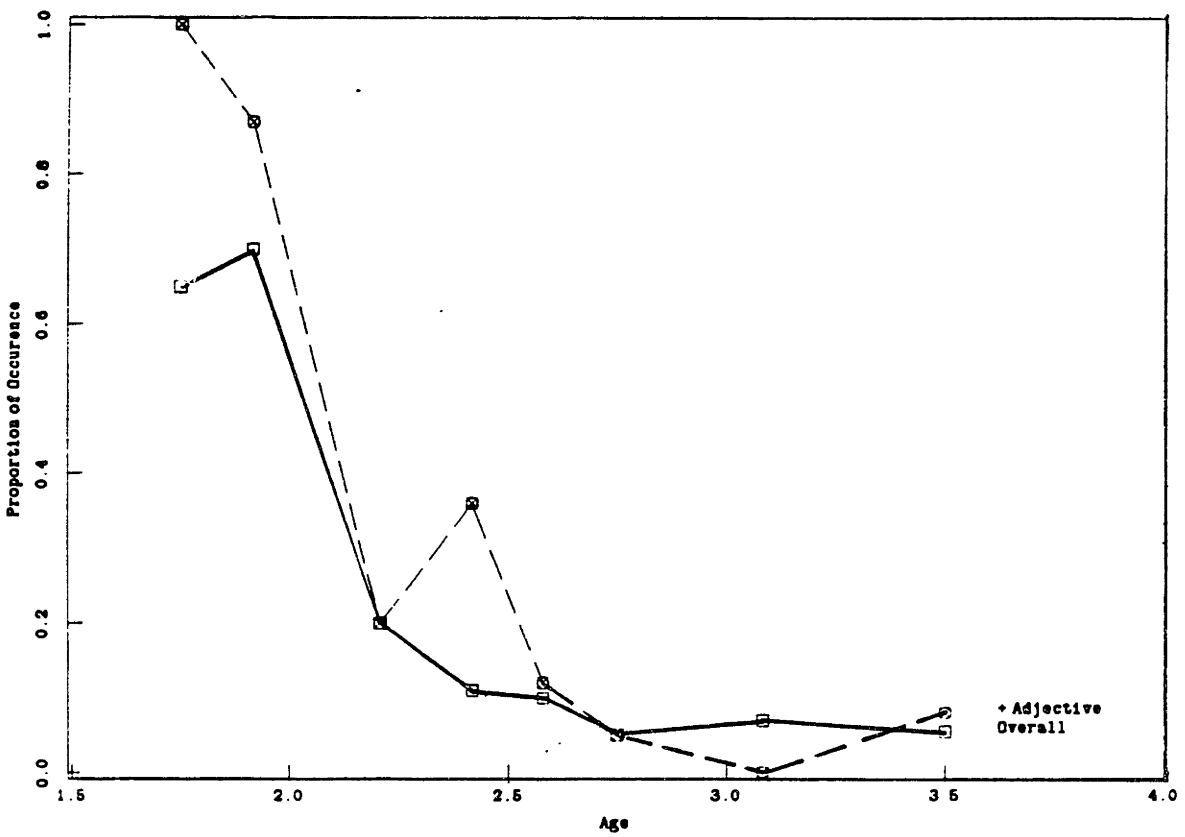


Fig 1.7 Plur-Count Nouns in Null-Det Contexts: SM

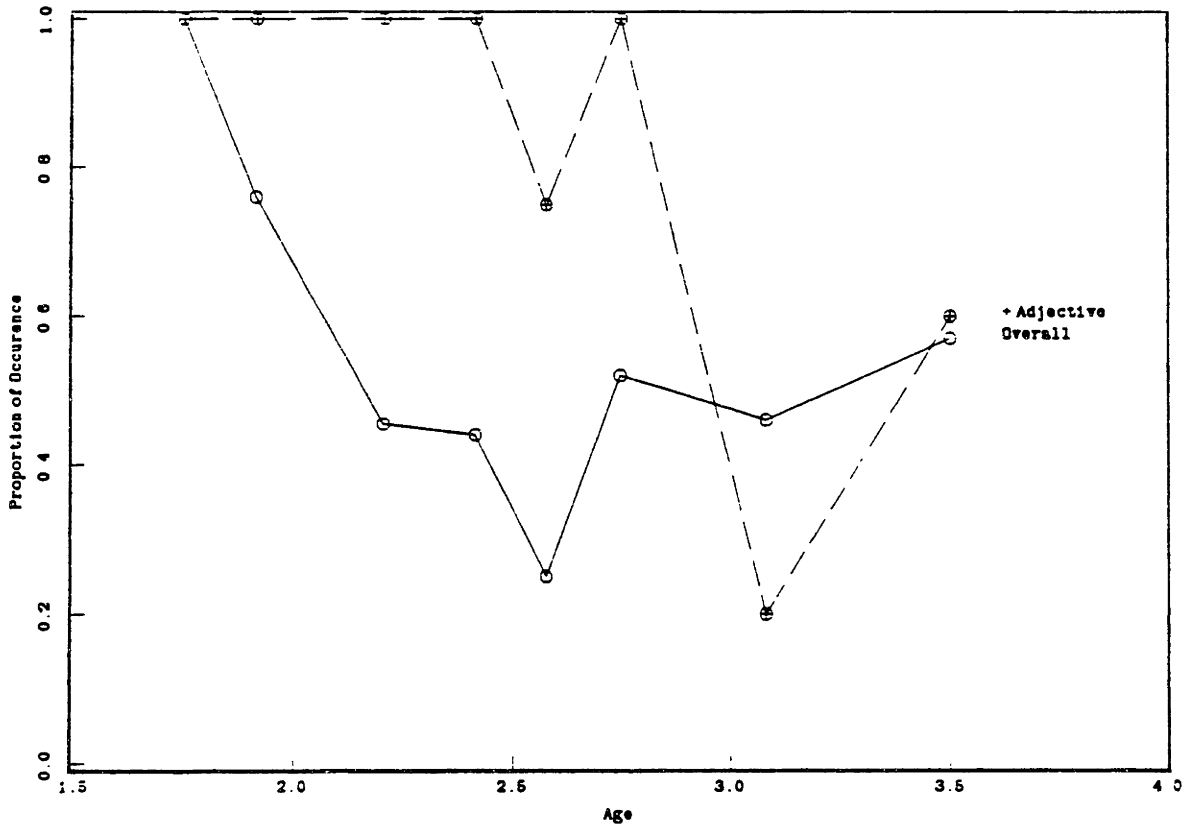


Fig 1.8. Mass Nouns in Null-Det Contexts: SM

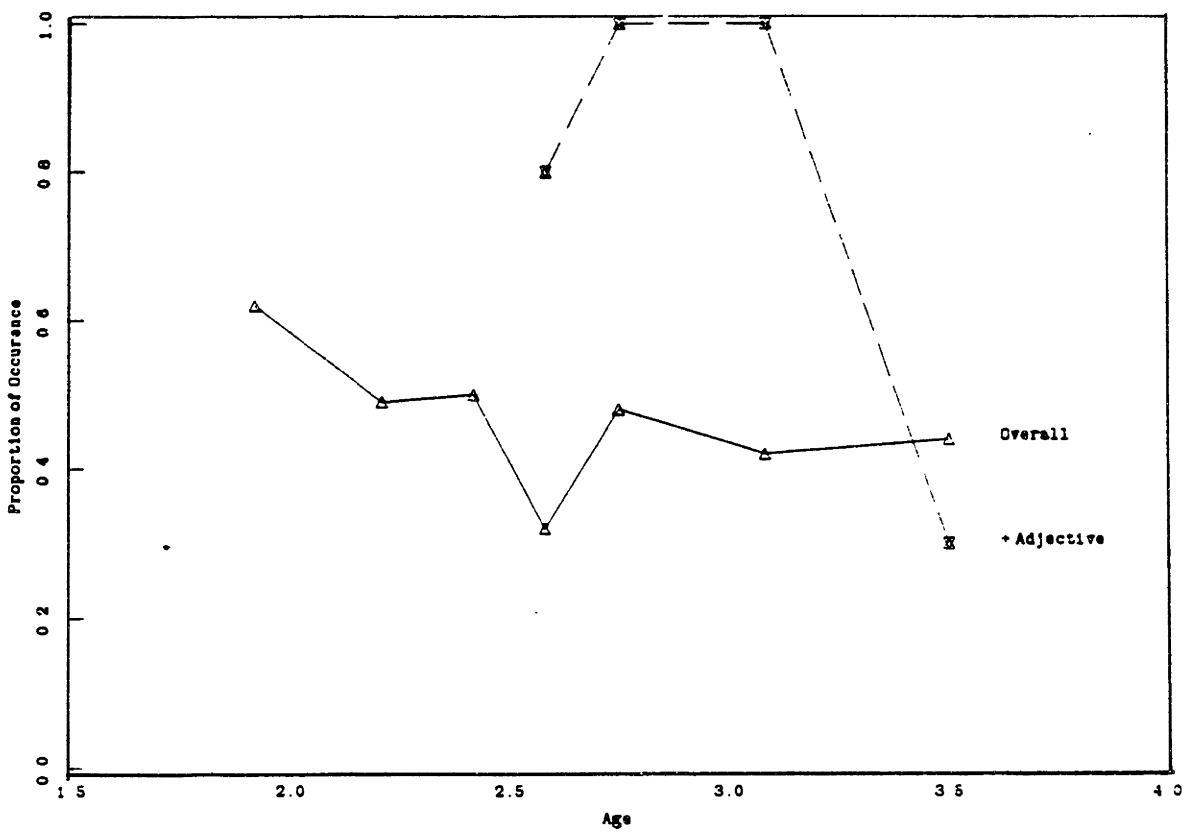


Fig 1.9 Sing-Count Nouns in Null-Det Contexts: HS

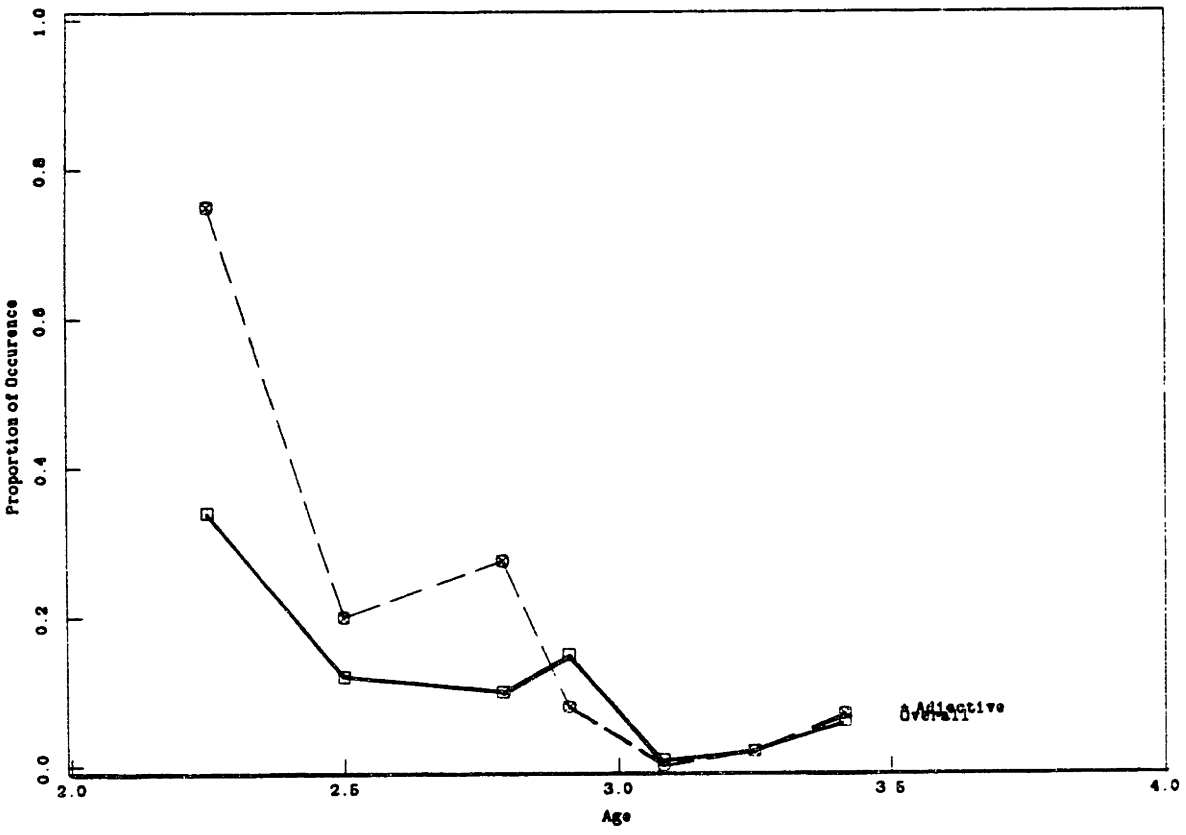


Fig 1.10 Plur-Count Nouns in Null-Det Contexts: HS

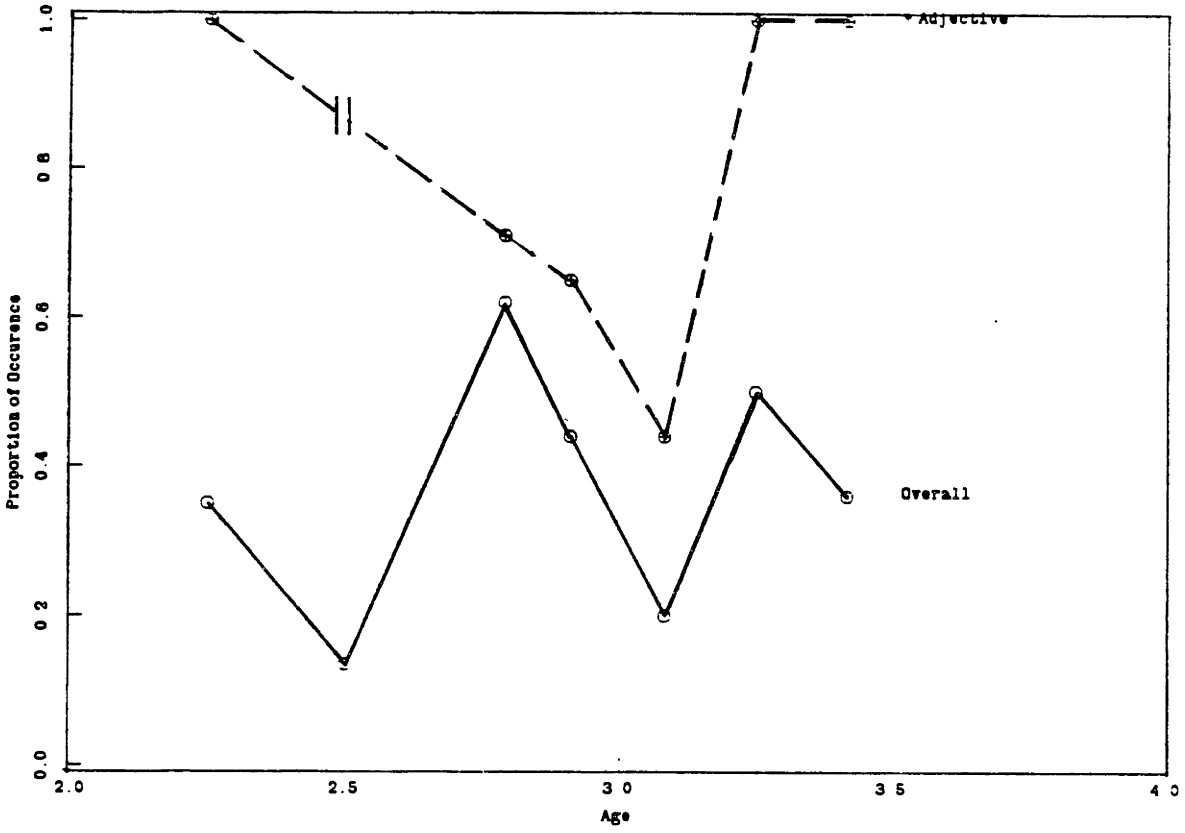
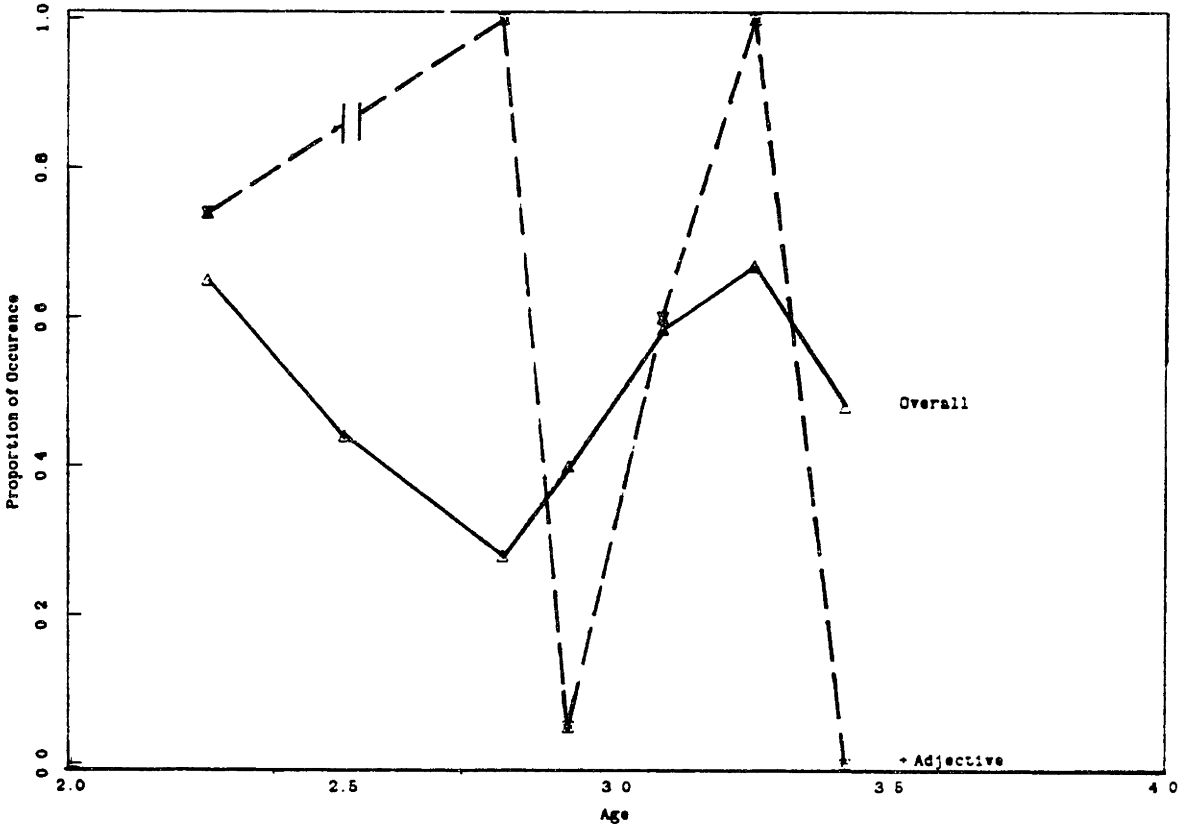


Fig 1.11 Mass Nouns in Null-Det Contexts: HS



The first condition for demonstrating a lack of structural differentiation between determiners and adjectives stated that NP's containing adjectives and sing-count nouns should show a disproportionately high occurrence rate in null-det contexts. The relevant data are to be found in fig 1.6 for SM and 1.9 for HS. For both subjects, while the occurrence rate for NP's with adjectives is higher in the early stages, from 2;2 (SM) and from 2;6 (HS) the trends follow each other about as perfectly as one could expect from such randomly sampled data. Notice that 2;2 is exactly the age at which branching occurs for SM, and 2;6 is one sample point before branching for HS (see previous section). In other words, as soon as there is evidence that sing-count nouns are differentiated for determiner obligatoriness, the adjective-NP trend follows the general NP trend almost exactly. Thus the presence of the adjective is essentially irrelevant to the learning of the rule and there is no evidence from the present data to suggest that determiners and adjectives are subsumed under a generalized "modifier" category. Rather, the evidence points to a clear structural differentiation of the two categories.

Given the above evidence, testing for the second condition pertaining to possible processing limitations becomes somewhat superfluous. However, examining the graphs for plur-count and mass nouns (figs 1.7-8 (SM), figs 1.10-11 (HS)), there does appear to be a generally higher rate of occurrence in null-det contexts when adjectives are present (bearing in mind the small numbers involved). Similarly, for singular count nouns, the rate is somewhat higher before the branching point. A processing limitation of the sort outlined previously may well explain the higher rates for these cases. That is, determiners are omitted when an adjective is present, due to some limitation on the number of components in an NP.

However, if such is the case, it appears that determiner omission only occurs when the resulting construction is *grammatical* according to the child's current rules. In the case of sing-count nouns, prior to branching there is no rule stating that determiners are obligatory, therefore omission of the determiner is not ungrammatical for the child at that point. Thus

we see the effect of the presence of adjectives in omission of determiners. However, as soon as the obligatory determiner rule shows signs of being in evidence, presence of the adjective no longer causes omission of the determiner.

General Discussion

In this first chapter we have examined the development of a number of rules that in one way or another invoke the count/mass distinction. In very general terms, there appear to be two main patterns of development. Either restrictions are in evidence from the earliest samples (i.e., Determiner Selection, Plural Restrictions and Plural Agreement) or else, in the case of the obligatory determiner rule for singular count nouns, the data show no evidence for the rule until later in the corpora and even then have a protracted course of development over a number of months before being completely enforced. Let us consider from these facts, when one should attribute the existence of a distinction along the lines of count vs. mass.

To answer this question one needs some kind of criterion. Consider first, the most simplistic distributional criterion:

> [A] The child has acquired the count/mass distinction when either count nouns or mass nouns occur in contexts that the other does not. Furthermore, these contexts are ones that differentiate count and mass nouns in the target grammar.

If criterion [A] is adopted then, barring a few errors here and there, both subjects, in this sense, had acquired the count/mass distinction from the earliest samples. The fact that the obligatory determiner rule comes in later is of no real consequence since condition [A] does not require that all rules be effective.

Now let us consider a more stringent criterion:

> [B] The child has acquired the count/mass distinction: (i) When count and mass nouns are distributionally distinguished (as in condition A) and (ii) When count and mass nouns have attained separate categorical status in the child's grammar.

Criterion [B] is more stringent than [A] in that surface distributional distinctions alone are no longer sufficient. What is required is evidence that the distributional distinctions reflect underlying categorical distinctions. To show that distributional and categorical distinctions do not amount to the same thing, consider how speech samples from a child might show distributional distinctions even though his grammar does not distinguish the two noun types as separate categories.

It was noted earlier that there were two main patterns of development of rules: those that are effective from the beginning (as far as our samples go) and those that have a later, more protracted course of development. The rules following these two patterns of development can also be characterized in terms of whether they can be semantically motivated. Those that are acquired early, all share the property that they reflect, in a very direct fashion, the semantics of functors involved (i.e., determiners and plurals). For example, take the semantic properties of *a*. Part of its function involves quantification over discrete individuals (e.g., *a car* refers to a single object). The majority of the child's mass nouns, however, tend to denote continuous forms such as *milk, water, sugar* and so on (see chapter IV). Because continuous forms are, by definition, not discrete and consequently unindividuated, the use of *a* as a modifier (e.g., **a sand*) would involve a semantically anomalous construction (independent of the syntactic facts). Notice, however, that for some mass nouns, *a* would not be semantically anomalous if used in construction: e.g., *a celery* since celery can be discrete and individuated (i.e., a stick of celery).

Let us suppose that the child knows the semantics of *a* but does not categorically distinguish count and mass nouns (i.e., they are both simply nouns). If the set of mass nouns that the child uses tend to denote continuous forms, then simply knowing the semantic function of *a* would be sufficient to show a distributional distinction without the categorial distinction being established yet. One might wish to compare a child learning, say, Hopi where there is no categorical distinction to learn, yet one might still find distributional distinctions between what we take in English to be count and mass nouns, simply because of the semantic functions of the articles and quantifiers.

For all of the early occurring restrictions, an account of the kind outlined above could be constructed. That is, *a, another,* numerals and plurals all semantically function over either discrete individuals or plural sets. If the mass nouns used by the child mostly denote continuous forms, then application of the relevant determiners and plurals could, hypothetically, be prevented without any reference to a categorical distinction between count and mass nouns.

Consider now the case of the later occurring restriction in which determiners are stated to be obligatory for singular count nouns. The striking characteristic of this rule is that it seems to be quite arbitrary in nature. For example, while for most standard dialects of English the rule is effective, for some Northern English dialects (e.g., Yorkshire), a sentence such as:

(1.8) Shut gate and come in house

is perfectly acceptable and sentences of the type are often used. Furthermore, it is hard to see how the restriction could come about through knowledge of the semantic function of either determiners or plurals since these elements are simply not present in the illegal constructions (i.e., null-det contexts).

Given that the semantic motivation for this rule is quite minimal,[15] in order to account for the acquisition of the rule, one must make reference to the noun categories over which the rule is written. In other words, the grammar of the child must contain distinct count and mass categories. Therefore, if the child's data showed distributional evidence for the acquisition of the obligatory determiner rule, then it may be inferred with some confidence that there is evidence for the existence of categories thus satisfying criterion [B].

In proposing that the early occurring distributional distinctions for *a, another* etc. could represent processes that did not reflect underlying categories, we are not actually taking a stand on the issue. The alternative account is simply posited as a hypothetical explanation. The point being made is that because such an explanation is possible, it is not clear that we can attribute the existence of a categorical distinction from the earliest samples to these two children, although such attribution seems assured when they show evidence of the obligatory determiner rule. In Chapter IV, we shall return to these data with an eye to answering the more general question of whether the underlying categories, whenever they are acquired, are semantically based (i.e., equated with *objects* and *substances*). In examining the semantic properties of mass nouns in more detail we shall be able to evaluate more thoroughly the categorical status of these nouns in early speech.

The main basis for the present chapter has been to examine the development of early occurring restrictions. We noted that for the less frequent quantifiers such as *much, many,* and so on, the subjects appeared to have considerably more problems. In the next chapter, we shall consider the development of these and other low frequency quantifiers within the framework of a model of categorial generalization. We shall also consider whether rules such as those restricting plurals to count nouns truly make reference to the count noun category

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[15] This is not to say that the null-det construction itself does not have a semantic interpretation, as it certainly does signal some kind of "generic" reference (see Chafe 1970). Rather,the restriction against singular count nouns does not seem to fall out from the semantics, especially given the dialectical variation.

or whether, as suggested in this chapter, distributional differences may arise by virtue of the individuating function of the relevant forms. One should bear in mind that this question is quite distinct from the question of whether the categories themselves are semantic (see Chapters III and IV).

Chapter II

Experimental Studies of the Development of Formal Restrictions

Introduction

In the previous chapter we examined the development of formal restrictions invoking the count/mass distinction that occurred at an early age. With respect to selection rules, we were interested in the specification by the determiner for count vs. mass and singular vs. plural. Furthermore, we examined the restriction limiting pluralization to count nouns only. In essence, these restrictions involve relationships between three factors:

a) The determiner

b) The noun subcategorization: [± count]

c) The plural: [± pl]

The relationships can be schematized in the following manner:

I Selection for count/mass:	Det - [± count]
II Plural agreement:	Det - [± pl]
III Plural Restriction:	[± count] - [± pl]

The data from the longitudinal samples indicated that for high frequency determiners, the appropriate restrictions were enforced from the earliest (or at least very early) samples. However, there are a number of reservations. First, as we were restricted to a

fairly small set of determiners there is little or no information on the substantial number of other quantifiers that differentiate between count and mass nouns with quite interesting patterns of selection (c.f., table 0.1 and relevant discussions in Chapt. I). Second, although many of the restrictions were in evidence from the very earliest samples, it was pointed out that such restrictions could have been a consequence of knowledge of the semantic function of determiners and plurals without necessarily invoking actual categorical distinctions between noun types. It was only in examining the development of the obligatory determiner rule that there was clear evidence of categorical status for the distinction.

In the present chapter, the focus will be to a large extent on the development of restrictions for the less frequent quantifiers such as: *several, much, each* and so on. To obtain sufficient data for these quantifiers, experimental methods were used. In looking at the development the questions will be framed in terms of the notion of "categorial generalization". That is, the process by which lexical items are generalized into new contexts on the basis of their category type. Also, we shall attempt to test for the hypothesis that plural restrictions are acquired on the basis of semantic function without reference to count/mass categories per se.

The Acquisition of Restrictions

Consider the problem faced by the child in acquiring the appropriate selection rules for determiners. Having established that a particular word is a determiner, by some induction procedure, she must figure out which noun subcategories are allowable in construction with that determiner. Furthermore, if the noun is a count noun, she must determine whether a singular or plural form should be used. In the case of the early acquired restrictions it was noted that determiners such as *a, another* and so on make quite perspicuous reference to individuation in their semantic functions, as do plurals. Given certain constraints on the set of early mass nouns (i.e., that they denote unindividuated entities) the

child may quite easily restrict use to count nouns only (or, at least, errors would be quite low).

However, in the case of the less frequent quantifiers, the relationships are not so transparent. Consider the contrast between *much* and *many* which both mean something like "substantial amount". Because *many* quantifies over count nouns it suggests that there is something of a semantic difference from *much* which requires mass nouns. However, it would seem that the semantic difference here amounts to little more than a function of this selectional difference. In other words, *much* and *many* could be replaced in the language with one unrestrictive quantifier and still have maintained the same semantic distinctions according to whether a count or mass noun was being quantified. In fact many languages do not make a lexical distinction for the equivalent of *much* and *many* rather they only use a single form. If it is the case then, that for some of the lower frequency quantifiers, semantic properties denoting individuation arise post hoc from their selectional features it would seem that the child could not use these properties as a means of restricting use prior to learning the actual selectional properties themselves. In other words, the child could not know that *many* differed semantically from *much* if he did not know that *many* quantified over count nouns and *much* over mass nouns.

Furthermore, even if the intrinsic semantic properties of quantifiers were fairly perspicuous in invoking individuation, the fact that they are so rare in early speech suggests the possibility that the child may not have had sufficient experience with them to have induced the relevant semantic properties (see Hanlon 1981, for some evidence in this respect). For these reasons, one might be led to expect a very different pattern of development from the almost instantaneous establishment of restrictions found in the previous chapter.

Notice that in talking of the establishment of restrictions via semantic functions, this is not to be confounded with the question of whether the count/mass subcategories are themselves semantic. We are essentially dealing here with the same distinction as that outlined in the general introduction. That is, rather than trying to determine whether count/mass subcategories are equated with *object vs. substance*, we are postulating when quantificational properties of determiners and plurals may or may not help in restricting their use. This may be contingent to some extent on the semantic properties of the count and mass nouns, but not necessarily on the categories actually being semantically defined. This latter issue is dealt with in the following two chapters by directly looking at the nouns themselves.

Categorial Generalization

Having considered the acquisition of restrictions from the point of view of the semantic function of determiners and plurals, we will now consider a slightly different perspective. The purpose of syntactic categorization is to allow the use of generalized rules that do not apply to individual words but to sets of words, i.e., categories. Such generalization is the basic ingredient for guaranteeing that a child can generate sentences that have not occurred in his input. All that is required is a set of rules written over categories and knowledge of which words belong to which categories. Thus, on hearing a word such as *sib* in the context: "John is sibbing", the child could assign it to the verb category for which he has other rules such as [NP V#ed] and thus produce the completely novel: "John sibbed" (c.f., Maratsos & Chalkley 1981, who incorporate such generalization processes into their model).

While such generalizations may seem quite trivial in the light of 25 years of generative grammar, it is by no means obvious that all grammatical development is of this form. In fact Baker (1979) has argued that such rules as dative alternation (e.g., John gave the book to me → John gave me the book) could not be generalized in this fashion but must be

learned for each verb heard in the relevant construction. Contrary to such a view I shall propose that the process of category development does involve a stage whereby rules employing categories are completely general with only certain semantic and pragmatic restrictions.

The model of categorial generalization that I shall propose may be likened to Chomsky's (1975) characterization of categories as consisting of an n-level hierarchy with the most general level at the top and the most restrictive subcategorizations at the bottom. Thus, on one branch we would have *words* → *nouns* → *count nouns* and possibly further invoking such features as *animate*, *human* and so on. In the case of determiners one could consider the tree structure branching from the general determiner category to articles and quantifiers down to the various subclasses listed in table 0.1 (i.e., Unrestricted UR, Restrictive Count R-C, Restrictive Mass R-M and so on).

What we shall postulate is that when quantifiers are first acquired, there is no information available to the child as to their selectional features. Thus, one should find them coming in at the most general level consistent with their known properties. For example, the child may know that a particular word is a quantifier by dint of its position in the NP, quantificational role, and so on. However, even though he may only hear this quantifier with, say, count nouns, he may require a substantial amount of evidence before concluding that this pattern indicates selection by subcategory rather than random variance in the input. If however, the intrinsic semantic properties indicate something like individuation, then this may be a means of acquiring the restrictions more rapidly (as in the case of the high frequency forms of chapter I). By arguing in the previous section that the lower frequency quantifiers may not provide the child with enough semantic information, then we are postulating that errors will occur that reflect the initial assignment of quantifiers to the most general level.

We shall take the most general level to be the Unrestrictive (UR) pattern exhibited by quantifiers such as *more, most, less* and so on. Quite simply, these quantifiers do not choose between count and mass selection (pluralization will be treated separately). The prediction therefore is that quantifiers in the Restrictive classes (R-C and R-M) (e.g., *many, several, much* etc.) will assimilate to this pattern in early development. To remind the reader of the relevant patterns a shortened version of table 0.1 is reproduced in table 2.1. We have only included the quantifiers that will be tested in the following experiments.

The precise predictions are that one should find what we shall term "Selection Errors" made by children. These involve the use of restrictive quantifiers with nouns of the wrong subcategory (e.g., **many soup, *much tables* etc.). While such errors have been attested by various parents to me, we shall attempt to find more systematic evidence for them by employing experimental techniques in Experiments I and III. We shall take the existence of such errors in a substantial quantity to be evidence for the initial acquisition of quantifiers at the most general level.

Pluralization

The last prediction of selection errors for restrictive quantifiers was made, contingent on the postulation that the child would not have sufficient semantic knowledge of quantifier function available to restrict use. In the case of plurals there is a different story. We have seen that restrictions on plurals and plural agreement seem to show a very early acquisition trend. One possible source of error was that there was some tendency to leave off plurals where required for agreement (e.g., **more book*). It was suggested that this may be a function of the telegraphic nature of early speech since such errors were much greater than those for overpluralization.

Table 2.1 Selectional Properties of Quantifier Classes

Determiner	Det N [+count] [-pl]	Det N [+count] [+ pl]	Det N [+mass]
Quantifiers			
Unrestrictive (UR)			
Some	(x)	x	x
Any	(x)	x	x
All (the)		x	x
Enough		x	x
More		x	x
A lot of		x	x
Restrictive Count (R-C):			
Several		x	
Many		x	
E-Quantifiers:			
Each	x		
Every	x		
Either	x		
Restrictive Mass (R-M):			
Much			x

Thus, apart from a few "performance errors" in the case of underpluralization, plural agreement appears to be well under control. Again, we may point here to the semantic function of plurals in enabling such an early development. One could imagine that the child may have a simple rule such that singular forms apply with individual reference, plural forms apply to sets greater than one. Note however, that such a procedure will not guarantee a correct analysis. For example, in some languages such as Hungarian, plural agreement of nouns with quantifiers requires that singular and not plural forms be used. For example, **sok fak* (many trees) is ungrammatical, the correct form being *sok fa* (many tree) (see MacWhinney 1974, for a discussion of the development of plural agreement in Hungarian). The point is that plural agreement does involve dependencies between the determiner and the plural marker that go beyond simple semantic-functional knowledge. However, as a first step, the child would not go far wrong if such semantic knowledge was all he had.

With respect to the English quantifiers, in most cases the above strategy would yield few errors. For example, *a car* denotes a single object, *many cars* denotes a plural set and so on. The one exception is the case of the E-quantifiers (*each, every, either*). It will be recalled that one of the criteria for membership of this class was that while agreement requires singular forms (c.f., *each car* not **each cars*), quantification actually involves sets of more than one object (e.g., *each car* quantifies over a number of cars). In this case then, the semantic function of plurals would be unlikely to help the learner in acquiring the appropriate singular agreement.

For the E-quantifiers then, if there is generalization of this class we would predict both selection errors (e.g., **each soup*) and also overpluralizations of the form: **each chairs, *every chairs, *either chairs*. In other words, these quantifiers would assimilate to the unrestrictive pattern not only with respect to selection but also with respect to pluralization. Notice that the claim here is actually stronger than simply claiming that pluralization is guided by semantic functions. We are claiming that the predicted overpluralization is

governed by a dependency between the determiner and the plural. The semantics will simply not block the overgeneralization in this case, whereas it would be blocked if such overgeneralization led to semantically inappropriate constructions. In the discussion of the experimental results, we shall attempt to justify this stronger claim.

Restrictions Preventing the Pluralization of Mass Nouns

The final issue to be addressed in this chapter concerns the nature of plural restrictions with respect to mass nouns. We have postulated that the child may initially employ a simple semantic rule with respect to pluralization whereby plurals are only used to denote sets of more than one. If the referent of a mass noun such as *soup* were not discrete then, again such a strategy would produce few errors. The fact is, however, that such a strategy would also be lacking. Consider the case in which one had some soup, but the soup was in a number of cans. In a sense the referent would now be discrete and greater than one, but the appropriate description would still not allow the use of a plural (c.f., **there's some soups*). It is in such a case that we see the need to make reference to a syntactic level of description. That is, *soup* may not be pluralized purely by dint of the fact that it is subcategorized as a mass noun, not necessarily because of its perceptual appearance.

The question is, then, what constrains the child's use of plurals: perceptual properties such as discreteness and number, or the actual subcategorization of the noun being used? If the former were the case, then one would expect the child to pluralize mass nouns when their referents were discrete and numerous (e.g., soup in cans) but not when they were in a continuous form (e.g., soup loose in a pot). If, however, the child's plurals were constrained by subcategorization, then there should be no difference across different modes of presentation. This question will be addressed in experiments I and II.

Summary of Predictions

We have postulated that quantifiers will initially be acquired at the most general level with no restrictions on noun subcategorization or pluralization except for constructions that are blocked by semantic inappropriateness. The following errors are therefore predicted:

Selection Errors

*Many water *Much cars

*Several water

*Each Water

*Every water

E-Quantifier Overpluralization

*Each cars

*Every cars

*Either cars

We shall also test two competing hypotheses with respect to mass nouns. Either plural restrictions are semantically constrained in which case pluralization will occur when referents are discrete, or else they are constrained by syntactic subcategorization and thus discreteness of the referent will make no difference.

In the first experiment each of these questions will be tested employing a forced-choice sentence judgement paradigm. The second and third experiments will be extensions employing production-oriented sentence-completion tasks.

Experiment I

Forced-Choice Sentence Judgements

Introduction

In the first experiment we shall be testing for all three predictions: Selection Errors, E-Quantifier Pluralization and Mass Noun Pluralization. The method employed was a forced-choice sentence judgement task. In the task judgements were obtained from children as to the grammaticality of certain quantifier-noun sequences. Unfortunately, it is not always possible to simply ask a child whether a sentence sounds "good" or "silly" as this often leads to confusion on the part of the child (c.f., Brown & Bellugi 1964). Some attempts in pilot studies to obtain such judgements from young children often led them to merely say that everything sounded "silly" with no real understanding of what was being asked of them. Furthermore, the judgements we will be attempting to obtain often involve quite subtle distinctions between the presence or absence of a plural or the subcategorization of a noun.

To circumvent these problems, in the present task the child was given both a "good" and a "silly" sentence. In training, these sentence-pairs were very distinct in that the "silly" sentence was extremely deviant (e.g., *She's wearing a brown dress* vs. **Is wear browning she dress*). On the main items, the sentences constituted minimal pairs differing by either the quantifier used (e.g., There's *a lot of* soup here vs. *There's *several* soup here), or the presence of the plural (e.g., We need more soup vs. *We need more soup*s*). It was hoped that having both sentence forms presented would clarify for the child what was required in judging a sentence to be either "good" or "silly". In the discussion section, we shall attempt to evaluate how effective the method proved to be.

Method

Subjects

Sixty-four subjects were originally tested, however, 16 of these were eliminated from the test (see Procedure and Results sections). The final population consisted of 48 subjects: 3;3 to 5;10, mean age: 4;9. There were 8 three-year-olds, 20 four-year-olds and 20 five- year-olds. Most of the subjects dropped from the test were three-year-olds. Of the 48 subjects 26 were female and 22 male. All were native speakers of English and were of mixed socioeconomic backgrounds.

Materials

The materials used in the experiment included 2 puppets and a doll's house containing assorted miniatures. Miniatures used as count noun referents included: a sink, a clock, 2 kettles, 4 sacks, 4 chairs, assorted jars, cans and pots, doughnuts and brownies. Referents for mass nouns included: soup, corn, coffee, sugar and tea. In the "discrete" (DM) conditions these were presented as a number of cans or sacks of the substance. In the "continuous" (CM) condition substances were either in a transparent jar or an open pot. Stimuli for practice trials included: ham, sausages, bottles, an oven, a vacuum cleaner and a coffee grinder. A female doll (Mrs. Potter) served as the subject of the story.

Procedure

Subjects were tested individually by two experimenters. One operated two puppets while the other maintained dialogue with the child and brought out miniatures from the doll's house placed on a table in front of the subject. The test was in two parts: training and test items. In the training section, children were introduced to the puppets and were shown the doll's house. They were told that the puppets were going to talk about some of the

things in the house and that one of the puppets would say something that sounded "Okay" while the other would sound "silly". The child was then given an example of a good sentence spoken by one of the puppets ("that's a nice house"). The experimenter then commented: "... That sounds okay dosn't it?". This was followed by the other puppet saying a silly sentence ("house nice this is a"), followed by the comment: Now that sounds kind of silly dosn't it?" The child was then instructed to give a gold star to the puppet who had "said it okay".

Subjects were given one more item where they were told which puppet to give the star to, after which they were to choose for themselves. There were a further ten practice trials in which subjects received correction if they chose the wrong puppet. Once the subject had given three consecutive correct responses, he was moved onto the main items. If the subject failed to reach this criterion after ten practice trials, his data were not included in the analysis. The training procedure was designed to familiarize the child with the task of choosing the correct sentence from the pair presented and giving the gold star to the appropriate puppet, theus indicating the good sentence. The training sentences all contained pairs in which it was very obvious which was the correct one (see Appendix 1). Generally, by the time subjects had gone therough the training procedure, they were confident in their responses and did not appear to have problems understanding the task demands.

Presentation of the main test items was within the context of a story of a doll preparing a meal for four people. This allowed for the relevant use of quantifiers to be tested (e.g., "there's not enough chairs"; "there's a lot of soup" etc.). No feedback was given on the main items. The sentence pairs were designed to test for the 3 predictions: Selection Errors, E-Quantifier Overpluralization and Mass Noun Pluralization. The specific items are detailed below and more extensively in Appendix 1.

Selection Errors

Selection errors involve the use of a restrictive quantifier with an inappropriately subcategorized noun (e.g., **Several Soup, *Much Chairs *Many Coffee* etc.). The sentence pairs chosen to test for such errors were minimally contrasted in the choice of quantifier. That is, in the correct sentence, the quantifier appropriately selected for the subcategory of the noun (e.g., *a lot of soup*) whereas in the incorrect sentence, selection was inappropriate (e.g., **several soup*). The constraints on the choice of quantifiers required that: (i) one of the pair be grammatical and appropriate to describing the relevant quantities, (ii) the quantities should be "semantically similar" in respects other than selection for count/mass (e.g., *several* and *a lot of* both indicate substantial quantities).

The Quantifier-Noun sequences that were contrasted included the following:

Restrictive Count (R-C)

**several* soup	**each* tea
a lot of soup	*all the* tea
*too *many* coffee	**every* corn
too *much* coffee	*all the* corn

Restrictive Mass (R-M)

*too *much* doughnuts
too *much* doughnuts

For example, on a typical trial, the puppets would be asked if there was enough tea for four people. One would reply:

"Yes, but we'll have to use *each* tea"

and the other:

"Yes, but we'll have to use *all the* tea"

A correct response was scored if a star was given to the second puppet, otherwise a selection error was scored. Notice that in producing an error in this condition, the child is required to reject a sentence that should be perfectly acceptable for him. Therefore, it is not predicted that such errors should be overwhelming but at least above some performance baseline for the task.

To test for a baseline error rate required a contrast that one would expect the child to have mastered. The contrast chosen was *a* vs. *some*, the former being an appropriate modifier for a (singular) count noun and the latter for a mass noun. It was observed in chapter I that errors for these determiners were very rare, suggesting that children have mastered the distinctions at least by the age of 3 (the youngest subjects to be tested here). Also, Brown (1957) has shown that the *a* vs. *some* contrast to be an effective indicator of noun subcategorization for children of age 3 and older. The relevant sentence-pairs contained sequences of the following kind:

Baseline: *some* **vs.** *a*

*a soup	* some sink
some soup	a sink

No errors are predicted in this condition assuming that children have mastered the relevant linguistic contrast. Those that do occur are taken to indicate general performance difficulties with the task (e.g., distraction, inability to comprehend the task etc.).

E-Quantifier Pluralization

E-Quantifiers (*each, every, either*) were predicted to be chosen in construction with plural count nouns (e.g., **each* jar*s*). The contrasts for this condition involved the presence or absence of a plural on count nouns:

*each jars	*every pots	*either kettles
each jar	every pot	either kettle

To determine the significance of any errors obtained, a set of baseline contrasts were constructed, also involving the presence or absence of the plural. The quantifiers for the baseline condition were chosn from the Unrestricted (UR) class. Once again, from what evidence there was in chapter I, the children appeared to have mastered plural agreement for these quantifiers. The pairs tested are listed below:

Baseline: (UR) Quantifiers

*some brownie	*enough chair
some brownies	enough chairs
*more pot	*a lot of can
more pots	a lot of cans
*any doughnut	
any doughnuts	

Again, errors are predicted to be low for this condition indicating performance rather than linguistic problems.

Mass Nouns and Pluralization

The final question was whether restrictions against pluralizing mass nouns are constrained by noun subcategorization. As outlined in the introduction, the test for whether this is so involves presenting referents for mass nouns as either discrete countables such as cans of soup or contiuous uncountables such as loose soup. Subjects were divided into one of two groups: "Discrete Mass" (DM) and "Contiuous Mass" (CM). For the DM group, referents for mass nouns were either a number of cans or sacks of the relevant substance (see fig2.1a). For the CM group, the mass referents were loose, either in a pot or a transparent jar (see fig 2.1b). The relevant contrasts again involved the presence or absence of the plural,

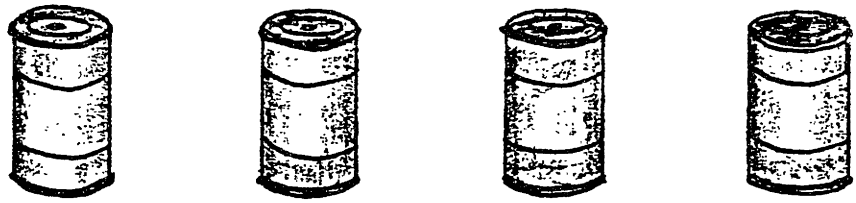


Fig 2.1 a Discrete Mass (DM) Stimuli: Soup Cans

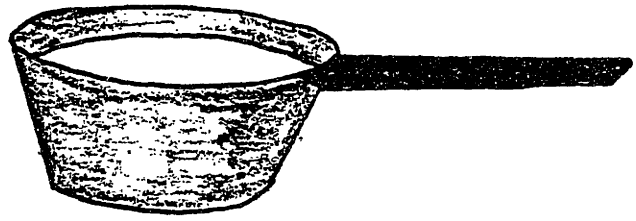


Fig 2.1 b Continuous Mass (CM) Stimuli: Loose Soup

this time on mass nouns. The quantifiers used were from the UR class.

Mass Noun Pluralization

*some teas	*enough coffees
some tea	enough coffee
*more coffees	*a lot of teas
more coffee	a lot of tea
*any soups	
any soup	

If it is true that children do not invoke noun subcategorization in restricting plural use, then one should find a difference between the DM and CM groups with the DM group making errors of pluralizing mass nouns but not the CM group. If on the other hand, children do refer to subcategorization features in pluralization, then one should find no difference between these groups.

Results

Of the 66 subjects originally tested, 10 were disqualified for failing the pre-test, three for perseveration, three for alternation and two for voluntary withdrawal prior to completion. The final pool of 48 subjects included 8 three-year-olds, 20 four-year-olds and 20 five-year-olds. For purposes of age trend analysis, subjects were divided into three groups of 16 by age. The mean ages of the three groups were : [I] 3;10, [II] 4;9 and [III] 5;7.

Selection Errors vs. Baseline

Selections errors involved a choice of *several, many, each* and *every* with mass nouns and *much* with count nouns (e.g., **several tea, *too much pots*). Baseline condition errors involved the choice of *some* with a singular count noun (e.g., **some sink*) or *a* with a mass

noun (e.g., **a soup*). Error rates for these two conditions are shown graphically in fig 2.2. As predicted, selection errors were significantly greater than baseline errors (21.8% vs. 8.3%, $t = 3.6$, $p < .002$, two tail). Error rates were fairly consistent across the three age groups only declining slightly: [I] 25%; [II] 23%; [III] 17.1%. The correlation of errors with age was not significant ($C = .08$, $p = .6$), suggesting that restrictions for these quantifiers are yet to be worked out by the age of five for many children. In the baseline condition it was striking that all errors involved choices of *a* with a mass noun (e.g., **a soup*) while errors with *some* did not occur. The reason for this difference will be discussed in the evaluation of the task.

E-Quantifier Overpluralization

Errors were predicted to occur with *each, every and either* in which a plural rather than singular form of the noun was chosen (e.g., **every jars* rather than *every jar*). These errors were predicted to be higher than baseline rates for Unrestricted quantifiers involving a contrast between singular and plural nouns (e.g., **more jar* vs. *more jars*). Error rates are shown in fig 2.3. Errors of plural agreement for E-Quantifiers were significantly greater than baseline rates (40.3% vs. 11.7%, $t = 3.6$, $p < .002$, two-tail). Thus the predictions were well supported.

Mass Noun Plurals

In this condition we were testing whether the form of presentation of a mass noun referent would affect pluralization depending on whether the referent was a number of discrete containers (cans or sacks) (DM) or if the substance was presented as a continuous form (CM). Differences in error rates for DM and CM groups should indicate that children are not making reference to the sucategorization of the noun, but rather are simply using discretness and number as a means of determining the applicability of pluralization.

Fig 2.2 Selection Errors vs. Baseline

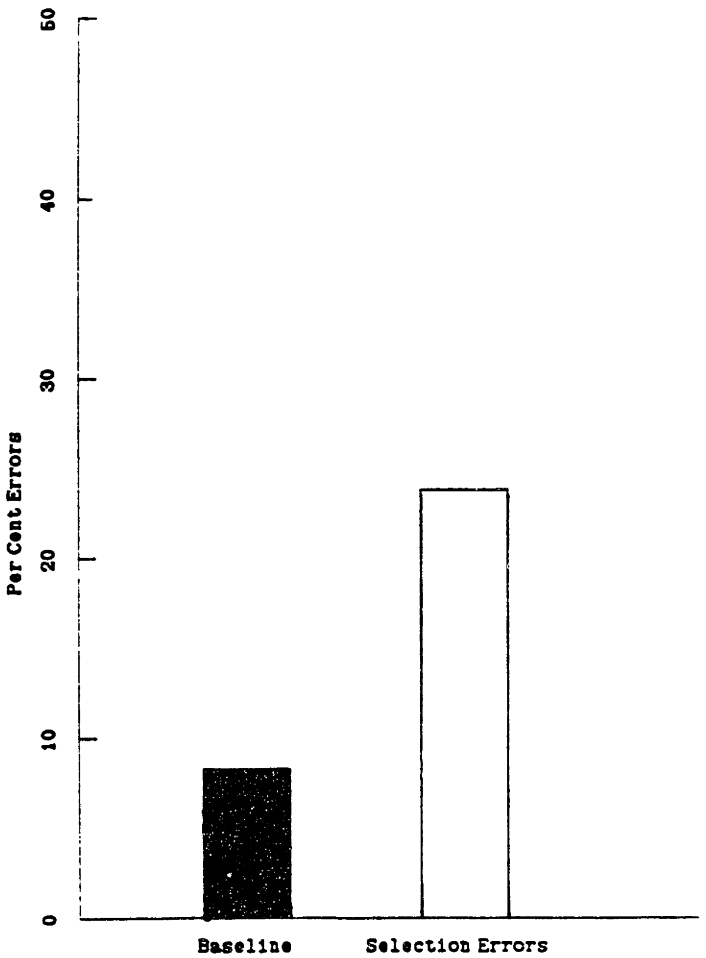
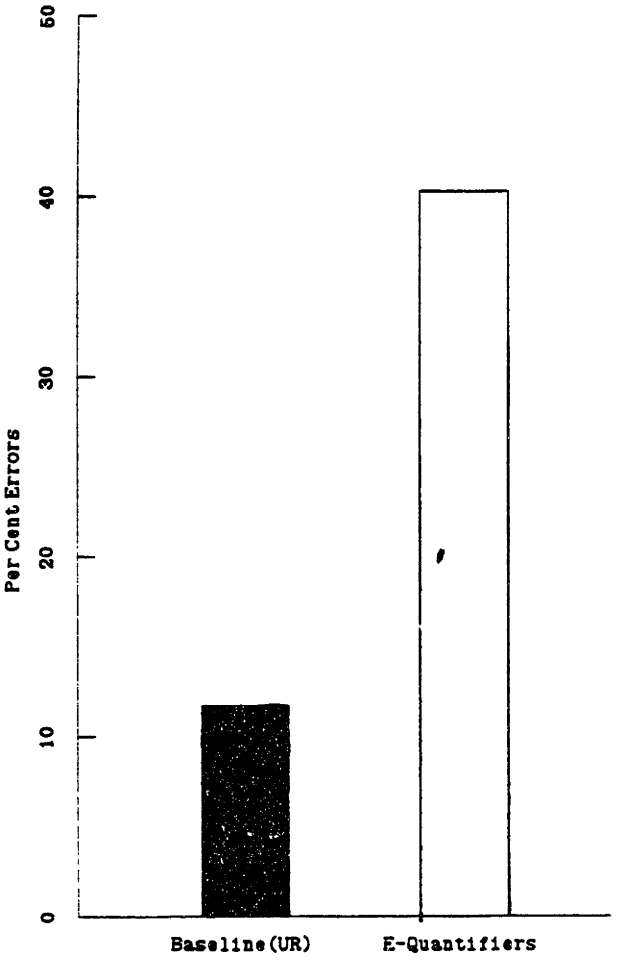


Fig 2.3 Plural Errors: E-Quantifiers vs. Baseline (UR)

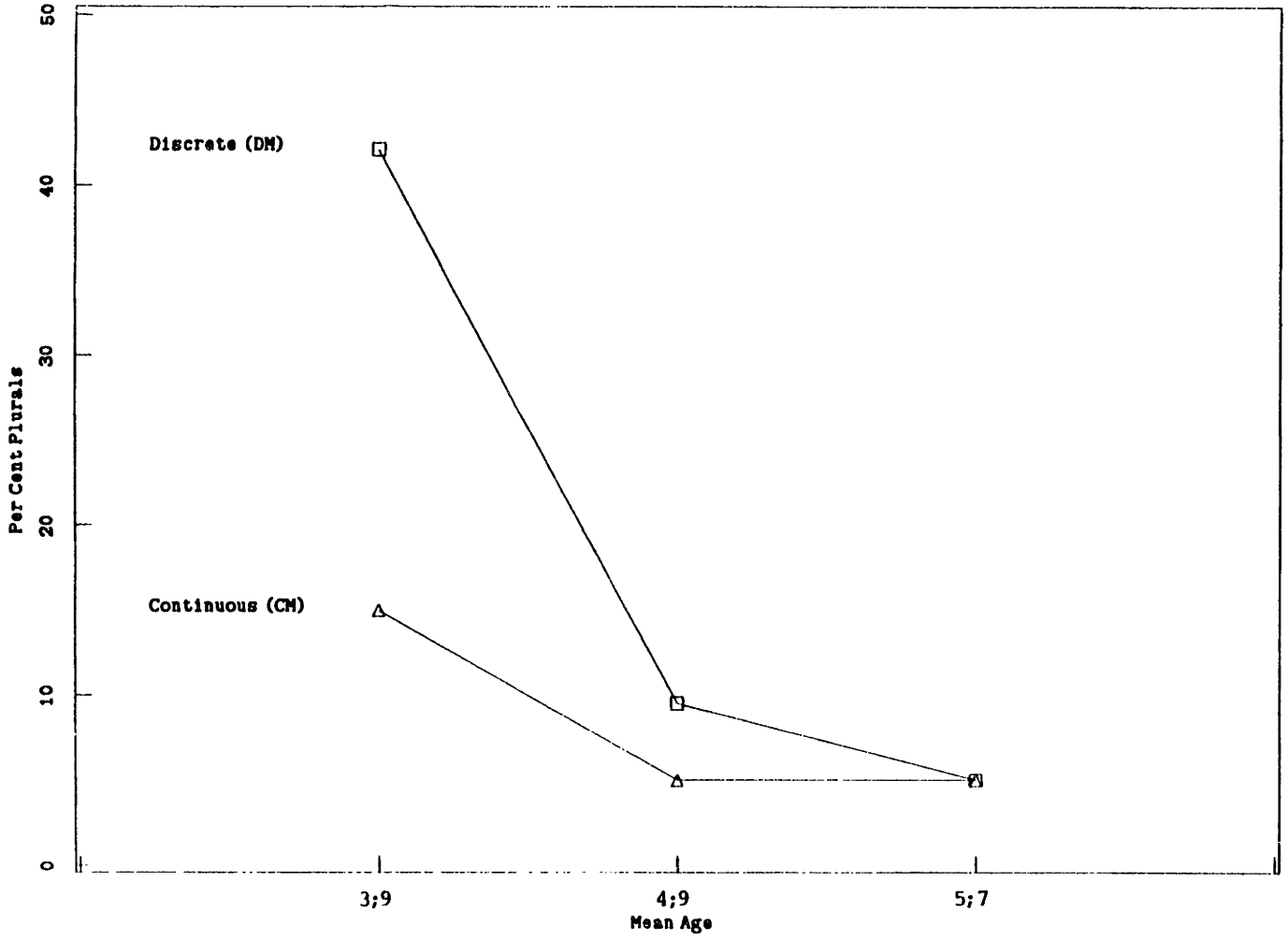


Although error rates for the DM conditions were higher than those for the CM conditions (18.3% vs. 8.3%) this difference was not significant overall (Mann-Whitney, $p = .08$). However, when errors are broken down by age groups as in fig 2.4, it can be seen that the difference between the two conditions is much greater for the youngest group (Mann-Whitney, $p = .04$) while the older groups showed no significant differences. Not surprisingly, there was a significant correlation of errors with age for DM groups ($C = .38$, $p = .01$). From these results the conclusion would appear to be that the youngest subjects were relying on a semantic strategy in order to constrain pluralization. That is, for a large proportion of their responses, they did not seem to make reference to the subcategorization of the noun in restricting the "use" of plurals. Older subjects, on the other hand, do not appear to be pluralizing purely on the basis of perceptual properties, rather their choices are constrained by noun subcategorization and mass nouns are, in general, not pluralized. To forewarn the reader slightly, it should be pointed out that this conclusion will be modified significantly in the light of results from the next experiment.

Reliability of the Test

Metalinguistic tasks are often difficulat to use as evaluations of linguistic knowledge as one is often not sure to what extent errors are a reflection of the child's linguistic competence or simply a result of his inability to comprehend the nature of the task. That is, to what extent are errors merely due to performance factors? In using the forced-choice design it was hoped to make the task clear to the child. The large number of three-year-olds dropped from the analysis suggests a lower bound on the age of children for which such a design is applicable. For those who remained, how can we ascertain whether they knew what it meant for a sentence to be "good" or "silly"?

Fig 2.4 Mass Noun Plurals Chosen in CM and DM Conditions



It is noteworthy that in one condition (**some sink* vs. *a sink*) there were no errors. This would seem to indicate that performance factors involving purely task demands might not have been a large factor in causing errors. However, not all of the conditions in which errors were expected to be low turned out to be as clean as this result. In particular, the same contrast except with a mass noun caused 16% errors (i.e., **a soup* vs. *some soup*). How do we explain the disparity?

In the task, the child is presented with two sentences constituting a minimal pair differing in either the determiner employed or the presence or absence of the plural marker. The child is therefore required to hold in memory the two sentences and locate the relevant aspect that differentiates them. In the *some* vs. *a* contrast, children only made errors in choosing **a soup* but not **some sink*. One major difference between these two is tht *some* is much more phonologically distinct than *a*. In this case, children may have not retained the *a* from the ungrammatical construction. That is to say, **That's a soup* may have been interpreted as *That's* $\emptyset$ *soup* which is not ungrammatical. If this were the case, then conflicting error rates would be accounted for. In support of this explanation, a further contrast had been included in the task but was not used for testing predictions. This contrast involved *a* vs. $\emptyset$ (no determiner) used with count nouns (*there's a clock* vs. *there's clock*) and mass nouns (*there's soup* vs. **there's a soup*). If children were mis-hearing (or mis-remembering) the article, then this should cause significant errors. Error rates turned out to be 20% or these conditions (21% count, 19% mass), thus supporting the present interpretation.

Phonological distinctness could also account for why errors were not at zero in baseline conditions where singular and plural forms were being contrasted (e.g., **some pots* vs. *some pot*). As in the previous account, children may not have distinguished these well. In fact, a similar phenomenon was reported by Brown (1973, p.133), in which he notes that at a stage when his subjects were consistently producing singular and plural forms appropriately in speech, when tested on a comprehension task, they tended to make many errors.

For example, they would often choose a single pencil when asked to point to "the pencils". While the discrepancy is unaccounted for by Brown, it is possible that children often do not attend well to minor form differences such as plurals. If phonological distinctness can account for a majority of the errors in baseline conditions, then it would seem that subjects did not have problems with the demands of the task, per se, but that they did have comprehension problems when critical forms were not distinct.

Summary and Conclusions

The results of this experiment have confirmed the predictions that restrictive quantifiers are at first learned at the most general, unrestrictive level. Two kinds of errors were found: Selection Errors and Overpluralizations with E-Quantifiers. A further hypothesis was tested regarding the nature of early restrictions on the use of plurals. It was found that when referents for mass nouns were made discrete, then there was a tendency for three-year-olds to incorrectly choose plural forms. This result suggests that these younger subjects were not constrained by noun subcategorization when making the errors, but rather, were employing a more semantic strategy in their choices whereby something like "discreteness" rather than the feature [+ count] was the determinant of pluralization.

It was also found that children were very good at making sentence judgements using this paradigm as long as the forms were quite distinct. However, we were required to drop a large number of younger subjects. In the next two experiments we shall attempt to confirm the present results employing a more production-oriented task without eliminating so many of the three-year-olds.

Experiment II

Production Task: Pluralization

Introduction

In the previous experiment, a number of issues were raised as to the effectiveness of using a metalinguistic task for testing the various predictions. Although there appeared to be a minor problem with the distinctness of certain contrasted forms, it may be concluded that such factors do not affect the significance of the differences between test and baseline conditions. However, it is still desirable to provide further support for the predictions with a task employing a different response mode that relies less on the child's "reflective" abilities and more on natural speech processes. Also, it would be valuable to obtain results from younger subjects who were not able to pass the pretest of the previous experiment.

The method employed in this experiment was a sentence completion task in which the child was given an incomplete sentence requiring a final noun (e.g., "Over there we have more ... what?"). The response of the child is to complete the sentence with either a singular or plural form of the relevant noun. This task is very much along the lines of Berko's (1958) "wug test" in which children were required to produce plural forms of nonsense words. In this task however, only real words were used. Because the relevant contrast is singular vs plural for noun completion, it was not possible to test for selection errors (see experiment III). Therefore, only E-Quantifier overpluralization and mass noun pluralization was tested.

Method

Subjects

Of the subjects who failed the pre-test of experiment I, 7 were recruited for this experiment. To those were added a further 19. Four subjects failed to complete the task, thus leaving a final total of 22 subjects (13 female, 9 male). Ages ranged from 2;10 to 4;10, mean age 3;3. Subjects were from varied socioeconomic backgrounds, all were native speakers of English.

Materials

Materials included the doll's house and miniatures from experiment. I. Only one puppet was required for this task.

Procedure

The test conditions were identical to those of experiment. I, except that only one puppet was used. Subjects were tested individually by two experimenters with the doll's house and miniatures from the previous experiment used as stimuli. Subjects were introduced to the puppet (Mickey-the-Monkey) and were told that he had a problem because he could never finish what he was saying. They were asked if they could help him out by finishing his sentences for him. To ensure that the child knew what word to use, the appropriate noun was "modeled" in the previous context as in the following exchange:

E:	Can you see the *chair* here? Can you say *chair*?
S:	*Chair*
Puppet:	If there's four people, we'll need more ...
S:	*Chairs*

Pre-modeling in this fashion poses a problem in that the child may be biased to complete the sentence with the noun in the same form (singular or plural) as it was modeled. Therefore, subjects were divided into two groups: (i) those receiving singular forms for modeling

and (ii) those receiving plural forms. Mass nouns were not modeled in the plural form.

Prior to testing a short training procedure was used involving sentence completions (e.g., *This is a nice ... <house>*). Subjects were required to complete three consecutive training items without assistance before moving on to the main test. If a subject failed to complete on a training item, he was told the appropriate response and asked to repeat it. On the main test items two predictions were tested: (a) E-Quantifier Overpluralization (b) Mass Noun Pluralization with discrete, but not with continuous referents.

E-Quantifier Overpluralization

The three quantifiers tested in this condition were *each, every* and *either*. The sentences requiring completion ended with one of these quantifiers, e.g., *There's soup in each ... <pot/s>*. The following completions were required:

E-Quantifiers

Each	<pot/s>
Every	<jar/s>
Either	<kettle/s>

Errors were scored if the child completed with a plural noun. For a baseline condition, Unrestrictive (UR) quantifiers were again used:

Some	<brownie/s>
Any	<doughnut/s>
More	<pot/s>
Enough	<chair/s>
A lot of	<can/s>

Singular completions were scored as errors. It was predicted that errors would be significantly higher for E-Quantifiers than for UR quantifiers.

Mass Noun Plurals with Discrete Referents

As in the previous experiment, subjects were divided into two groups according to whether they received Discrete Mass noun referents (DM) such as cans and sacks of the substance, or Continuous Mass referents (CM) such as substances loose in a transparent jar or in a pot. UR quantifiers were used as in experiment I. The child was required to complete with either a singular or plural mass noun:

Some	<tea/s>
Any	<coffee/s>
Enough	<tea/s>
More	<sugar/s>
A lot of	<coffee/s>

Subjects in this test were all within the age range of the youngest group for experiment I, therefore to support those findings, errors of mass noun pluralization should occur when referents were discrete (DM) but not when continuous (CM).

As subjects were quite young in this test, it was necessary to keep it short. Therefore, of the 11 main test items, subjects received 7 items: 3 E-Quantifiers; 2 Baseline items (UR); 2 Mass items. Two groups of subjects received complementary distributions of items in order to test the complete set (see Appendix 2). In addition, subgroups were formed for those subjects receiving DM vs. CM stimuli as referents for mass nouns. All subject groupings were counterbalanced for age and sex.

Results

All subjects passed the pretest with very few problems. Four subjects did not complete the main test and were therefore not included in the analysis.

E-Quantifier Pluralization

It was predicted that subjects would complete with plural forms when E-Quantifiers were employed (*each, every, either*) and that such errors would be greater than those found with plural agreement for Unrestrictive (UR) quantifiers (*some, more, any, enough, a lot of*). Results are shown in table 2.2 as percentages of (i) errors, (ii) correct responses and (iii) irrelevant responses (included are: "don't knows", non-responses and irrelevant responses). Results are broken down into groups according to whether they received singular or plural pre-modeling of the noun. No errors occurred with UR quantifiers whereas E-Quantifiers averaged 50% errors, thus clearly supporting the prediction. However, pre-modeling certainly appeared to be a factor in determining whether subjects used a singular or plural form for completion. That is, the form in which the noun was pre-modeled was a good predictor of whether the child completed in the singular or plural form (Fisher exact, $p < .025$). This pre-modeling effect was only a factor for the E-Quantifiers and error results were still significant even when pre-modeling was in the singular form. The significance of the pre-modeling effects will be discussed at some length in the General Discussion.

Results for E-Quantifiers showed a large number of irrelevant responses. Most of these (7/11) were generated from completions with *either*. On this item, subjects were presented with two kettles and the puppet was asked which one they should use. The puppet responded: "We can use either ... " The majority of irrelevant responses tended to be of the form: "the big one" or "this one". There are a number of possible explanations for this: (1) they did not know the word *either*, (2) they took the incomplete sentence to be a complete sentence (as it could be with slightly different intonation). There is insufficient evidence to choose between these two accounts. However, the large number of irrelevant responses for *either* suggests that children did have certain problems with the term, and errors in these conditions may not be a reliable indicator of support for the predictions. If error scores for *either* are removed from the analysis, there are still an average of 50% errors for *each* and

Table 2.2 Results for E-Quant and Baseline Conditions: Errors, Correct and Irrelevant Responses, as Percentages of Total Responses.

	Modeled Form	Error	Correct	Irrel
Baseline	sg	0	95.5	4.5
	pl	0	91.7	8.3
	TOTAL	0	93.5	6.5
E-Quant	sg	32.2	61.3	6.5
	pl	68.0	11.4	20.6
	TOTAL	50.0	33.8	16.2

every with now only 9% irrelevant responses.

Mass Noun Plurals

In this condition, it was predicted that subjects receiving discrete (DM) stimuli would produce plural mass nouns whereas those receiving continuous (CM) stimuli would not. Error rates are shown in table 2.3. The 4.5% rate for the DM condition represents only a single error and does not differ significantly from the 0% errors in CM conditions. The prediction is clearly not supported and conflicts with the corresponding result for experiment I in which it was found that children within the age range of those in the present study did make significantly more errors in DM that in CM conditions. The reason for this conflict will be discussed in the following section.

Discussion

Two results have been found in the present test. As in experiment I, E-Quantifiers were found to occur with plural as well as singular count nouns (e.g., **each jars*) once again supporting the prediction that such quantifiers are acquired without restrictions on pluralization. Although there was some question of interpretation with *either*, the results for *each* and *every* alone show equal evidence for the generalized use of this set of quantifiers.

The second result did not confirm the findings of experiment I where it was found that younger subjects chose plural mass nouns if referents were discrete (DM). In the present study employing a more production oriented task, the distinction between discrete and continuous referents made no difference. In other words, as in the longitudinal production data from Chapter I, subjects were almost perfect in respecting restrictions against pluralizing mass nouns. The data from the present study suggests furthermore, that this restriction is not simply a consequence of the semantic properties of the plural marker, but is truly con-

Table 2.3 Percentage of Plural vs Non-Plural Mass Noun Completions with Discrete vs Contiuous Referents

	Plural	Non-Plural	Irrel.
Continuous	0	95.5	4.5
Discrete	4	91.7	4

strained by the subcategorization of the noun.

The question is, how do we reconcile the findings from Experiment I? Initially it was considered that perhaps in the production task, the discreteness and numerosity of the mass noun referents had not been made as salient as they could have been. A pilot study was run in which children were shown cans of soup etc. Each can was pointed out by the experimenter as he said: "see the soup here (pointing), and here ... " and so on. Even with this quite painstaking individuation of the soup cans, errors of mass pluralization were again negligible (the elicitation was again sentence completion). Therefore, it does not seem that the problem is one of salience.

There are two main differences between the task demands of experiments I and II. The most obvious difference is that in the first experiment, children were required to reflect on the acceptability of the two sentences whereas in the second task the response was more automatic. That is, the child was simply required to say what he thought to be an appropriate completion for the sentence. In many ways then, the second task resembles processes occurring in natural speech to a greater extent than the first. The second difference relates to the fact that for experiment I, the child was provided with a plural mass noun in one of the choices. It was not required to be self-generated as it would have to be in the production task.

Why should these two factors cause different results? One explanation concerns the way pluralization rules are accessed. One function of plurals is, in a sense, "exophoric" in that one is required to determine whether one is speaking about a singular or plural referent. One might expect such use to be semantically and pragmatically determined. On the other hand, there are also more syntactically constrained functions that require either reference to noun subcategorization or agreement with the determiner. As was previously discussed, there is not always a correspondence between these two demands. It may well be that for

the younger subjects, when conscious introspection is required to some degree, then the more semantic or pragmatic functions become available but not the more autonomously constrained syntactic processes. However, when performing a task involving these autonomous processes (e.g., sentence completion), performance becomes constrained by the syntactically based knowledge.

An alternative account points to the fact that there are cases in which mass nouns may be pluralized when there is category-switching as in: *Give me some beers.* That is, under certain conditions, it is possible to use a mass noun as if it were a count noun. Although none of the contexts were appropriate for such switching, it may have been the case that the younger subjects were accepting mass noun plurals by analogy with such cases. [16] In other words, when the child is provided with a plural mass noun (as in the forced-choice task), she chooses it by analogy, but if she is not provided with it (as in the sentence completion) there is no motivation to produce it.

On both of these accounts, the assumption must be that the underlying competence of the child does involve knowledge of constraints that make reference to noun subcategorization. Whether such constraints operate depends on the demands and nature of the task. It is an interesting question as to when and how the child acquires the relevant knowledge about when category switching is appropriate. It would appear that, at least in production, such constraints are enforced at quite a young age. However, it would require a considerably more systematic study of the relevant parameters to say anything definitive on this issue. An interesting result did occur, however, in the next experiment that could throw a little light on this question.

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[16] This account was suggested to me by Molly Potter.

Experiment III

Sentence Completion: Selection Errors

Introduction

To summarize the position so far; in Experiment I three kinds of errors were found: Selection Errors, E-Quantifier Overpluralization and Mass Noun Pluralization (with discrete referents). Experiment II attempted to replicate the latter two results using a more production oriented method. While pluralizations were found with E-Quantifiers (*each, every and either*), the result for mass noun plurals was not confirmed and was suggested to be something of an artifact of the nature of the metalinguistic task. In the present experiment, we shall attempt to support the findings for selection errors, again using a sentence completion paradigm.

In the previous experiment, the child was required to complete a sentence with a noun in either the singular or plural form. In order to obtain selection errors, it is necessary to have two nouns available: one mass and one count. For example, if the target nouns were *tea* and *boats*, subjects would be given a sentence to complete such as: *In here we have several ... <tea/boats>*. If the child completed with *tea*, then there would be evidence for selection failure. The prediction was that children would complete sentences with nouns of the wrong subcategory when the quantifier was restrictive. In other words, we are predicting that the early use of these quantifiers is at the most general level and therefore unrestricted.

Method

Subjects

Subjects included 36 children aged 3;0 to 5;10. There were 12 three-year-olds, 12 four-year-olds and 12 five-year-olds. Thirteen were male and 23 female. Most of the subjects were from middle-class backgrounds, all were native speakers of English.

Materials

Materials included one hand puppet (Mickey-the-Monkey), plastic farm animals, 3 black trays (4, 6 and 10 inches in diameter), one orange tray with animal pictures on the side (10" diam.). Referents for count nouns included toys and other small objects: Cars, Crayons, Chairs, Boats, Flowers, Marbles, Planes. Mass noun referents were of two forms: Continouous (CM) and Discrete (DM) as in the previous experiment. The discrete forms are noted in parentheses, the substances tested included: rice (boxes), coffee (cans), cocoa (sachets), tea (bags), sugar (cubes).

Procedure

The aim of this experiment was for subiects to complete a sentence with either a count or a mass noun (or both). This meant that it was necessary to provide a situation in which both nouns could equally constitute the target noun for completion (on pragmatic grounds). The situation presented in the task was one whereby the referents for the mass noun and count noun were both in the same tray. For example, a tray would contain some tea and four boats. The child would be told (by the puppet): *In this tray we have several ...* to be completed with either *tea* or *boats*. Assuming that the array alone would not favour one or the other noun for completion, it is possible to assess the extent to which the child's choice of nouns is determined by selection rules on the quantifier.

To arrive at the rather unlikely situation in which such things as tea and boats end up in the same tray, the experiment was set up as a sorting task in which a puppet was required to sort out objects into different trays. In one (orange) tray, he was to put all of the

animals. In the other (black) tray, he was to put everything else (e.g., tea and boats). After each sorting, the puppet was asked what was in the black tray. This was followed by an incomplete response such as: *In there we have several* ... The child was asked to help finish the sentence. Three different sized black trays were used depending on the size of the stimuli, the same animal tray was used on all items.

Prior to testing, the child was familiarized with the various objects and substances to be used (see Materials section) and was asked if he knew their names; if not he was told them. A training procedure prior to the main test session involved subjects simply completing sentences with animal names. For example, the puppet would be shown an animal and would be asked what it was. He would then say: *Oh, that's a* ... - the child was then asked to help the puppet in finishing the sentence. Before moving onto the main items, subjects were required to complete three consecutive completions without assistance. No subjects failed to pass this criterion. When the child moved onto the main items the sorting game was explained to him and he was asked if he could help the puppet remember the names of things.

In experiment I, the referents for mass nouns were of two kinds: Discrete (DM) and Continuous (CM). This contrast was extended to conditions where pluraliation was not an issue (i.e., selection errors). As we are attempting to support the selection error results, it was necessary to maintain similarity with experiment I on methodological grounds. Therefore, subjects were divided into two groups: those receiving discrete referents for mass noun (DM) (e.g., tea bags) and those receiving continuous referents (CM) (e.g., loose tea). As pluralization was not an issue in the present test, there were no predictions with respect to the contrast. However, in keeping with the results from expt II, one would not expect discreteness to cause pluralization of mass nouns as this is a similar production task.

Selection Errors

Restrictive Quantifiers (R-C and R-M) were tested on the main items. These included the following:

Restrictive-Count	Restrictive-Mass
Several Many	Much (x2)
Each Every	

Much was used on two items in order to provide more data on mass-selection. Selection errors were scored if the child completed with a mass noun for R-C quantifiers (e.g., **several tea*) and a count noun for R-M quantifiers (e.g., **too much marbles*).

Trays were filled with a number of the relevant objects under description. This number was varied according to the size of the objects: usually about 4 for large objects such as cars, and about 10 for smaller objects such as marbles. If mass noun referents were discrete (DM) then the number of containers was equated with the number of count nouns referents. If referents for mass nouns were continouous (CM) then the volume of the substance was roughly equated with the total volume of the objects. In the case of *much* and *many, much* requires an intensifier (c.f., *?I have much tea* vs. *I have too much tea*). Therefore, both *much* and *many* were preceded by *too*. The relevant situation involved using a small tray and having both objects and substances spilling over the sides and eliciting the comment: *Oh, there's too much/many ... <cocoa/marbles>*. In these situations, care was taken to ensure that both objects and substances contributed equally to the overspill.

In probing for selection erors, it was predicted that subjects would complete sentences with nouns of the wrong subcategory. As a control, it was necessary to ensure that such errors were not the result of children ignoring the quantifier and simply naming whatever objects or substances happened to be present. A contrast was therefore required to

provide a performance baseline level.

Baseline

It will be recalled that in experiment I the baseline contrast employed was *some* vs. *a* (with singular reference). While there were no errors with *some* (e.g., **there's some sink*), *a* was shown to be less reliable in that there were some 16% errors. These errors were attributed to the fact that *a* is not phonologically distinct. The problems with the use of *a* are compounded in a completion task because *a* is homophonic with the hesitational interjection: *uh*. This is clearly not a good choice as the last word in an incomplete sentence. Therefore, *one* was substituted since it has the same selectional properties as *a* and is more distinct and unambiguous.

To maintain parity with test items, *one* was tested on 4 items to compare with *several, many, each* and *every* which were each tested once. The errors in these conditions would all involve completion with a mass noun. There were two items using *much* as the determiner which was counterbalanced with an equal number of items with *some* as the baseline determiner. Errors in these cases would involve completion with a count noun.

The twelve test items therefore involved the following quantifiers:

	TEST	BASELINE
	Several	One
(R-C)	Many	One
	Each	One
	Every	One
(R-M)	Much	Some
	Much	Some

Errors were predicted to be higher for the restrictive (test) quantifiers than for the baseline

determiners since from chapter I there is evidence that the baseline determiners had selectional properties well established from early on. Therefore, any errors in the baseline conditions should indicate performance difficulties rather than linguistic problems.

All subjects received 6 main items, 6 baseline items and training. For the CM/DM contrast, subjects were divided into two groups and were given either discrete (DM) or continuous (CM) referents for mass nouns. The CM/DM contrast was not expected to affect selection errors. However, since mass nouns would occur in some of the completions, it would be possible to seek support for the findings from experiment II where pluralization did not occur for mass nouns in either condition. Similarly for E-Quantifiers (*each, every*) used in this test, one would expect to find them occurring with plural count nouns as found in the previous experiments.

Results

In completing sentences it was possible for subjects to make one of four types of responses: (i) Count noun, (ii) Mass noun, (iii) Count and Mass noun, (iv) Mass and Count noun (iii and iv are ordered). (i) and (ii) are clearly errors if the determiner requires a noun of the alternative subcategory (e.g., **too much <marbles>, *too many <cocoa>*). In the case of (iii) and (iv) things are more ambiguous. Consider the following cases:

(2.1) Several <cars and rice>

(2.2) *Several <rice and cars>

In the case of (2.1), this could be either grammatical or ungrammatical depending on the scope of the quantifier:

(2.3) ((Several cars) and rice)

(2.4) *(Several (cars and rice))

On the other hand, (2.2) is always ungrammatical. This holds true for all quantifiers except *some*:

(2.5) *Some rice and car

(2.6) *Some car and rice

Both (2.5) and (2.6) are ungrammatical and both readings of (2.5) are ungrammatical:

(2.7) *((Some rice) and car)

(2.8) *(Some (rice and car))

However, notice that (2.8) is not ungrammatical due to a selection error (i.e., using *some* with a singular count noun), but because of the obligatory determiner rule for singular count nouns. As we are only interested in selection errors for this task, for our present purposes, (2.5) is still ambiguous. Therefore, in cases of conjoined nouns, selection errors were scored only when the first noun used was of the wrong subcategory as in (2.2) and (2.6). Cases such as (2.1) and (2.5) were considered ambiguous and therefore not included in the analysis of the data.

A number of subjects used classifiers with mass nouns as in:

(2.9) there's one ... <box of cereal>

These were scored as count nouns, as were compounds such as *tea bags, sugar cubes* etc. Also, a number of subjects inserted determiners as in:

(2.10) there's some ... <a boat (and cereal)>

(2.11) there's some ... <cereal and a plane>

In cases such as (2.10) where the inserted determiner precedes the first noun, it was assumed that the stimulus quantifier from the incomplete sentence was not effective in selecting the noun (i.e., it was being ignored). Therefore, such responses were not included in the analysis. In cases such as (2.11) where the determiner modified the second noun, this did not affect the error scores which were determined only from the first noun. However, if the inserted determier was the same as the stimulus determiner as in:

(2.12) we've got several ... <crayons and several tea>

this was scored as two responses: one correct and one error.

Given that there is a certain amount of adjustment in the numbers of counted responses, error scores will be given as the proportion of errors to the total number of counted responses in a condition. In other words:

Error Score = errors / errors + correct responses

In analyzing the scores, we shall first compare *some* vs. *much*, then *one* vs. {*several, many, each, every*}. Finally, we shall examine pluralization errors on mass nouns and following *each* and *every*.

Some vs. Much

In this condition, errors involve completion with a count noun (e.g., **some car, *too much marbles*). Error scores are predicted to be greater for *much*. CM and DM scores are analyzed seperately and error scores are shown in fig 2.5. Shaded bars indicate discrete referents for mass nouns (DM) and open bars continuous referents (CM). In both conditions

Fig 2.5 Failure to Select Mass Nouns: Some vs. Much.

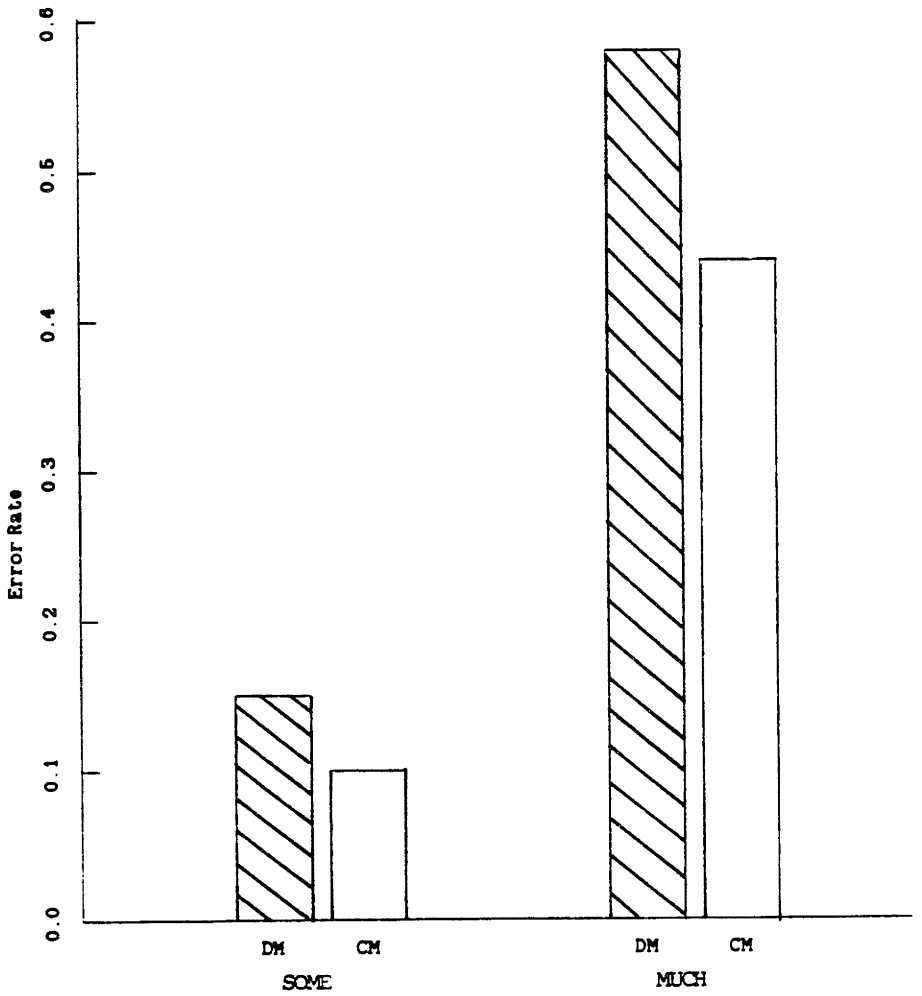


Fig 2.6 Age Trend for Selection Errors: Much vs. Some (Baseline)

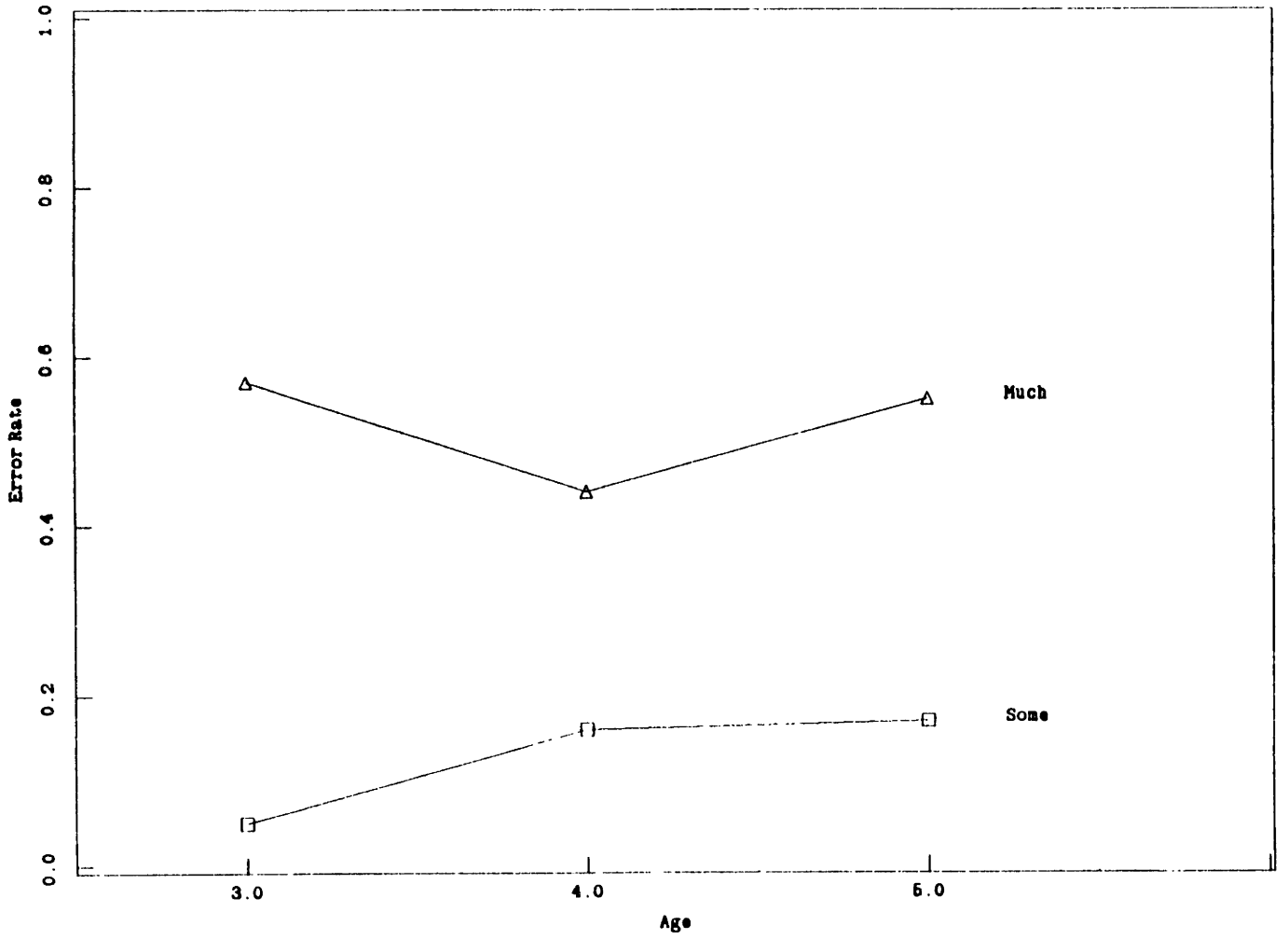
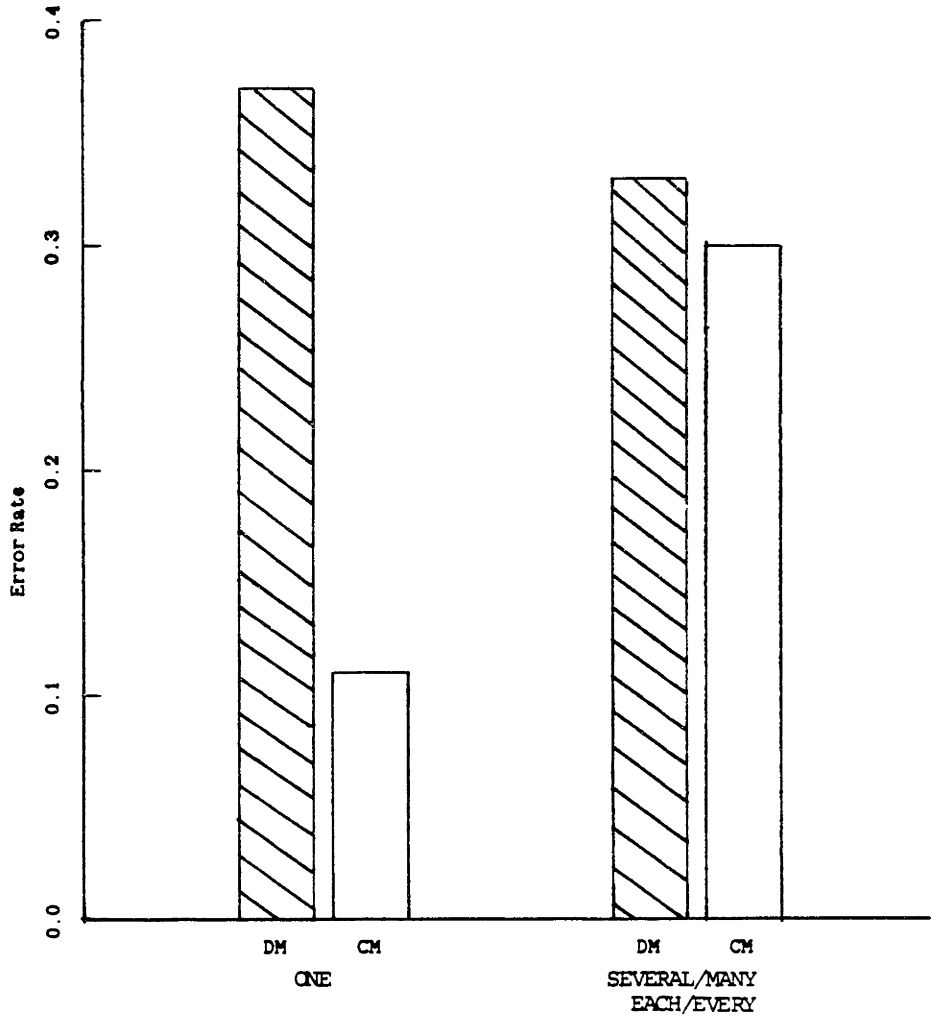


Fig 2.7 Failure to Select Count Nouns: One vs. R-C Quantifiers.



errors were higher for *much* (DM: $t = 3.557$, $p < .01$; CM: $t = 3.74$, $p < .002$; DM+ CM: $t = 5.13$, $p < .002$; all tests two-tail). Thus, the prediction is strongly supported in all conditions. Age trends are shown in fig 2.6. In neither condition was there a decline in error rate with age suggesting that the appropriate selection rules are still in the process of development at the age of five.

One vs.{Several, Many, Each, Every}

Completion with a mass noun constitutes a selection error in this condition. Errors for *one* (e.g., **one rice*) were predicted to be lower than for the R-C quantifiers (e.g., **several rice*). On a preliminary analysis of the error rates it was found that there was not a significant difference between baseline and test conditions. These were respectively: .24 vs. .32 (t - .84, $p = .4$, n.s.). These results are shown in fig 2.7. Shaded bars represent DM groups and open bars CM groups. In the CM condition, that is when referents for mass nouns were loose substances, the error rates for the test conditions were significantly greater than for the baseline condition ($t = 2.695$, $p < .02$, two-tail). In the DM condition on the other hand, errors were actually slightly higher for the baseline than for the test conditions (.37 vs. .33 respectively). This means that when referents for mass nouns were discrete such as cereal in boxes, subjects were likely to use the mass noun as a completion for *one*, thus creating an error (e.g., *in here we have one ... <cereal>*). Such errors were significantly greater in the DM than in the CM conditions ($t = 2.59$, $p < .02$, two-tail). Selection errors for the main test items did not differ between the CM and DM conditions.

What these results suggest is that subjects' use of *one* was, in many cases, not constrained by the subcategorization of the noun, but rather was determined by reference to properties such as discreteness and individuation alone. This is remarkably similar to the proposal that we tested for plurals but were unable to find in the production task of experiment II. The significance of this result will be discussed in a later section.

Pluralization with E-Quantifiers

Although the present experiment was not designed to test for pluralization with E-Quantifiers, it is important to ensure that they occur using this paradigm to support the findings of experiments I and II. Overall, error rates for pluralization with *each* and *every* were at .58. The age trend is shown in fig 2.8. As can be seen, such errors do drop off for five-year-olds after reaching a peak of .7 at age four. Such rates are well in line with the findings of the previous experiments.

Mass Noun Plurals

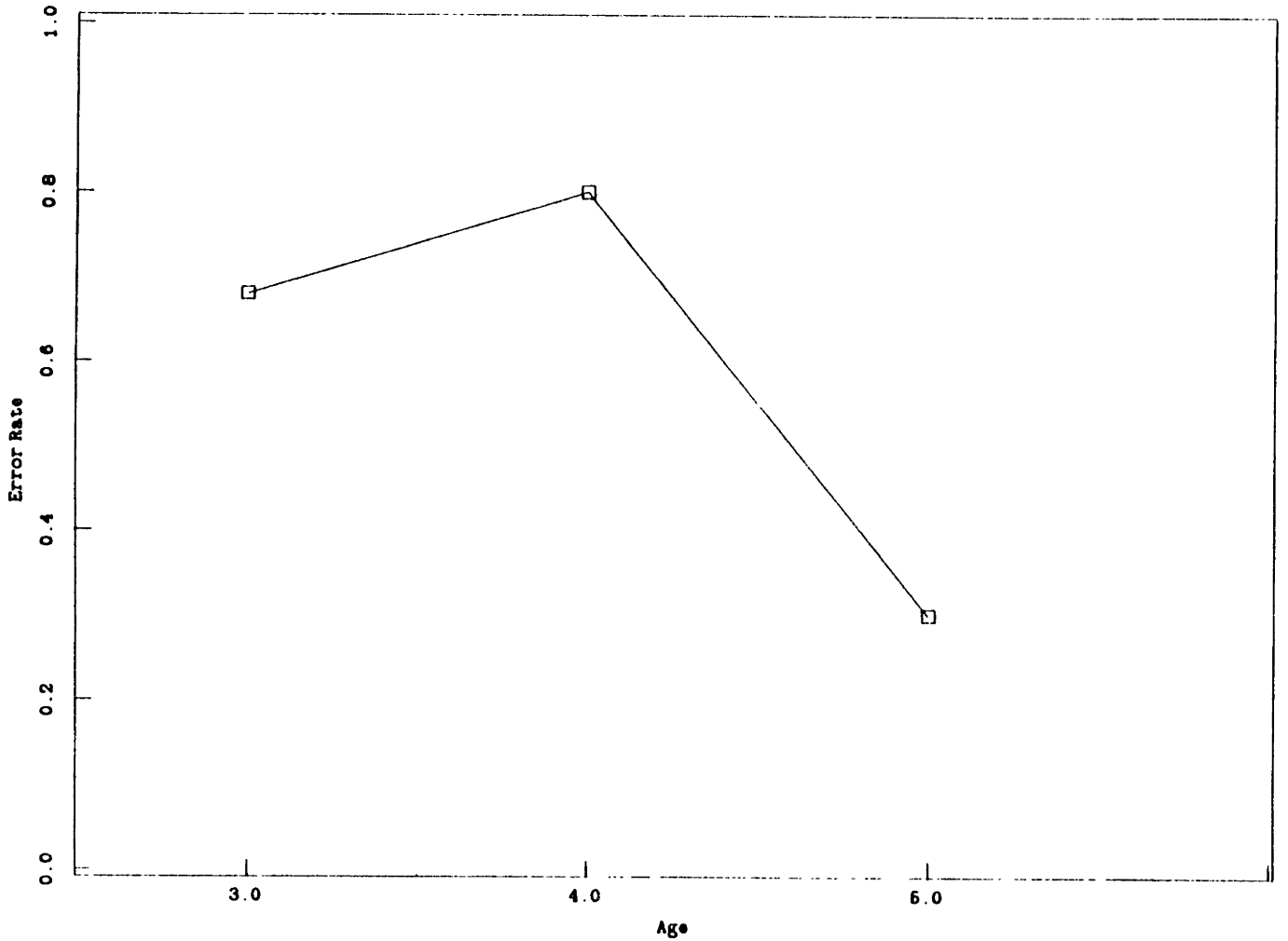
From the evidence of experiment II we should expect that children would not pluralize mass nouns in either CM or DM conditions, since this also is a production task . The relevant errors for mass noun plurals are: .07 (DM) and .02 (CM) This difference is not significant. However, these errors did tend to cluster around scores for three-year-olds whose error rate was .21 (DM) and .06 (CM). As there were only six subjects in each of the conditions at this age, the result was not significant (Mann-Whitney, $U = 12$, $p = .2$).

In examining these errors more closely, it was found that all errors of mass noun pluralization occurred with *sugar*, none were with *tea, coffee, cereal, cocoa or rice.* The discrete stimulus for *sugar* was sugar cubes, whereas for the other nouns the referents were in packages or containers (e.g., cereal boxes, tea bags etc.). Sugar, in the form of cubes, does often get used as a count noun as in:

(2.13) How many sugar*s* do you want?

Notice however that it is not possible to pluralize when packages or containers are refered to:

Fig 2.8 Age Trend for Plural Errors with E-Quantifiers



(2.14) *How many tea*s* do you want? (= tea bags)

It would appear then that quite young children are sensitive to some of the pragmatic constraints relevant for using mass nouns as count nouns. As it turns out, the particular situation used in the experiment was not so appropriate. One might argue that adults would also use a plural in this context, but the fact that only a few of the three-years-olds and none of the older subjects did, suggests that this is an error of an immature learner, not a direct reflection of the organization of the full system.

Summary and Conclusions

In this experiment, selection errors have been found to occur with quantifiers requiring exclusive selection for either count (R-C) or mass nouns (R-M). Also, we have found that E-Quantifiers occur with plural, as well as singular count nouns. These results again lend support to the postulation that quantifier categories are acquired at the most general level with no restrictions other than those imposed by constraints on semantic and pragmatic appropriateness.

One surprising result was that errors for *one* showed a differential pattern when the mass noun stimulus was either a discrete or continuous form. It appeared that when stimuli included discrete mass noun referents, children were quite likely to use the mass nouns in completion for *one*. Notice that such a difference did not occur in cases where we were testing for selection errors (e.g., *several, many, much* etc.). In other words, *one* appears to be behaving just as we had predicted that the plural would behave if it was not being constrained by the subcategorization of the noun. Rather the use of *one* appears to be a function purely of its semantic individuating function.

It will be recalled that in the introduction to this chapter it was suggested that determiners such as *one*, *a* etc. make very perspicuous use of individuation in their function, whereas the less frequent quantifiers are less perspicuous in this respect. This difference appears to be reflected in the results we obtained since children did not seem to be affected by stimulus properties for these lower frequency forms. What may be happenining then, is that the acquisition of subcategorization restrictions for early acquired determiners may evolve from their individuating function, whereas the later acquired ones inherit their restrictions in a much more formalized manner (i.e., from their distributional properties).

In the General Introduction, we pointed out that the child would require some organizing properties in order to limit the number of possible subcategorizations from the billions that are pontentially available in an unconstrained distributional analysis. We suggested two potential candidates, one was to semanticaly base the categories in terms of objects and substances, the other was to exploit the common function of certain determiners in their individuating role and use this as a basis for correlating their distributions. So far we have not tested the former since that is the subject of the next two chapters. Instead, we have obtained some preliminary evidence that the latter is an organizing property. Of course, these two strategies are by no means mutually exclusive, but neither are they identical.

To be clear about the relevant distinctions here, it must be remembered that in all of the experiments performed so far, when we have contrasted "discrete" vs. "continuous" referents, the mass nouns in question were still names of ***substances*** and not ***objects***. That is, whether one puts soup in cans, pots or jars, it does not change the intrinsic semantic properties of the noun, the soup remains a substance throughout. It may be the case that the child has some disjunctive criterion, such that if a referent is discrete, or if it names an object then treat it as a count noun, and conversely for mass nouns. To test such an hypothesis, we shall have to wait for the next chapter.

What seems odd is that we achieved a strong effect of discreteness for responses with *one* but not with the plural (excluding the case of sugar cubes in the youngest subjects). It may well be the case that the point in development when restrictions become constrained by subcategorization rather than discreteness is not the same for all functors. Thus, the plural may well show an earlier development in this respect. The reasons for such asynchrony may involve the higher frequency of plurals or the fact that they are bound rather than free morphemes may make the child more alert to syntactic coordination of restrictions. [17] Such issues seem to be beyond the scope of the present analysis but are intriguing nonetheless. One should also consider the possiblity that the errors in the present experiment may well be an overestimation of the lack of restriction. Since it was the experimenter, and not the subject who produced the *one*, we may be tapping a very different set of restrictions than if we had been able to get the child to elicit the *one* and the noun. Notice that with the plural, the child was required to produce the form himself (unlike *one*), and this in itself may be the cause of the discrepency. Such issues must be left to future research for resolution.

Categorial Generalization: An Assessment

In all of the experiments of this chapter we have continued to find support for the hypothesis that quantifiers are initially acquired at the most general level (at least the lower frequency ones studied here). Restrictive quantifiers do not seem to obey their restrictions for count or mass selection, and E-Quantifiers are found to occur with plural as well as singular nouns. Let us first examine the latter result for the E-Quantifiers. Perhaps the first criticism of this finding is that the overpluralizations have nothing at all to do with the quantifier, the child simply pluralizes when a plural referent is denoted, as it is when *each,*

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[17] This might especially be true if there were some kind of locality constraints on the formal analysis of restrictions carried out by the child. That is, the plural becomes restricted earlier because it is "nearer" the noun. If analyses were locally bound in some sense, this would effectively answer Pinker's (1983) criticism that an unconstrained distributional analysis of categories would require 2^n - 1 definitions of context, where n = no. of words in the sentence.

every and *either* are used. The criticism is well taken, and for this result to be interesting, one would like to show that there is a real *dependecy* between the quantifier and the form of the noun, since, in general, pluralization is a form of agreement with the selectional properties of the quantifier. In other words, if the only thing we are tapping is the child's semantic knowledge of plural functions, then we are saying nothing about generalization of quantifier use.

Showing such a dependency is no easy matter. However, what we can show is that the simplest case for independent pluralizing functions (as outlined above) is wrong in quite interesting ways. The relevant data for this demonstration are those found in experiment II. It will be recalled that subjects were divided into two groups according to whether the initial modeling of the noun was in the singular or plural form. Having received the modeling (i.e., repeating the noun), they were then tested with the completions. For the unrestrictive quantifiers (*some, all, any, enough, more*), there was no effect of such modeling. That is, subjects always produced the plural form. However, in the case of the E-Quantifiers there was a very significant effect. The relevant data are reproduced in table 2.4. (Results for *either* are not included since there were many problems with this case). As can be seen the effect of the pre-modeling is to determine about a third of the responses. In other words, if semantic functions are determining a good proportion of the responses, an equal number are being determined by pre-modeling effects.

Notice that this is not simply a response bias affecting all responses since such a bias was not effective for the other class of quantifiers. Although, to be sure, it is a response bias of sorts. However, it is not the kind of thing that one would expect to affect the semantic function of the plural - especially if one takes that function to be quite well defined and controlling the ovepluralization results found in this chapter. A more consistent, but not definitive explanation is that while semantic functions may be at work in production of incorrect plurals, they are "permitted" in a sense, because they are specified by the E-

Table 2.4 Effects of Pre-Modeling on Pluralisation with *Each* and *Every*

		Response	
		+ pl	-pl
Modeled Form	+ pl	75	17
	-pl	25	65

Values given as percentages of total responses

Quantifier, as are singular forms. Such a dependency between the quantifier and the [± plural] feature would not necessarily give primacy to semantic or pre-modeling biases, but may be open to either. This may seem like a strange way of trying to show a dependency between the plural and the quantifier, but I think there is a suggestion in these data that we are dealing with something more than a simple semantic control of pluralization.

For selection errors, we basically run against the same problem: are we really tapping a generalization process or simply random choices of nouns with restrictive quantifiers? There is certainly a difference here between our result and what is known commonly as *over-generalization*. In the latter case, one minimally requires evidence that in a previous period of acquisition, the child was using forms correctly, he then makes the overgeneralization errors and finally returns to the correct pattern (e.g., *went* → *goed* → *went*). This U-shaped function is pervasive in acquisition (see Bowerman, in press) and is usually taken to be indicative of: 1. Initial rote learning; 2. Acquisition of the appropriate rule; 3. Acquisition of the appropriate restrictions on application of the rule.

In the present case, we have not demonstrated such a pattern, except perhaps where the child first learns *every* in constructions such as *every day, everyone* and so on (c.f., chapter I). It does not seem likely that such a pattern would in general emerge considering that the age trends for selection errors did not indicate any U-shaped function. Thus, the term *generalization* rather than *overgeneralization* seems more appropriate here. In other words, we are claiming simply that the child is able to use the fact that *many, several, each* etc. are quantifiers as a basis for general use in quantifying over the noun class. It is only later that such use becomes restricted to a subclass (count or mass). Such a result is not at all obvious since alternative explanations could suggest for example, that restrictions would be very early if the child were to first learn the semantics of these quantifiers with respect to such properties as individuation etc. Such properties might then be the basis for restricting use. Instead, the pattern that has emerged suggests that possibly these semantic functions

emerge as a consequence of selectional properties rather than in advance of them.

It would seem that the notion of a descending hierarchy of categories and subcategories outlined previously (c.f., Chomsky 1975) is in fact a very good metaphor for the acquisition process, as evidenced by the present results. One cannot, of course, immediately generalize this pattern to all acquisition processes at the categorial level. For example, when one finds evidence for U-shaped development with initial rote learning of forms, this is essentially inverting the process by going from the most particular level up to the general level and back down again. Thus, we have perhaps oversimplified the model for our present concerns. We need to specify the relevant parameters for when forms will initially be learned by rote and when they will not. Furthermore, we need to know more about exactly which rules create errors of generalization or overgeneralization and which do not. For example, errors with dative alternation (e.g., **He donated me the egg*) appear to be quite rare (Baker 1979), but not non-existent (c.f., Lord 1979). The relevant semantic, syntactic and distributional facts that may influence production of errors sill require a considerable amount of working out in order to produce a coherent account the the child's strategies in generalizing and restricting use.

While we do not expect the results of this chapter to provide any definitive answers to such questions, the general message is taken to be that generalization on the basis of category assignment is to be expected in the unmarked case. Categories are entities whose existence is only attested by the fact that they allow for generalizations of constructional use across sets of lexical items. As we noted in the analysis of longitudinal data, constructions such as *some lots of* - on a par with *a lot of*, provide prima facie evidence for the existence of categories. Similarly, we take construcions such as *many water, much chairs, every jars* etc. to indicate a coherence at the categorical level in the acquisition of these forms.

Chapter III

Are Count/Mass Categories Semantically Based?

Introduction

In the present chapter we shall make an initial attempt to be clear about what it means exactly for a category be semantically rather than syntactically based. Having established this, we shall proceed to test some of the consequences of such a position in three experiments. The first two will involve a word learning paradigm evaluating on what basis children subcategorize new nouns, the third will involve testing how children have subcategorized nouns that they have already learned.

In the General Introduction we established that the count/mass distinction was a syntactic one in so far as the subcategorization of a noun must be determined on the basis of what kinds of linguistic contexts it occurs in. Relying soley on properties of the referent leads to incorrect predictions for many noun subcategorizations (e.g., *furniture* etc.). It was also stressed that the sense in which "semantic" is used here relates to the intrinsic properties of the referent (i.e., being an object or substance). In so far as the count/mass distinction differentiates the mode of quantification for a particular noun, then in that sense the syntactic distinction does signal a semantic one. The point is, because there are nouns like *furniture, silverware, substance* and so on, whose count/mass subcategorization is in opposition to the semantic characterization (objects vs. substances), this means that the way in which a noun is quantified is not a direct function of its intrinsic properties.

In examining the claims for the semantic basis of early categories, it is clear that what is intended is the notion of intrinsic semantic properties. For example, Pinker (1983) quite unequivocally proposes that early nouns are equated with the semantic types: *person,*

place or thing. It is also claimed that the semantic definition is later replaced by a syntactic-distributional one in order to account for the fact that the semantic definition will not work for all cases (e.g., "Harry went for a *walk*"). Notice then, that the postulation of early semantic categories implies that the child's categories are fundamentally different in kind from those of the adult. The reason that such a position is held presumably reflects the assumption that semantic (or rather conceptual) categories are already available to the child and therefore a direct mapping of syntactic categories onto those semantic ones will be much easier.

We shall assume that the claim that a category is semantically based amounts to a claim that the rules invoking the category are written over semantic types that are derived from experience with the non-linguistic environment. A corollary to such a view is that the following two points should hold:

> [I] The assignment of a new word to a particular category is a function of its intrinsic semantic properties rather than its syntactic distribution.
>
> [II] The set of lexical items assigned to a particular category is restricted to only those exhibiting the appropriate semantic properties as prescribed in the semantic definition of the category.

Let us examine the implications of these two conditions for the count/mass distinction. For [I], one would expect that when learning a new word, the child would examine its referent; if it was an object, he would categorize the noun as a count noun. If it were a substance, then he would categorize the noun as a mass noun. The linguistic construction in which the word appeared would essentially be irrelevant to the process. For [II], one would expect that the

set of count nouns would be restricted to those referring to objects, whereas the set of mass nouns would be restricted to nouns referring to substances.

An alternative account is one whereby the categories are syntactically defined from the beginning. On this account, subcategorization would be on the basis of the linguistic context in which the noun occurs (e.g., what kind of determiner modifies it). The set of count nouns would be restricted to those that occur in count noun contexts in the input (e.g., [a ___]) and mass nouns would be those that occur in mass noun contexts (e.g., [some ___]). In other words, given a rich enough input, perfect storage etc. the child's categories should be the same as those of the adult.

Does the syntactic account preclude the child from learning that there is a correlation between syntactic categories and semantic types? - Clearly not. The syntactic account merely states the basis on which the child determines the subcategorization of a noun, it does not claim that the child is blind to semantic properties. In fact Brown (1957) showed experimentally that children of 3- to 5-years of age did know the correspondence. Their subjects were taught nonsense words as either *a latt* or *some latt* (plus a variety of other contexts). From the information of the linguistic contexts, they were able to determine that the former should denote an object and the latter, a substance. While these experiments demonstrate knowledge of the correspondence, they do not show whether the distinction is semantic or syntactic in the sense in which we are presently interested. That is, such a result might be predicted from either account.

A second question concerns whether the child could use the alternative source of information if necessary. This introduces a distinction between whether a category is *exclusively* semantic/syntactic or *essentially* semantic/syntactic. Recall the case of gender (c.f., Karmiloff-Smith 1979). In those experiments, it was shown quite unequivocally that young children never assigned nouns to gender categories on the basis of semantic properties

even when other cues such as determiner and noun ending were not effective (i.e., she used forms that did not indicate how the noun should be subcategorized). Therefore, for gender, the categories are *exclusively* formal in early development. In the case of the count/mass distinction it is not likely that the categories would be exclusively syntactic (i.e., where semantic cues could not provide the child with a cue to subcategorization) especially since Brown has demonstrated that children do seem to have learned the correspondences.

Consider the case in which there is no syntactic cue. For example, if the child heard a new word such as *garn* in the context: [the ___]; because *the* is totally unrestrictive, there would be no subcategorization cues of a syntactic nature. In such a case, the child might well examine whether the referent was an object or a substance and then subcategorize the noun on that basis. Notice that an adult in a similar predicament would probably also employ the same strategy. For example, if one were shown a strange substance and were told that it was "the garn", one would probably end up using the noun *garn* as a mass noun. However, if one were later to hear someone in authority referring to it as "a garn", one's subcategorization for the noun would quickly change to that of a count noun. In other words, while one may use semantic cues in the absence of syntactic ones, the syntactic cues will always overide the semantic ones when present. In this sense, the categories are essentially syntactic while, unlike gender, they are not exclusively syntactic.

Could categories be essentially semantic (but not exclusively) for young children? They probably could, but such a situation would be somewhat bizarre. In other words, when semantic cues were absent (i.e., when the referent is not clearly an object or substance) then the child uses the syntactic context. Note however, that the reason most people postulate that children's categories are semantic and therefore radically different from those of the adult, is that there is an assumption that the child needs the semantic properties and cannot operate at a purely formal level. Thus, while essentially semantic categories are not impossible, postulating such a position looses much of the motivation for the semantic basis in the

first place.

Whether one proposes exclusively or essentially semantic/syntactic categories the crucial test is when the two sets of cues are in conflict. That is, when substances are denoted by count nouns and objects by mass nouns. Such a case will be tested in experiments IV and VI. In experiment IV we shall examine the assignment of new nouns to their respective categories (i.e., corollary [I]). In experiment VI we shall examine whether children's existing count/mass categories are organized according to semantic properties or syntactic distributions (c.f., corollary [II]). The middle experiment, V, will attempt to examine whether alternative cues to the critical ones (semantic or syntactic) are effective in establishing subcategories. That is, are the critical cues exclusive or essential, and if other cues are effective, are they less so than those claimed to be the critical ones?

Experiment IV

Semantics vs. Syntax: Word Learning

Introduction

The purpose of the present experiment is to test whether children assign new nouns to count or mass categories on the basis of semantic properties or syntactic distribution. To imitate the word-learning situation children were taught nonsense words such as *garn*. In order to test the two competing accounts, we took advantage of the fact that the two cues to subcategorization: semantic properties and syntactic context could be in conflict as they are with, say, *furniture*. That is, objects being prototypical count noun referents were referred to as *some garn* (i.e., using a mass noun context) and substances were referred to as *a garn* (i.e., using a count noun context). If children base subcategorization assignment on semantic properties, then the nouns referring to objects should be categorized as count nouns, and substances should be mass nouns. However, if syntactic cues are critical, then subcategorization should be in the opposite direction, in agreement with the linguistic context.

Having established which of the two cues is most effective, a further question concerns whether the alternative cues are totally ineffective as in the case of semantic cues for gender, or whether the fact that the two sets of cues are in conflict does affect categorization. In addition to the conflict condition described above, children were also given items for which semantic and syntactic cues were in accord. That is, objects were referred to as: *a garn* and substances as: *some garn* (or the appropriate nonsense word for that condition). A comparison of *accord* and *conflict* conditions enables us to determine whether there is any effect of having the two sets of cues in competition.

Method

Subjects

A total of 44 subjects were initially tested. Four were excluded (see results section), thus leaving a total of 40. Ages ranged from 3;5 to 5;5, mean age 4;3. To determine age trends, subjects were divided into groups of 20 by age. The younger group ranged in age from 3;5 to 4;1 (mean age: 3;9) and consisted of 11 males and 9 females. The older group ranged from 4;2 to 5;5 (mean age: 4;9) and consisted of 6 males and 14 females. Subjects were mostly from middle-class backgrounds, all were native speakers of English.

Materials

In the training section, 15 pairs of flash cards were used. One of the pair contained a line drawing of a nonsense object and the other contained a picture of two of the objects. Nonsense words available for this condition included: *Tib, Brine, Pon, Shap, Gren, Sib, Dap, Carb, Lobe, Vell, Durn, Prote, Lop, Kip, Thorp.* On the main items, 4 object and 4 substance stimulus sets were used. The objects were chosen to be things that the child would not know the regular names of and in many instances they were painted in unusual colors. These included: electrical components, file clips, fuses and wall plugs. These items were kept in transparent plastic beakers. The substance stimuli were unusual-looking liquids presented in four test-tubes. Their colors were: brown, green, silver and metallic red. Names for the main items included: *Brode, Cabe, Grote, Garn, Fant, Turp, Cheem and Latt.* The control condition included pennies (about 25) and water in 4 test-tubes. A small toy robot (Mickey-the-Martian) was also used.

Procedure

The procedure included four sections: (1) training; (2) real word control; (3) semantics and syntax in *accord*; (4) semantics and syntax in *conflict*. On the main test conditions (3 & 4), subjects were presented with either objects or substances. These were referred to using either count noun contexts or mass noun contexts. In the count noun context, subjects would be told:

> This is *a* garn. Have you ever seen *a* garn before? Well this is *a* (red) garn and here's *a* (blue) garn, and here's *another* garn

In general, the experimenter attempted to use the noun in as many and as diverse contexts as was allowable. For mass nouns, the context was of the form:

> This is *some* garn. Have you ever seen *any* garn before? This is *some* (green) garn, and this is (green) garn as well ... etc.

Nouns were always used in the singular form in the introduction, and subjects were asked to repeat the word (e.g., "Can you say *garn*?"). To test for categorization, subjects were required to do a sentence completion as in experiments II and III. The completion was of the form:

> "Over here we have a/some garn, over there we have more ... what?"

If subjects completed with a plural form (more garn*s*), this was taken as evidence of count noun subcategorization. If a non-plural form was used (more garn), this was taken as evidence of mass noun subcategorization. The results from experiments II and III support the claim that the singular/plural contrast with *more* is a reliable indicator of subcategorization (in production tasks).

The object stimuli were chosen to be things that the child would not know the names of such as electrical components (see fig 3.1). In the *accord* condition, a single object was referred to as "a garn" (or whatever nonsense word was used) and other count noun contexts. For completion, a number of the objects in a plastic beaker were pointed to, saying "Over there we have more ..." In the *conflict* condition the objects were introduced in mass noun contexts. Here, "some garn" etc. denoted a number of the objects (about three). The reason for this was that if one were to say: "some furnture", for example, reference would normally be to a group rather than an individual. The relevance of this difference in quantity will be examined further in experiment V.

For the substance stimuli, it was necessary to provide a situation in which pluralization would be plausible. That is, one would not expect the child to pluralize when a non-plural referent is used. To overcome this problem, substances were presented in four test-tubes (see fig 3.2). Notice that this does not affect the nature of the semantic cue in the sense that we are currently employing that term. The referent still constituted a substance, regardless of its containment. The *accord* and *coflict* conditions were identical with respect to the mode of stimulus presentation. "Some garn" (accord) and "a garn" (conflict) both refered to a single test-tube of the substance. In the completion, the other three tubes were pointed to.

To ensure that the child realized that it was the substance and not the test-tube that was being referred to, the experimenter pointed to the liquid inside the tube which was shaken around to draw attention to the liquid. Also the experimenter said: "*In* here we have a garn ..." As a further control, real words (*penny* and *water*) were tested under the same presentation conditions. For example, the water was also in the test-tubes. Assuming that children know that *water* is a mass noun, then if they did not pluralize, this ensures that the presence of the test-tube was not causing subjects to pluralize a mass noun and therefore it was an effective measure of subcategorization. Similarly, the use of *penny* as a count noun

Fig 3.2 Substance Stimuli

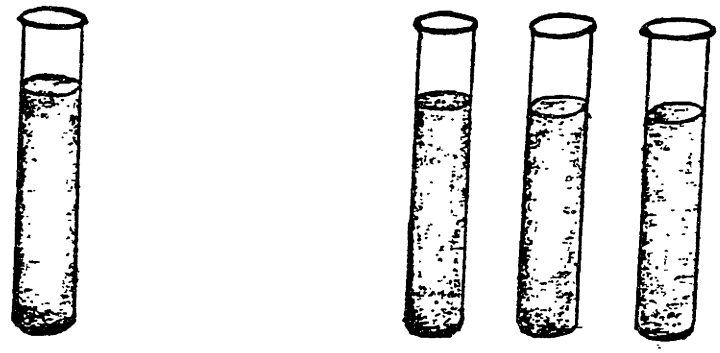
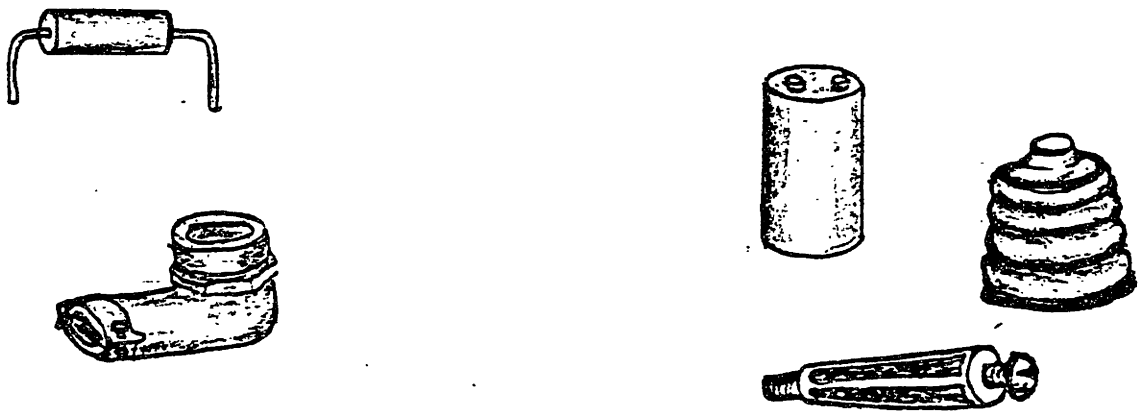


Fig 3.1 Object Stimuli



control ensured that subjects would pluralize count nouns under the relevant conditions.

In pilot studies, it was discovered that subjects did not always spontaneously pluralize nonsense words (i.e., they often produced only singular forms). Therefore, prior to testing, subjects were trained in pluralizing nonsense words. This involved showing them a picture of a nonsense object and telling them it was a picture of "a sib" (or the appropriate word). They were then shown a picture of two of the objects and were told: "Here's a picture of two ... what?" They were then encouraged to complete the sentence. If they did not complete with a plural form, they were given it and asked to repeat. Subjects were required to produce three consecutive spontaneous plurals before being given the main items.

The test was designed in the form of a game with a small toy robot called Mickey-the-Martian. The robot had brought some things from Mars to show the subjects and was going to teach them the names. The subject was then given the four conditions: (1) Training with pictures; (2) Control with *penny* and *water*; (3) Accord Condition (4 items); (4) Conflict condition (4 items). The main test items are schematized in fig 3.3. For each of the accord and conflict conditions there were 2 object stimuli and 2 substance stimuli. On the semantic account it was predicted that subjects would complete with a plural when objects were referred to (i.e., count) and non-plural when a substance was referred to (i.e., mass). On the syntactic account, it was predicted that pluralization, and presumably categorization, would be in accord with linguistic context: *a garn* → *more ... garns*; *some garn* → *more ... garn*. These two predictions are thus differentiated in the conflict condition.

If the non-critical cue in the conflict condition (semantic or syntactic) were totally superfluous, there should be no difference in the accord and conflict conditions. However, if the non-critical cue is partially effective, then this should show as a decrement in the scores for the conflict condition when compared to the accord condition.

Fig 3.3 Contexts & Stimuli for Experiment IV

Condition	Linguistic Context		Stimulus
Control	*a* penny	<--->	PENNY
	some water	<--->	WATER
Accord	*a* garn	<--->	OBJECT
	some garn	<--->	SUBSTANCE
Conflict	*a* garn	<--->	SUBSTANCE
	some garn	<--->	OBJECT

All subjects were run in the order described here (1 - 4) with randomization of items within conditions. Nonsense words were randomized across conditions in one of four predetermined sequences. Subjects were disqualified from the analysis if they (i) failed the training criterion after 15 trials; (ii) produced incorrect forms (± plural) in the control condition.

Results

Of the 44 subjects originally tested, 3 were disqualified for failing the training phase, and one for pluralizing *water* in the control condition. The fact that only one subject failed this control confirms that having the referent of a mass noun in test-tubes does not persuade the child to pluralize (c.f., also expts. II and III). Therefore, the method of using plurals did appear to be a reliable indicator of subcategorization. The final population of 40 subjects was divided into two groups by age (see Subjects section).

Conflict Condition

For purposes of data analysis, response patterns were categorized across the four items within each of the accord and conflict conditions. Patterns where all four responses indicate a syntactic basis for assignment are coded as SYN[4]. Here, subjects pluralised for *a garn* but not for *some garn*. Three such responses are coded: SYN[3]. Conversely, the equivalents for semantic response patterns are SEM[4] and SEM[3]. That is, where subjects pluralized object names, but not substance names. Since SYN[2] = SEM[2] this pattern is termed "equivocal" or EQ. Coded seperately are patterns where subjects produced the same response for all four items. Four plurals were coded as RB+ (response bias: + plural); four non-plurals were coded as RB-.

Concentrating on the conflict condition, overall results are shown in fig. 3.4. The upper graph shows the responses of the older subjects and the lower, inverted graph, those of the younger subjects. Although there were a large number of response biases, where subjects did show differentiation the results are strikingly clear. Only two subjects approached a semantic pattern (SEM[3]) and none gave the full SEM[4] pattern. Syntactic patterns (SYN[4] & SYN[3]) on the other hand were predominant among the interpretable response patterns ($n = 22$). This result was highly significant ($\chi^2 = 4.28$, $p < .001$). While, the older subjects were slightly more polarized toward the syntactic patterns with no EQ patterns, both groups showed significant biases to assignment on a syntactic basis (Younger: $\chi^2 = 7.46$, $p = .03$; Older: $\chi^2 = 14.7$, $p < .001$). Clearly the results for this condition favour the syntactic over the semantic account.

Accord vs. Conflict

While the results clearly show that children use syntactic cues in preference to semantic ones when the two are in conflict, it remains to be seen whether the semantic cues are totally superfluous or whether the opposition of the two sets of cues did affect response patterns. By comparing the results for the accord condition where there was no conflict, it is possible to ascertain the extent to which subjects were affected by the conflicting cues.

Results for the accord condition are shown in fig 3.5. Response patterns are coded SS[4] ... SS[0] according to the number of responses in the direction predicted by both semantic and syntactic cues. Comparing this figure with fig 3.4 for the conflict condition, it can be seen that responses here were certainly more unambiguous. Thirty-seven of the 40 subjects produced SS[4] or SS[3] patterns with fewer response biases (2 vs. 13) and no EQ patterns. The response biases and equivocal patterns thus appear to be a consequence of the fact that semantic and syntactic cues were in conflict. In other words, the conflicting cues did cause some children to fail to differentiate responses on the basis of the relevant cues.

Fig 3.4 Response Patterns in Conflict Condition
Younger vs Older Subjects

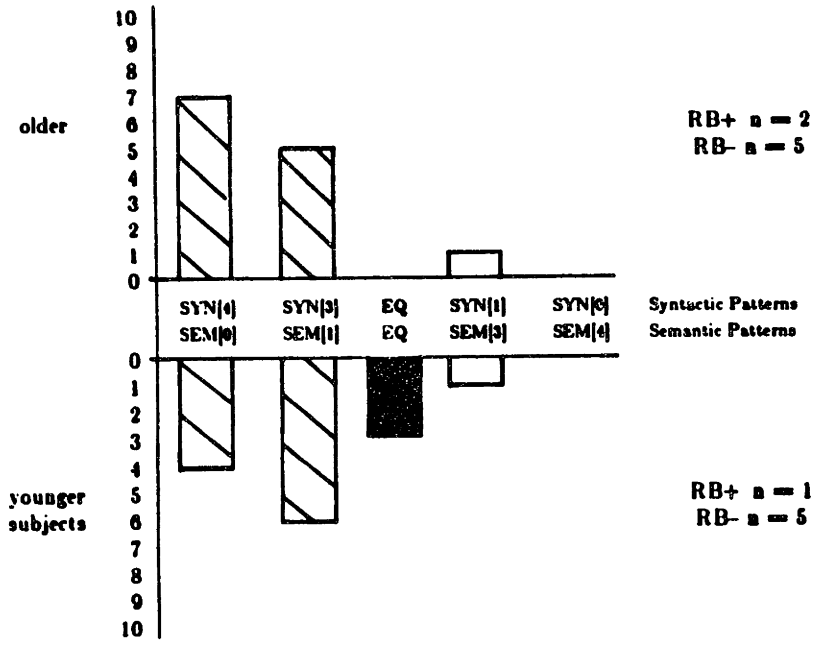
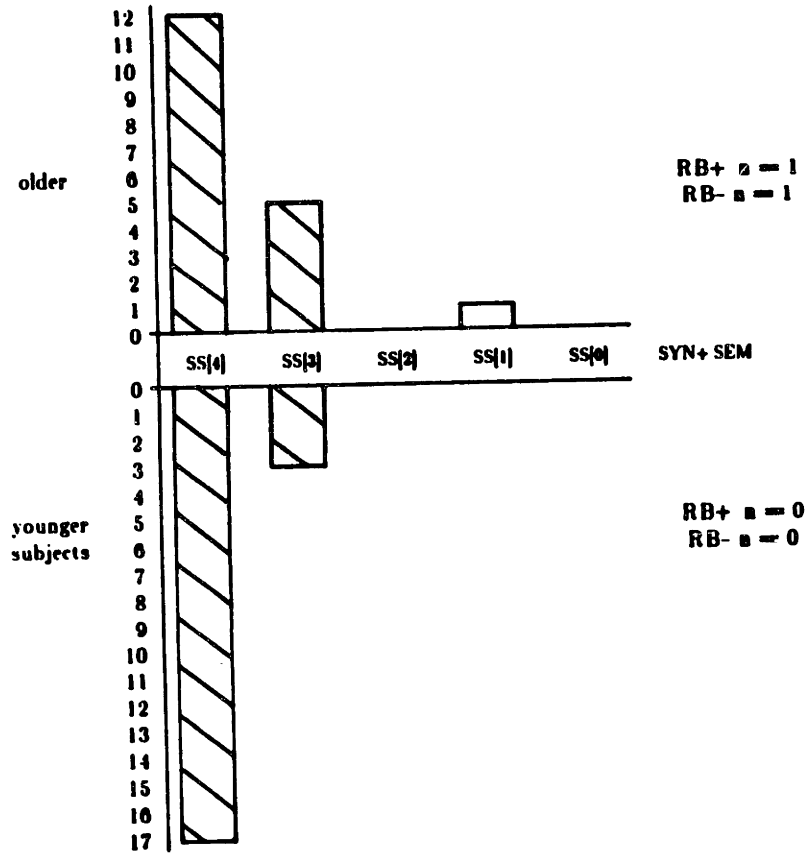


Fig 3.5 Response Patterns in Accord Condition
Younger vs Older Subjects



Seperating this effect for the two age groups, it was found that the decrement was only significant for the younger group (Younger: $p < .01$; Older: $p < .2$, McNemar test).

Conclusions

The main result for this experiment has shown that when children are able to indicate categorization on the basis of either semantic or syntactic cues, they overwhelmingly categorize on the basis of the syntactic context. That is, the type of determiner is a much more effective cue to categorization than the intrinsic semantic properties of the referent. As we noted previously, however, there is a sense in which certain nouns are more prototypical examples of either count or mass nouns than others. That is, those nouns whose referents are naturally discrete or continuous and are quantified in accord with this semantic property tend to be prototypical count or mass nouns. For example, *water* is a more prototypical mass noun than, say, *furniture*.

Having semantic and syntactic cues in conflict did cause some children to not pluralize on a consistent basis and produce either response biases or equivocal patterns. While such subjects were in a minority, this result does show that the count/mass distinction is very different from gender. In other words, the presence of the semantic cues does seem to matter, not to the extent that they are used as a basis for subcategorization, but that they appear to "support" the syntactic cues, at least for younger subjects. In the next experiment, we shall attempt to determine the relative efficacy of the two cues (semantic and syntactic) when they are not in conflict and not conflated (as in the accord condition).

Another question to be addressed concerns the differences in the number of objects in the two conditions. It will be recalled that when the object stimuli were referred to as *a garn* (count context), a single object was presented. However, in the conflict condition, *some garn* (mass context) referred to a group of objects (c.f., *some furniture* usually refers to a group of

objects rather than a single piece of furniture). This difference in quantity could, in itself, constitute a clue to subcategorization, independent of semantic and syntactic cues. We shall therefore attempt to isolate this factor and compare its effectiveness as a cue in the next experiment.

Experiment V

The Efficacy of Semantic and Syntactic Cues in Isolation and the Effects of Differences in Quantity

Introduction

In the previous experiment we examined the basic issue of whether nouns are assigned to their subcategories on the basis of semantic or syntactic properties when the two are in conflict. Where subjects did show differentiation in terms of their response patterns, it was clear that category assignment was on the basis of linguistic context. However, it was also noted that the fact that the cues were in conflict did affect response patterns. That is, children were much better at indicating subcategorization when there was no conflict. Along with Brown's (1957) result demonstrating children's knowledge of the syntactic-semantic correspondence, it appears that while the categories are *essentially* syntactic, they are not *exclusively* syntactic.

In the present study, we shall attempt to examine whether children are able to subcategorize on the basis of semantic properties when there are no conflicting or supporting syntactic cues. In other words, syntactic cues will be neutralized. The method for doing this is by introducing the nonsense word with *the* as determiner which is unselective for count or mass. If we are claiming that syntactic distribution constitutes the essential basis upon which the categories are defined, then the efficacy of semantic cues alone should be inferior to that of syntactic cues alone.

Neutralizing semantic cues becomes possible if a referent is chosen that is neither an object nor a substance. In the General Introduction it was pointed out that the subcategorization of many food terms is underdetermined by semantic properties since they can be construed as either discrete objects (e.g., a carrot) or as non-discrete stuff (e.g., some celery). In

the present experiment we used small beans as stimuli in order to neutralize semantic cues. Thus, while *bean* is a count noun, there are many perceptually similar food terms whose subcategorization is as a mass noun (c.f., *rice, corn*)

We may now state the first prediction:

> (1) When syntactic cues are presented in the absence of semantic cues, subcategorization should be more effective than in the converse case when semantic cues are presented in the absence of syntactic cues.

Effects of Differences in Quantity

It was noted briefly in the last experiment that the presentation of object stimuli was not identical for accord and conflict conditions. When they were referred to as "a garn" (accord), a single object was denoted. However, when such stimuli were referred to as "some garn" (conflict), a group of objects was denoted. The analogy was made with the case of using "some furniture" where one would normally denote a set of objects rather than, say, a single chair. The effects of quantity are illustrated in fig 3.6 where, even when there are no other cues (i.e., using *the* as determiner and beans as referents), the configurations may, themselves, provide the child with a subcategorization cue. This is because, while *the* is unselective with respect to count/mass and singular/plural, when a singular count noun is modified reference must be to an individual. If a group is referred to with a non-plural noun, this would preclude subcategorization as a count noun. [18]

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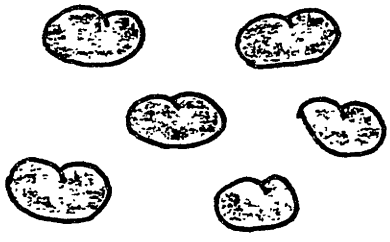
[18] Although the most likely interpretation would be as a mass noun in this case, this is by no means necessary. For example, the noun could be a collective such as *family* which denotes a group by a singular noun.

Figure 3.6 Quantity Differences as Cues to Subcategorization.

The Garn → Count noun



The Garn → Mass noun

It is of interest to determine whether children are sensitive to the fact that quantity differences can constitute a cue to subcategorization. We therefore tested whether they were able to subcategorize on this basis alone with stimulus arrays similar to fig 3.6. While they may be able to do so, we would not expect subjects to be as good as when there are syntactic cues available since we are postulating that subcategorization is a consequence of observing the selectional properties of determiners, not simply a function of the stimulus configuration. The second prediction is therefore as follows:

> (2) The effectiveness of syntactic cues alone will be greater than those resulting from differences in quantity.

Control for Quantity Effects from Expt IV

A further comparison is required to control for the conflation of syntactic and quantity cues in the conflict condition of experiment IV. It was noted that the conflation only occurred for object stimuli. For substance stimuli "a garn" (conflict) and "some garn" (accord) both denoted a single test-tube of liquid. Therefore there was no problem of conflation for those conditions and one can assume that it was the linguistic context that was determining the response. For the object stimuli there was a conflation. As we are claiming that subcategorization in the conflict condition arose principally on the basis of selectional properties of determiners, it is necessary to ensure that it was not simply differences in quantities that was doing the work. Thus we need a condition that replicates the result for the conflict condition, but with the syntactic cue neutralized. In other words, all stimuli are referred to as *the garn*. For object stimuli groups rather than individuals are denoted by this expression. Thus semantic and quantity cues are in opposition.

Once again, if the results from experiment IV are to be accounted for by syntactic selection of determiners, then one would not expect the effects of the semantics vs. quantity

conflict in this experiment to be as great as for the semantics vs. syntax conflict in experiment IV.

Summary

The aims of the present experiment are listed below as a series of questions and predictions:

Q1: Can children use semantic cues alone to determine noun subcategorization?

Pred (1): If semantic cues alone are effective, they should not be as effective as syntactic cues alone.

Q2: Can children subcategorize nouns with no semantic or syntactic cues, only relying on differences in quantity?

Pred (2): If quantity differences constitute cues to subcategorization for children, their effectiveness should be less that for syntactic cues.

Q3: When semantic cues and quantity cues are in conflict for object stimuli, does the quantity cue override the semantic one?

Pred (3): If quantity differences create a decrement in the extent to which children's categories may be determined by semantic properties (in the absence of syntactic cues), this decrement should be less than when syntactic

cues are involved (as in the conflict condition of expt IV).

Method

Subjects

There were initially 45 subjects, 6 were not included in the final analysis thus leaving 39 subjects ranging in age from 3;0 to 5;11 (mean age 4;5). Twenty two were female, 18 were male; all were native speakers of English, mostly from middle-class families. For comparisons with experiment IV, it should be noted that while the number of subjects was almost the same, the age range was extended slightly. Mean age was more or less comparable (4;5 vs. 4;3).

Materials

Materials included 4 sets of substances each in 4 test-tubes, and four sets of object stimuli. These were the same as in expt IV. In addition, there were eight quantities of California beans dyed in various colors. These were stored in transparent plastic beakers. Flash cards, water and pennies and the robot retained from expt IV were used in this experiment.

Procedure

Training was identical to experiment IV using flash cards and the robot. In all there were 4 test conditions and 2 controls. The test conditions varied along 3 parameters: semantic cues, syntactic cues and quantity differences. In testing for Q1 and Pred (1), subjects were given semantic cues (objects vs. substances) in the absence of syntactic cues (using *the* as determiner). This was contrasted with syntactic cues (*a* vs. *some* etc.) in the absence of semantic cues (beans). Quantities were in accord with the relevant cue that was present. In

the semantic condition, "the garn" referred to a single object or a test-tube of liquid. In the syntactic condition, "a garn" referred to a single bean, "some garn" referred to a group of beans.

For the quantity condition, "the garn" referred to a single bean (count) or a group of beans (mass). Semantics and quantity in conflict was was similar to the semantics alone condition above except that when object stimuli were used, "the garn" referred to a group rather than an individual.

In each of the four conditions there were 4 items. Two of these had potential cues for count subcategorization and two for mass. In most respects presentation was identical to experiment IV. However, it was necessary to provide a situation in which use of the definite article was pragmatically appropriate. Therefore, pairs of items were presented together thus providing a contrastive sense for the definite reference as in the following:

E: This is *the* garn (pointing) and this is *the* turp (pointing)

Item pairs were also used for *a/some* in the syntactic condition, even though it was not necessary on pragmatic grounds. This was simply to maintain a similar mode of presentation across conditions. For sentence completion, items were isolated from the pairs:

E: Over here we have the garn, and over there we have more ...

Again, a plural completion (more garn*s*) was taken to indicate count subcategorization and non-plural (more garn), mass subcategorization. Prior to the completion, the child was asked to repeat the nonsense word in the uninflected form. As in the last experiment, water in test-tubes and pennies were used as controls. This time however, their names were modified by *the* (i.e., *the water/the penny*).

For half the subjects main test items using object/substance stimuli were presented first, and those using beans were presented last. For the other half, this order was reversed. Within these partitions order of presentation was randomized in four predetermined sequences. The *water/penny* control condition was presented directly prior to conditions with object/substance stimuli. All subjects began the task with training for pluralization using flash cards (see expt IV). Groups of subjects assigned to the various orders were balanced for age and sex. Subjects were eliminated from the analysis if: (i) they failed to reach criterion in the training phase, (ii) their completions for *water* or *penny* were in the wrong form (± plural).

As in the previous task, the experiment was designed in the form of a game in which Mickey-the-Martian was to teach subjects the names of some of the things he had brought from Mars. For the beans, subjects were told that they were "Martian food" thus establishing their function with respect to ability to be ground up etc.

Results

A total of five subjects were eliminated on the basis of failing to reach criterion on the training phase. Another subjects was eliminated for pluralizing *water* in the control condition. Otherwise, there were a total of 39 subjects included in the analysis. For purposes of age-trend analysis, subjects were divided into two groups. The younger group contained 19 subjects ranging from 3;0 to 4;5. The older group of 20 ranged from 4;6 to 5;11.

In reporting the data, we shall follow the format of the questions and predictions laid out in the introduction. The first question was addressed to whether children could use semantic cues in the absence of syntactic ones. The first prediction proposed that the efficacy of semantic cues alone would be inferior to that of syntactic cues alone. The results for the semantic and syntactic conditions are shown in figs 3.7 and 3.8 respectively.

Fig 3.7 Response Patterns for Semantics Alone Condition
Younger vs Older Subjects

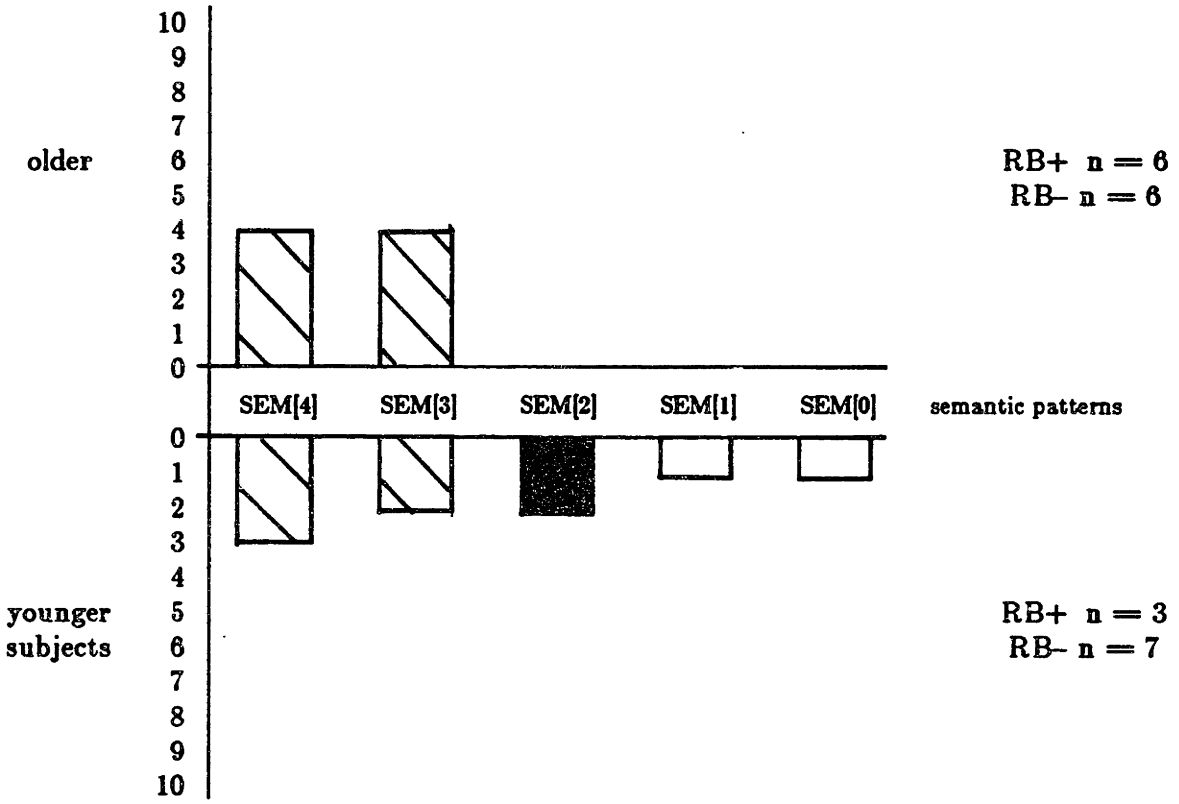
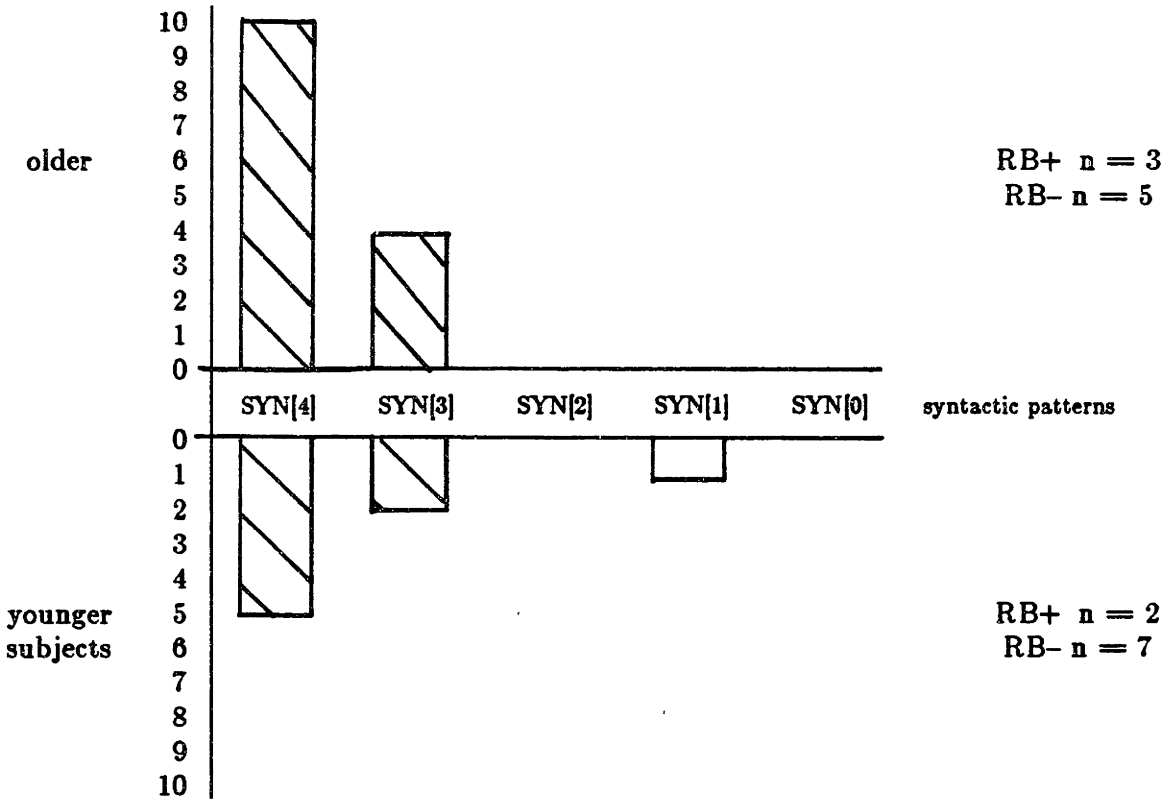


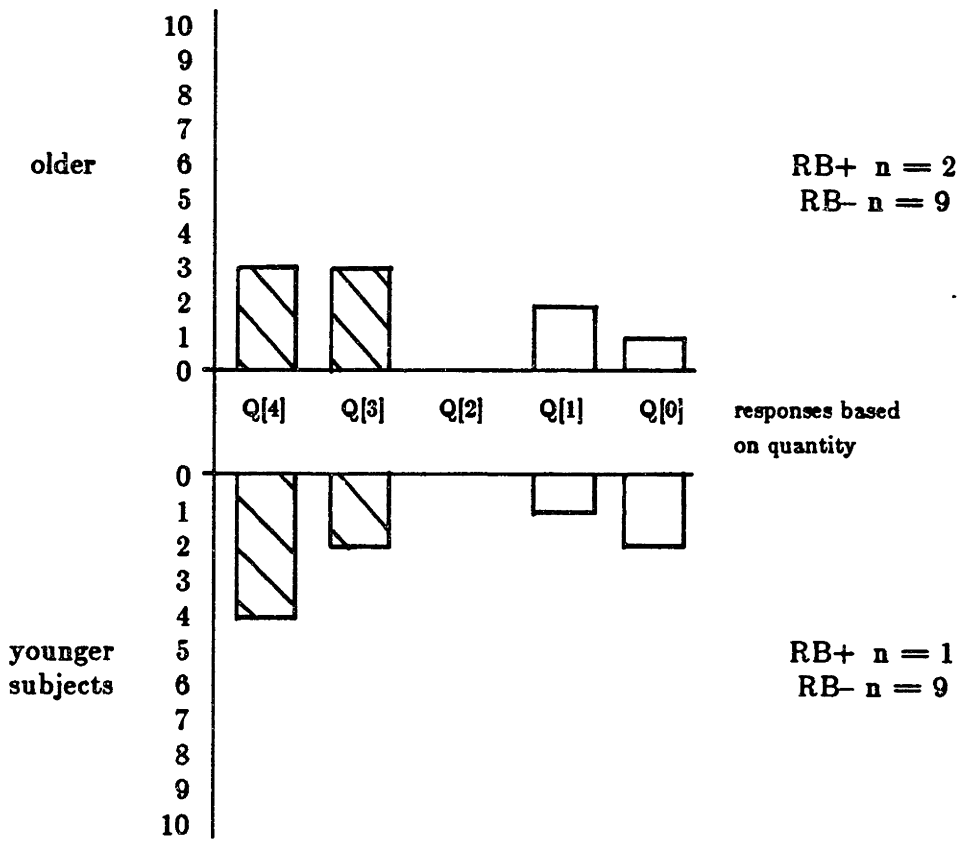
Fig 3.8 Response Patterns for Syntax Alone Condition
Younger vs Older Subjects



Response patterns are coded in the same manner as experiment IV: SEM[4] ... SEM[0] for the semantics condition and SYN[4] ... SYN[0] for the syntax condition. Upper graphs represent scores for older subjects and lower, inverted graphs represent scores for younger subjects. As one might expect, subjects were able to employ semantic cues as a basis for category assignment. The pattern in fig 3.7 shows a significant bias toward SEM[4] and SEM[3] patterns ($\chi^2 = 12.1$, $p < .005$). In the syntactic condition, the trend also showed a significant bias favoring syntactic patterns ($\chi^2 = 33.8$, $p < .001$). Comparing the two graphs, it is clear that the syntactic condition produced more patterns consistent with the relevant cues and that there was more polarization toward fully syntactic patterns (SYN[4]) than to fully semantic patterns (SEM[4]). The difference between the distributions did not quite reach significance (McNemar, $p = .07$).

The second question was addressed to the issue of whether children could use differences in quantities as the only cue for subcategorization. The prediction was that if such cues were effective, they would not be as effective as syntactic ones. The relevant data for the quantity condition are shown in fig 3.9. Again,there was a significant bias favoring responses based on quantity cues ($\chi^2 = 9.77$, $p < .01$). While this result suggests that children are indeed sensitive to the fact that differences in quantity can signal noun subcategorization, the distributions are much less clear-cut than those for semantics and syntax. For example, there are a substantial number of patterns in opposition to those predicted. The fact that there is no reason to expect such patterns, suggests that there is a fair amount of random responding in this condition. In regard to the prediction of superiority of syntactic cues, it was found that subjects responded consistently with the relevant cues to a significantly greater extent in the syntax condition than in the quantity condition (McNemar, $p < .05$).

Fig 3.9 Response Patterns for Quantity Alone Condition
Younger vs Older Subjects



The final question concerned the effects of quantity being in conflict with semantic cues when object stimuli are used. The graph for the semantics-alone condition is reproduced in fig 3.10 for comparison with that for the semantics vs. quantity condition in fig 3.11. While the two distributions did not differ significantly (McNemar, p = .25), it can be seen that the main effect was with the older group. The effect of conflicting quantity should show up in a tendency for subjects to produce non-plural rather than plural completions for object stimuli since these were presented as a group and were referred to as: "the garn" (c.f., "the furniture"). As the substance stimuli are also predicted to produce non-plural completions (independent of quantities), then the effect of conflicting quantities should show up as an increase in non-plural "response biases" (RB-) - perhaps an inappropriate name in this case.

RB- patterns were doubled for the older group when there were conflicting quantity cues (McNemar, p = .08) whereas for the younger group, the number was slightly less. This age difference is somewhat surprising since there was no evidence in fig 3.9 for the quantity alone condition that older subjects were more sensitive than younger ones to quantity as a cue. Neither was there evidence that semantics was any less of a cue for the older subjects (c.f., fig 3.10).

As for prediction (3) concerning the relative effects of a conflict in quantity with those for a conflict in syntax with semantics, one is required to recall the results froms experiment IV. In that study, it was shown that when semantics and syntax were in conflict, subjects almost never subcategorized fully on the basis of semantic properties (only two approached such a pattern). While there was a decrement for the older subjects in the semantics vs. quantity conflict condition (fig 3.11), in general the distribution still showed a bias in favor of semantic patterns (binomial, p = .01) and furthermore did not differ significantly from the semantics-alone condition (fig 3.10) in which there was no conflict (McNemar, p = .25). Clearly then, the results from the previous experiment cannot simply

Fig 3.10 Response Patterns for Semantics Alone Condition
Younger vs Older Subjects *(= fig 3.7)*

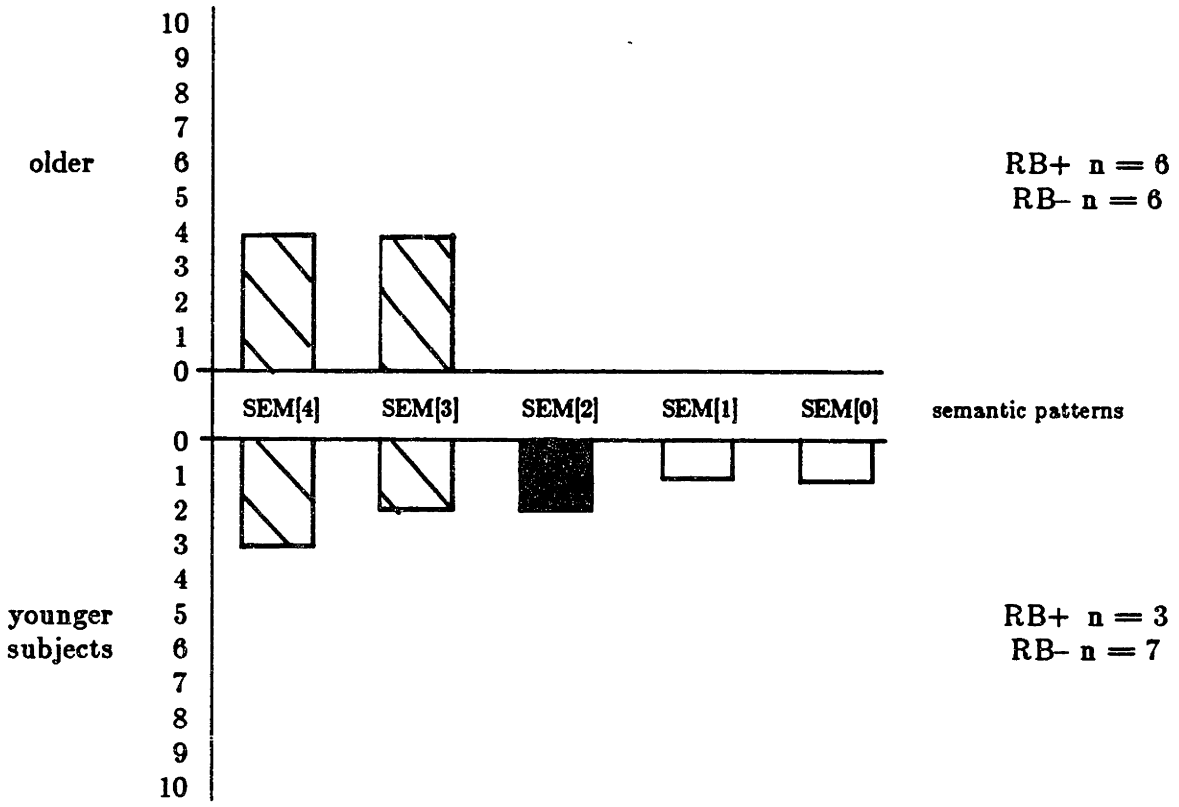
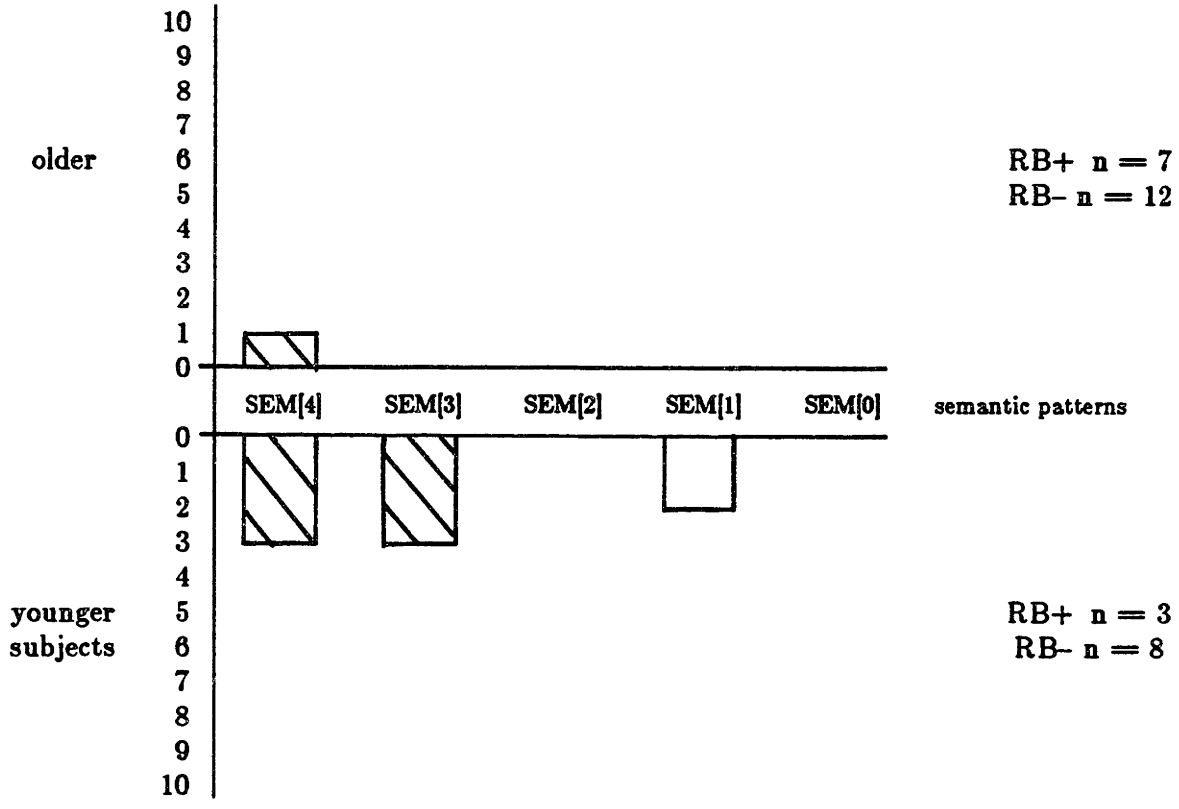


Fig 3.11 Response Patterns for Semantics vs. Quantity Conflict Condition Younger vs Older Subjects



be explained in terms of quantity differences. The fact that there was a difference in the number of objects referred to in the accord and conflict conditions, appears to be of little significance. In other words, the child's subcategorization was a function of the selectional properties of the determiners.

Discussion

In this experiment we were not concerned with whether the count/mass distinction is semantic or syntactic for the child, but rather we were investigating the relative efficacy of each of the possible cues in isolation. It was found that semantic cues alone were effective in determining noun subcategorization for many of the subjects, but not as effective as syntactic cues. This further supports the claim that the distinction, while not being exclusively syntactic, is essentially syntactic. Thus, while subjects can use semantic cues to determine subcategorization, the associated semantic properties are not as reliable a source as the form of the linguistic context. It was suggested in the last chapter that semantic properties may play some kind of supportive role that is, in a sense, parasitic on the syntactic cues. Such an interpretation was proposed when it was shown that subjects did produce more consistent patterns when there was no conflict between the semantic and syntactic cues. The fact that we have shown that semantic cues can be used (see Brown 1957 also), one might well expect that the child's ability to subcategorize would be improved if the natural discreteness of the referent more closely matched the mode of quantification.

Another finding was that even quite young children are able to use differences in quantity as a basis for subcategorization. The contrasts involved here were really quite subtle and although the patterns were not completely unambiguous, it is somewhat surprising that there was any trend at all. I suspect that there are many more aspects to such cues that have not really been tapped to a significant extent in this study. In trying to stick close to the ground on the basic issues of category development, we are in many ways ignoring

quite interesting questions that deal with the interaction of categorization and quantification. Such issues no doubt feed into the whole question of the representation of hierarchical concepts and whether such concepts in children allow for individuated reference. For example, Ellen Markman (unpub) has recently proposed that mass superordinates such as *furniture* are structured conceptually in a way that is easier for the child to represent than regular count superordinates such as *toy*. This is further related to her studies showing that collective nouns such as *family* are also more easily represented than count superordinates (c.f., Markman, Horton & McLanahan 1980, Markman in press; see also Macnamara 1982 for a discussion individual reference with superordinate terms).

In general, the picture that has emerged from the first two experiments in this chapter is that count/mass categories are essentially syntactic for the child, in the sense that subcategorization is determined on the basis of the linguistic context. While other cues do play a role, they cannot be considered to be as critical as that of syntax. It is unfortunate that in trying to imitate the word learning situation and test for all the various hypotheses, it is necessary to create such artificial conditions. While quite clear results have emerged from this process, we have been forced to ignore substantial numbers of subjects who produced response biases which, for our purposes, are quite uninterpretable. In the tasks, we have required subjects to subcategorize very large numbers of nouns almost instantaneously. We may safely assume that the natural word learning task is neither so brief, nor so demanding. Therefore it would be desirable to confirm the present conclusions for nouns that have been acquired in a more congenial manner. This will be the purpose of the next experiment.

Experiment VI

Subcategorization of Real Words: Semantic or Syntactic?

Introduction

In the introduction of this chapter it was asserted that a category is semantically based (for the child) if the rules invoked by the categorization were written over semantic types rather than syntactic categories per se. We have taken "semantic types" to be sets of terms whose referents share certain intrinsic properties. In particular, we have taken the semantic encoding of the count/mass distinction to be a claim that the subcategorization and selection rules invoking the count/mass distinction are written over the semantic types: *object* vs *substance* rather than the properly formally defined categories.

In determining whether a category was, in fact, semantically based, two conditions were postulated that should hold if this were the case. The first condition stated that assignment of new words to a particular category should be on the basis of the intrinsic semantic properties as defined above, rather than its syntactic distribution. Experiments IV and V were a direct test of this condition. The results have shown that the condition does not hold. Rather, children overwhelmingly assign nouns to the relevant subcategories on the basis of syntactic context.

The second condition stated that the set of terms in a particular category should be restricted to only those exhibiting the appropriate semantic properties as prescribed in the semantic definition of the category. In the case of the count/mass distinction, it should be the case that the set of count nouns should be restricted to those denoting *objects*. The set of mass nouns should be restricted to those denoting *substances*.

In testing the first condition it was necessary to employ words that the child would not know (i.e., nonsense words), and a note of caution was necessary in the interpretation of results from an artificial word-learning task. In testing the second condition, we are interested in how the child has categorized words that she has already learned in the course of acquisition, and therefore such problems do not arise.

It was noted in the introductory chapter that there are a certain number of exceptions to the semantic correspondence for the count/mass distinction. For example, a number of superordinate terms such as *furniture, silverware, jewelry, equipment* etc. denote classes of objects and yet they are syntactically categorized as mass nouns. If the child had semantically based categories, it would be predicted that such nouns should be miscategorized as count nouns. Similarly, it was noted that certain food terms are underdetermined with respect to their semantic properties. That is, they could either be construed as discrete objects or non-discrete, edible stuff. As a consequence, one finds that food terms tend to be subcategorized on a fairly arbitrary basis with respect to semantic properties. For example, *carrot* is a count noun, whereas *celery* is a mass noun. If the child were attempting to categorize such terms on a semantic basis, it seems unlikely that he could determine which subcategory the noun belonged to and one would thus expect errors of miscategorization.

The focus of the present experiment will be on the above two cases. That is, we shall examine whether children tend to miscategorize nouns where the semantic properties are either inappropriate or underdetermined with respect to count/mass subcategorization. This, in effect, will test the second condition postulating a restriction on the set of nouns in the count/mass categories to only those exhibiting the appropriate semantic properties.

Method

Subjects

Subjects included 40 children age: 1;11 to 5;9. There were 10 subjects at each of the ages: 2, 3, 4 and 5 (one subject who was 1;11 was included with the 2-year-olds). All were native speakers of English, most were from middle class families.

Materials

Materials included a series of small stores about 5" x 7" x 4" made of cardboard with windows in front exhibiting the wares. The kinds of stores included: Furniture, Silverware, Jewelry, Toy, Flower and Pet stores. A larger food store had a removable front with detailed counters, shelves and boxes of food inside. The boxes of food contained small toy food made from plasticine. The food included: carrots, celery, onions, lettuce, beans and rice. Also of relevance was a counter with varieties of miniature fruit (apples, pears, pineapples, bananas etc.). A series of flash cards was used for training sessions which had pictures of machines on them. The machines included: Coffee, Juice, Lemonade, Milk, Gumball, Cookie, Sandwich and Peanut machines. A small Paddington Bear was used as the subject of the story. For the pre-test, a series of eight picture cards were drawn which were divided into quadrants with one picture in each quadrant. The target pictures were of the nouns to be tested: *furniture, silverware, jewelry, toys, flowers, pets, carrots, celery, onions, lettuce, beans* and *rice*. Each card contained two target pictures and two distractors. The distractors included: paint-roller, electrical socket, paper-clip, filing cabinet, spatula, garden hose, oven ring, cassette recorder, wool, metal nut, door latch, spray can, pen top and accordion.

Procedure

The present test was in four sections: (1) Pretest, (2) Training, (3) Stores, (4) Food. The main sections of the test (stores and food) were an examination of whether children tend to miscategorize nouns if the semantic properties were either inappropriate or indeterminate. The nouns tested with inappropriate semantic properties included: *Furniture, Silverware* and *Jewelry.* These are all superordinates categorized as mass nouns whose referents are classes of objects. In contrast, count noun superordinates were also tested. These included: *Toy, Pet* and *Flower.* As the latter group exhibit appropriate properties for subcategorization it would be predicted that if subjects' count/mass categories were semantically based, the mass nouns should be categorized as count nouns, whereas the count nouns should receive the correct subcategorization.

Nouns tested with indeterminate semantic properties included food terms. These were chosen in pairs whose perceptual and functional properties were very similar, but whose subcategorization was opposed (i.e., one was count and the other mass). The count and mass pairs were, respectively: *vegetable/bean, carrot/celery, onion/lettuce, bean/rice.* Again, if subjects were categorizing on a semantic basis, then there should be many miscategorizations and one would not predict any clear differentiation of subcategories between the members of the chosen pairs.

The procedure for testing subcategorization required that nouns be presented in identical linguistic and non-linguistic contexts. This is a problem when both count and mass nouns are used, as they tend to take different determiners or appear as plural or non-plural forms. Even when *the* is used as a determiner, this requires differences in quantity, as noted in the previous experiment. The problem of finding identical contexts can be solved by using nouns in compounds. Store names were chosen for the test. Thus, *the furniture store* (mass) and *the toy store* (count) allow for identical linguistic and non-linguistic contexts. Most of

the food terms were compounded with *-box*, e.g., *the carrot box* vs. *the celery box*. *Fruit* and *Vegetable* however, were compounded with *-section* (i.e., *fruit section* vs. *vegetable section*).

The test for subcategorization involved asking the child:

Q: What do you get in a toy/furniture store?

ANS: Toy*s*/Furniture

In other words, the child's categorization was ascertained on the basis of whether he pluralized the noun in response. Some subjects gave singular responses but using an indefinite article:

Q: What's in the carrot box?

ANS: A carrot

While such responses were inappropriate for plural reference, they were taken to indicate count noun subcategorization.

Before receiving the main test items, subjects were given a training session with pictures of various machines. These included a lemonade machine, a gumball machine etc. (see Materials section). The names of the machines included four count nouns and four mass nouns. The subject was shown the picture of the machine and was told:

E: This is a (gumball) machine. What do you get in a (gumball) machine?

ANS: (Gumballs)

Subjects were given all eight items prior to testing on the main items in order to get them familiarized with the general procedure. If there was any hesitancy or irrelevant responding, the subject was encouraged to provide an appropriate response.

The context for testing the main items involved a story with a toy Paddington Bear. Subjects were told that Paddington had to go to the food store to get some food. A series of

small stores were lined up in front of the subjects with the food store at the end, thus requiring that Paddington pass all of the other stores on the way. As he passed each store, the subjects was told:

E: ... next he came to a (flower) store

Do you know what you get in a (flower) store?

ANS: (Flowers)

There were six stores with the names of the superordinates to be tested (3 mass, 3 count). The seventh store was a food store whose front lifted away, revealing various food items. On entering the food store, the child as shown the "fruit section" and the "vegetable section" and was asked for each of these: "What do they have in the *fruit/vegetable* section (ANS: *fruit/vegetables*). Next the subject was shown a series of boxes containing the relevant food items to be tested (carrots, celery etc.). For each of the food items, the subject was tested in a similar manner.

As stated previously, the purpose of the present experiment was to test words that children had already acquired. Considering the age range started at 1;11, it was necessary to determine whether subjects actually knew the words to be tested. Therefore a pre-test was administered. This involved showing subjects a card containing four pictures, one of which was of the probe noun which children were asked to point to. Most subjects were given the pre-test about a week before testing on the main experiment. However, for some it was necessary to give the pretest in the same session.

To summarize, there were four sections to the test: Pre-test, Training, Stores and Food. Conditions were always presented in this order, but within each condition, items were presented in one of four predetermined random sequences. On the main items evidence of count subcategorization was indicated by either a plural on the noun or use of *a* as determiner. Mass subcategorization was indicated by non-pluralization with no determiner.

Results

It was proposed that on the semantic account, children should tend to miscategorize nouns whose semantic properties were no in accord with the semantic definition of the count/mass distinction (viz *objects* vs *substances*). One should therefore find the highest error rates among the mass noun superordinates in the stores section. For food items there should also be high error rates due to the indeterminate nature of their semantic properties along the relevant dimensions. In both cases, error rates should be considerably higher than those for count noun superordinates whose subcategorization is appropriate to their semantic properties.

Alternatively, if children base their categorization on the syntactic contexts in which a noun has been heard, then there should be relatively few errors in any of the cases with no differences between nouns that are appropriately or inappropriately subcategorized by semantic criteria. After discarding non-responses, irrelevant responses and those items where children failed to choose the correct picture on the pretest, the error rate was calculated as the number of errors divided by the number of non-discarded responses (i.e., errors + correct responses). Failures on the pre-test were restricted to two-year-olds (58%) and three-year-olds (13%). Table 3.1 shows the error rates for the stores and food items with count and mass separated. In parentheses, the absolute error values are given. Overall, the picture is not one of rampant miscategorization for items with inappropriate semantic properties (stores - mass) or indeterminate semantic properties (food - count & mass). In fact the error rates indicate an average of half an error per child over the ten items (not including discarded responses).

For the mass superordinates, there is a higher error rate for the two-year-old group (.22) but this figure is somewhat misleading since 70% of the responses in this condition were discarded and the absolute figure is only 2 errors: one more than for count superordi-

Table 3.1 Error Rates in Stores and Food Test

Age Group	STORES Mass		STORES Count		FOOD Mass		FOOD Count	
2 yrs.	.22	(2)	.06	(1)	0	(0)	.28	(7)
3 yrs.	0	(0)	0	(0)	.06	(2)	.06	(2)
4 yrs.	.14	(4)	.10	(3)	.02	(1)	.07	(3)
5 yrs.	0	(0)	0	(0)	.10	(4)	.02	(1)
TOTAL	.07	(5)	.04	(4)	.05	(7)	.09	(13)

*Absolute errors in parentheses

nates. Furthermore, both errors were from the same child who did not actually pluralize nouns, but rather, used *a* as the determiner (i.e., **a furniture* and **a silverware*). In fact, he used *a* for most of his responses. What is particularly revealing is that he also used *a* in the training phase with the machines, producing: **a coffee, *a juice* and **a milk*. Thus, while the appearance is that mass superordinates result in more errors that count superordinates for two-year-olds, the difference is negligible in absolute terms and is clearly not the result of a semantic strategy, since *coffee, juice* and *milk* are all names of substances. It appears then, that the one subject who made the errors, really had no restrictions on the use of *a*. In such a case, it is not at all clear that inappropriate usage really constitutes evidence for miscategorization of the noun.

In general, the results for the two-year-olds are difficult to evaluate since there was such a high attrition rate. This was particularly true for the mass superordinates (70%) which may in itself suggest problems with this class. In fact the attrition rate was highest for this class right up until the four-year-old group. However, it is first of all not clear why, on a semantic account, subjects should simply not be able to respond to this class (or fail the pre-test) rather than miscategorize them. Secondly, an alternative explanation may be found in the fact that the mass superordinates were generally of lower frequency, except for *furniture* which is a relatively frequent word. A Spearman Rank Correlation of attrition rate with frequency (Kucera & Francis 1967) for the count and mass superordinates revealed very high significant values ($r = .94$, $p = .01$). In other words, low frequency items such as *jewelry* had high attrition rates, but *furniture* did not. Thus, it does not seem that children failed to respond to mass superordinates because of their inappropriate subcategorization, but rather they either did not know the words or did not know them very well. [19]

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[19] We shall assume that the attrition due to failing the pre-test was due to the child not knowing the word. This constituted the main chunk of the failures. Further attrition, may be due to the fact that while subjects did know the words in comprehension, they may have been unpracticed and thus difficult to produce in speech.

One other result that is of some consequence concerns the error rate for two-year-olds with count nouns food terms (28%). The appropriate items were: *carrot, onion* and *bean*. The error rate for two-year-olds is significantly higher than for three-year-olds (Fisher, $p < .015$), but not significantly higher than their errors for count superordinates: *toy, flower, pet* (McNemar, $p = .2$). As the subjects in this group were very young, it is likely that the explanation lies at the morphological level in that absence of plurals probably reflects early telegraphic speech rather than actual miscategorizations per se. It will be recalled that errors of underpluralization were quite common in the speech samples from chapter I and, like in this study, those of overpluralization were extremely rare. Such facts all add up to an account based on complexity at a morphological level.

The only other clustering of errors occurs within the four-year-olds who made 4/28 (14%) errors on mass superordinates and 3/30 (10%) on count superordinates. Again, the question here is not one of miscategorization since the two rates did not differ significantly (McNemar, $p = .7$). Why the rate should be higher than for, say, the three-year-olds is at present inexplicable.

Summary

In examining the semantic account of the development of the count/mass categories, we tested whether nouns whose semantic properties are either inappropriate or underdetermined are likely to be miscategorized when compared to nouns with semantic properties that are in accord with the semantic characterization of the distinction. While there were a few idiosyncratic differences in the data, it was shown that they could best be accounted for by explanations that were independent of subcategorization. Thus, when it was possible to obtain responses from subjects, even for the youngest ones, the responses were indicative of a correct subcategorization for nouns, irrespective of whether the semantic properties were

appropriate or inappropriate.

The present result therefore conforms to the general picture obtained from the previous two experiments. Within the conditions laid out at the beginning of this chapter, the semantic account has in all cases shown to be inaccurate in predicting the outcomes of experiments. The advantages of the present study are that we were not constrained to present the child with an artificial, overdemanding task. Rather, the task was really very easy and involved real, rather than nonsense words. The fact that we were able to test subjects at such a young age, allows us to make at least tentative inferences about developmental processes that would normally only be possible by using longitudinal data. While the data for the youngest subjects were not always clear-cut, the general message was clear: they seem to do very well in subcategorizing nouns without the aid of semantic properties.

In the next chapter we shall attempt to reconcile the findings of the present chapter with evidence from spontaneous speech samples. Again, the semantic and syntactic hypotheses will be tested against an analysis of distributional properties of various count and mass nouns in the corpora examined in chapter I.

Chapter IV

Evidence for Semantic vs Syntactic Categories in Free Speech

Introduction

In the previous chapter we experimentally tested the hypothesis that children's early count/mass categories are semantic in the sense of invoking a direct correspondence to the dichotomy between objects and substances. This semantic hypothesis was contrasted to the view that such a correspondence is not induced as a basis for representation of the distinction. It was, however, pointed out that neither of these hypotheses necessitates total exclusion of an analysis by the child of either formal or semantic properties. That is, if categories were semantic, they would still be required to play a role in the formal rules specifying the category (e.g., to determine certain co-occurence restrictions), and conversely, formal categories may still induce semantic consequences. It is the question of what is the essential basis for the count/mass distinction that is of interest in detailing the epistemological status of these categories in early development.

From the experimental evidence, we have found quite strong support for the view that there is no semantically based representation of the sort outlined above that supercedes a formal description of such early categories. Rather, assignment of a noun to either subcategory appears to be essentially contingent on it's distributional properties with respect to use with certain sets of determiners and plurals.

We began this thesis with an analysis of the development of the count/mass distinction from observations of developing distributional distinctions in the speech corpora of two children aged 1;9 to 3;6 (SM) and 2;2 to 3;5 (HS). That analysis was essentially devoid of semantic considerations. We were mainly interested in how the speech samples showed divergence in constructional use of what we take, in the adult language, to be count and

mass nouns. (Needless to say, attributing an equivalent categorization to the child is by no means justified). We were not therefore directly concerned with the questions raised in the previous chapter. In a sense, free speech samples are well suited for strict distributional analyses, however they are certainly less than well constructed for testing hypotheses concerning semantic influences. This problem is further confounded by the fact that the particular corpus we are using contains very sparse non-linguistic contextual information. Despite these drawbacks, we are obliged to examine the corpora for either supporting evidence for our current conclusions, or detrimental evidence that might serve to falsify them.

Analysis of the Corpora

It will be recalled that there were two kinds of rules examined in chapter I:

[1] Restrictions on the use of determiners and plurals with either count or mass nouns.

[2] The development of rules making determiners obligatory for singular count nouns.

For the first set of rules, it was found that the relevant early occuring functors were of the kind selecting or requiring count nouns. That is, *a, another*, numerals and plurals may not be used with mass nouns (ceteris paribus). It was found that errors for these functors were quite rare and showed a surprisingly early development for the restrictions. The first part of the present analysis will be an examination of the errors that do occur with these functors in use with mass nouns (e.g., **a sand*). The strategy for the analysis will be to classify mass nouns along semantic dimensions and to determine whether or not errors occur as a function of semantic properties thus supporting a semantic account of the distinction.

The second strategy will start by an examination of when count nouns begin to be used with determiners obligatorily (see [2] above). A determination will be made as to whether this development differs according to semantic type. This will be followed by an examination of whether *a, another,* numerals and plurals are also restricted to semantic types in their early use with count nouns.

Mass Nouns

In acquiring the mass noun subcategory the child is learning that this particular class of nouns cannot co-occur with certain functors (e.g., *a, another* etc.). Since these functors semantically indicate individuated quantification, we are equivalently saying that the child learns that a certain subset of nouns may not be quantified by individuation (assuming proper identification of the semantic functions of these morphemes). These would seem to be minimal requirements of any reasonable theory. A divergence of opinion emerges in the following form:

Semantic Hypothesis

The set of "mass" nouns is induced over common referential properties such as having unbounded form, ability to coalesce and so on. These properties thus become criterial attributes for assignment to the mass noun subcategory and, consequently, for preventing use with functors that require individuated quantification.

Syntactic-Distributional Hypothesis

The set of "mass nouns is induced over the set of linguistic contexts shared by a subset of the nouns (i.e., not occuring with plurals etc.). Referential attributes of nouns are not criterial in their assignment to subcategories. However, the fact that the contexts share

a common semantic function may, a fortiori, help to distinguish those contexts as criterial.

The last point, reiterated here from the introduction, says that a common semantic function (individuation) for the relevant linguistic contexts may be useful or even necessary for determining which are the relevant contexts distinguishing mass from count nouns. This does not imply an interaction of that function with the intrinsic semantic properties of the nouns themselves (viz being an object or substance).

The two statements above resemble those put forth in Chapter III as criteria for deciding whether the categories should be considered semantic or syntactic in the child's representation. The further consideration in the present chapter concerns origins. That is, what does the primary induction procedure look like rather than simply, what is the nature of the established representation.

The Semantic Properties of Mass Nouns in Early Utterances

It has become common to argue that the child's early lexicon is restricted in content for reasons of categorizability. For example Pinker (1983), Macnamara (1982) and others have claimed that children initially only learn nouns that conform to the semantic criterion of being a "Person, Place or Thing". It is not appropriate to argue the validity of this claim here, however we shall borrow the methodology as a means of determining whether there is support for a semantic account by virtue of the constitution of the set of early mass nouns. Minimally, the semantic account would require that a large proportion of mass nouns used by the child conform to the semantic criterion of denoting some substance-like material. If this were not the case, then there would be little basis for the relevant semantic induction over referential properties (i.e., having unbounded form etc.). If this criterion were met, then there would be a basis for the semantic claim, but clearly no evidence against an alternative, formal account.

Semantic Types in Early Mass Nouns

All mass nouns used by SM and HS were grouped into one of six semantic classes. The classes were chosen to reflect the major dimensions considered to be relevant to the child's possible semantic induction. It should be noted that the final choices were by no means clear-cut and may well be open to criticism regarding their appropriateness. They are ordered somewhat to reflect a progression from the prototypical substance class (fluids) to the least substance-like (abstract). A good inductive base would thus require significant clustering of mass nouns among the prototypical classes. The classes and their members are listed in table 4.1.

Fluids (F) and Solids (S) are fairly self-explanatory, both have the property of coalescence, but solids unlike fluids do have bounded, though not necessarily permanent, form (e.g., playdo). Clusters (C) are perhaps the hardest to characterize since they are somewhat ambiguous with respect to the relevant semantic dimensions. For example, it is not clear whether *garbage* denotes a set of individual things or an undifferentiated mass. The Grind/Object (G/O) class includes mostly solid food items plus a few others such as soap. The underlying property here is that the nouns denote objects with bounded, characteristic form, yet such form becomes mutilated in functional use (i.e., the objects are ground or chewed up). This class has been exploited previously in Expt.VI as being ambiguous as to the appropriate semantic categorization. The fact that count/mass subcategorization exhibits considerable cross-linguistic variation for this class further suggests that categorization would not immediately fall out from considerations of semantic properties independent of the use of the nouns within linguisic contexts.

The Object class (O) consists of the least substance-like concrete nouns that have all the properties associated with prototypical count nouns (e.g., furniture). This class was also employed in Expt. VI. The final class consists of the Abstract (A) nouns, not possessing any

Table4.1 Mass Noun Semantic Types Found in Corpora

FLUIDS (F)	FLUIDS (F)	GRIND/ OBJECTS (G/O)	CLUSTERS (C)
butter	polish	asparagus	garbage
beer	pepper	bologna	grass
broth	porridge	bread	hay
cream	rain	bacon	hair
coffee	sugar	beef	
catsup	syrup	candy	**OBJECT (O)**
cinnamon	sauce	chocolate	
grease	sand	cereal	furniture
gas	soup	celery	mail
glue	snow	fruit	money
honey	salt	food	silverware
ice cream	shampoo	gingerbread	underwear
jam	tea	grain	
jelly	water	gum	**ABSTRACT (A)**
jello	wine	ham	
juice		liver	company
milk	**SOLIDS (S)**	liquorice	football
mayonaise	paper	lettuce	heat (?)
medecine	plastic	rice	music
calcium	yarn	soap	room
ovaltine	clay	spinach	traffic
oil	playdo	salami	tennis
		spaghetti	
		toast	
		turkey	

concrete form and thus not being candidates for either mass or count nouns according to a semantic hypothesis. (On a more global semantic account they are not even candidates for the general noun category).

The occurence rate in tokens for each of these noun classes at each age sample is given in table 4.2a for SM and table 4.2b for HS. Values for types are shown in parentheses. While, in general, the Fluids (F) do constitute the largest class, the majority is by no means overwhelming with the G/O class often exceeding it within sample-points. Furthermore, while the "anomalous" classes (O and A) are small in size (as they are in adult language), they are present at the earliest samples for SM and the second samples for HS.

In general, the distribution of semantic types clearly contradicts any possible claim that the child only uses mass nouns that are substance-like. Whether the fact that substance-like nouns do constitute a majority provides sufficient support for an inductive base is not clear, since there is no clear notion of what the semantic induction procedure looks like and what its requirements are. However, if we are to take the semantic account quite literally (i.e., that nouns get assigned to subcategories on the basis of whether they denote objects or substances), then there is no way that the child would be able to appropriately subcategorize nouns in the G/O, O and A classes. There is however, a prediction that there should be more errors of miscategorization for these nouns which will be tested in the next section.

Errors on Mass Nouns by Semantic Type

It will be recalled that errors on mass nouns employing count selective functors (*a*, *another*, numerals and plurals) were relatively rare compared to the proportion of use of these functors with count nouns (see Chapter I). They were so rare in fact, that they can be listed quite conveniently as they are in table 4.3a for SM and 4.3b for HS. Errors are listed

Table4.2a Number of Tokens (& Types) for Semantic Classes Over Age: SM

	1;11	2;2	2;5	2;7	2;9	3;1	3;6	TOTAL
Fluids	6 (6)	20 (4)	19 (6)	23 (10)	25 (9)	46 (10)	23 (8)	163
Solids	6 (2)	9 (2)	4 (2)	5 (1)	2 (1)	13 (2)	30 (2)	69
Clusters	1 (1)	5 (2)	2 (2)	1 (1)	-	5 (2)	-	14
Gr/Obj	3 (2)	28 (5)	19 (6)	26 (7)	25 (7)	21 (6)	12 (4)	133
Object	-	-	2 (2)	-	-	1 (1)	1 (1)	4
Abstract	1 (1)	2 (2)	-	1 (1)	-	1 (1)	2 (2)	7

Table4.2b Number of Tokens (& Types) for Semantic Classes Over Age: HS

	2;3	2;6	2;9	2;11	3;1	3;3	3;5	TOTAL
Fluids	13 (6)	13 (7)	26 (8)	38 (11)	63 (15)	51 (12)	8 (6)	212
Solids	1 (1)	2 (1)	2 (1)	2 (1)	1 (1)	10 (1)	2 (2)	20
Clusters	-	6 (2)	1 (1)	4 (1)	7 (1)	-	-	18
Gr/Obj	43 (8)	7 (5)	3 (1)	9 (6)	14 (8)	17 (6)	15 (4)	108
Object	-	1 (1)	1 (1)	2 (2)	1 (1)	-	-	5
Abstract	-	-	1 (1)	-	1 (1)	2 (1)	-	4

Table4.3a Mass Noun Errors: SM

	1;11	2;2	2;5	2;7	2;9	3;1	3;6
a [550]	cream (F)	meat (G/O) company (A)	coffee (F)	liver (G/O) playdo (S)	sand (F)	juice (F)	stuff (G/O))
another [18]		playdo					
numerals [35]		*playdo (S)		*soap (G/O))			
plural [496]		coffee (F) *playdo (S) playdo (S) food (G/O)	meat (G/O) silverware (O)	soup (F) *soap (G/O) traffic	juice (F) toast (G/O) toast (G/O)		

Table4.3b Mass Noun Errors: HS

	2;3	2;6	2;9	2;11	3;1	3;3	3;5
a [494]		playdo (S) hay (C		candy (G/O) food (G/O) furniture (O)	celery (G/O)		
another [18]							
numerals [35]	toast (G/O)				porridge (F)		
plural [496]							

by age sample (horizontaly) and by error type (verticaly). Those entries marked with an asterisk represent single errors on the determiner and plural (e.g., **two playdos*) thus being entered twice in the table. The letter in parentheses after the nouns represents the semantic class of that noun. The number in parentheses after the functors represents the total number of tokens for that functor in the child's corpus. Thus, for example, even the most frequent error of pluralisation by SM, represents only 12/494 (2.4%) of the use of plurals.

Comparing the two subjects, the immediate impression is that HS made many fewer errors than did SM. The bulk of this difference arises from the fact that HS never pluralised mass nouns, even though he used 285 plurals in speech. This fact alone suggests that he had a well constrained notion of mass noun from very early on that was playing a crucial role in determining the use of plurals. We saw in the last section that there was a considerable amount of diversity in the range of semantic types within the mass nouns used by HS. Given this fact, it would be very difficult to account for the well developed restriction on plurals by invoking semantic properties alone. That is to say, many of the mass nouns simply did not possess the right semantic properties (Grind/Object & Abstract), or else they had properties appropriate for count nouns (Object). Surely, if there was a semantic basis for the distinction one would expect some errors of pluralisatin to occur with these nouns.

The breakdown of errors by semantic types is given in table 4.4a (SM) and 4.4b (HS). Proportional values are given in the three columns to the left. These are broken down by whether the error was of the determiner or the plural with the combined error rate in the third column. Absolute values (no. of errors / no. of tokens in the class) are given in the fourth column (see below for "Proto. vs. Non-Proto"). On the bottom row, the comparable figures are given for the proportional use with count nouns. Thus, in assessing the level of error rate with mass nouns, one should compare with these figures.

Table4.4a Errors for Determiners and Plurals by Semantic Type: SM

	DET	PLUR	DET + PLUR	Absolute Error	Proto. vs Non-Proto.
Fluids	.03	.02	.05	8/232	.05
Solids	.04	.03	.06	4/69	
Clusters	-	-	-	0/14	
Gr/Obj	.022	.04	.05	7/133	.07
Object	-	.25	.25	1/4	
Abstract	.14	.14	.28	2/7	

Table4.4b Errors for Determiners and Plurals by Semantic Type: HS

	DET	PLUR	DET + PLUR	Absolute Error	Proto. vs Non-Proto.
Fluids	.005	-	.005	2/212	.008
Solids	.05	-	.05	1/20	
Clusters	.05	-	.05	1/18	
Gr/Obj	.04	-	.04	4/108	.04
Object	.2	-	.2	1/5	
Abstract	-	-	-	0/4	

A preliminary examination reveals an apparent effect of semantic type. That is, the error rate does, in general, appear to be lower for the fluids than for the other classes. One problem that we face with this comparison is that we are dealing, in many cases with very disproportionate numbers. For example, for SM and HS respectively, there are 163 and 212 Fluids, whereas there are only 4 and 5 Objects. It is not at all clear how to assess the significance of such comparisons One possible method is to group the classes by semantic prototypicality. Thus, if we group Fluids and Solids as prototypical and Grind/Object, Object and Abstract as non-prototypical, (leaving aside Clusters), the resulting comparisons are shown in the right-hand columns of tables 4.4a and b. χ^2 comparisons between prototypical and non-prototypical classes did approach significance for HS ($\chi^2 = 3.03$, $p < .1$) but there was no effect for SM ($\chi^2 = .191$, $p = .75$).

Returning to tables 4.4 a and b, it can be seen that in classes where there are a sufficiently large number of tokens available (say, $n > 20$), the general error rate is about .05. The major exception to this generalisation is the fluid class for HS which levels out to .005, one tenth of the average proportion for the other major classes. It is this factor that causes the near significant difference. In other respects, HS's data are very similar to those of SM in showing error rates of about .05 for the larger classes. In determining whether this difference indicates a semantic basis for the distinction for HS, we shall now turn to an examination of the use of the noun classes in other pertinent constructions.

Occurence in Mass Noun Contexts by Semantic Type

We are interested in determining whether the low error rates for the Fluids class indicates that mass nouns are in some way defined over the notion of substance. If this were the case then we would expect this class of nouns to also be the main ones that occured in linguistic contexts restricted to mass nouns. That is, we should expect to find more constructions of the kind: *some sand* (F) than *some celery* (G/O), since *celery* is not a

prototypical substance. Utilizing the prototypical (F + S) vs non-prototypical (G/O + O + A) groupings, mass nouns were coded for whether they occured in (i) Unselective contexts that could take either count or mass nouns (e.g., *the sand, my juice*); (ii) Null-determiner (non-plural) contexts (e.g., *give me sand*); (iii) Mass noun contexts (e.g., *some sand*) or (iv) Count noun contexts (e.g., **a juice, *sands*). Null-determiner contexts are seperated from mass noun contexts proper since the data from chapter I indicated that this context does not distinguish count from mass nouns until later in development.

The results of this analysis are illustrated graphically in fig. 4.1a for SM and fig. 4.1b for HS. The results for HS are of primary interest here since he did evidence a difference in the error rate for prototypical vs non-prototypical semantic types (as shown in the fourth columns). Inspecting the third columns for use in mass noun contexts, it is clear that the predictions are not borne out. In fact the opposite trend occurs: non-prototypical mass nouns occur in mass noun contexts more often than prototypical mass nouns (this difference was not significant: $\chi^2 = 1.81$, $p > .05$). This present finding thus fails to support the hypothesis that early mass nouns (for HS) are defined over the "substance" properties.

Why do we find a contradiction between this and the previous analysis? The answer may be found if we inspect the two figures of 4.1. Essentially, there are many significant differences between prototypical and non-prototypical mass nouns in their distributions. However, the differences go both ways and there is not even a single significant trend that survives a cross-subject comparison. Thus, while SM did not show the difference in error rates in the previous analysis, she does show a difference in the use of prototypical vs non-prototypical classes in strictly mass noun contexts (third columns). This result may also have been taken to indicate the semantic nature of the early categories had it not been for the fact that one also finds quite spurious significant differences elsewhere. Given the variety of mostly inexplicable effects here, it is hard to argue that one particular effect for one child indicates that the categories are semantic.

Fig4.1a Use of Prototypical vs Non-Prototypical Mass Nouns by Syntactic Contexts: SM

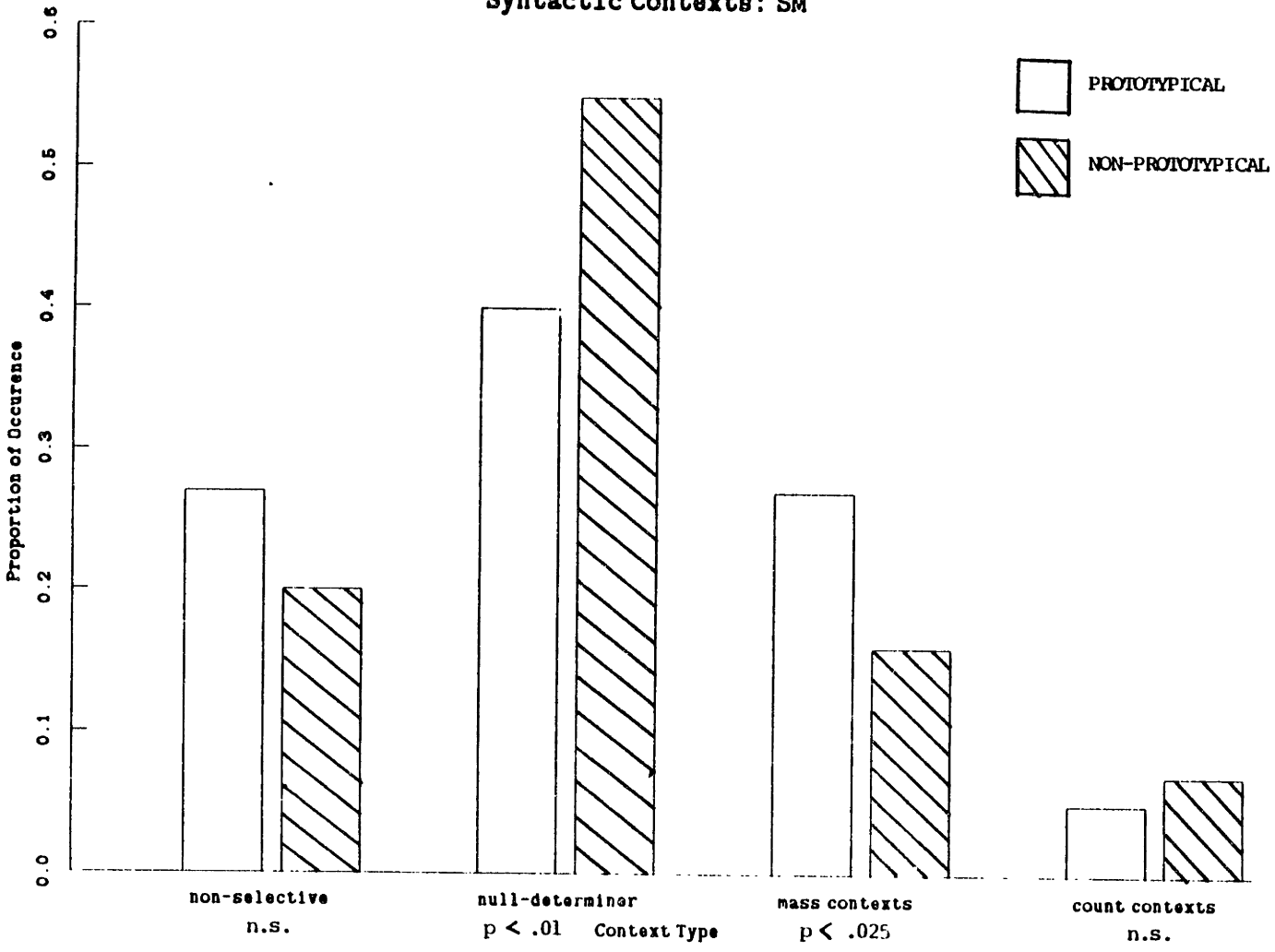
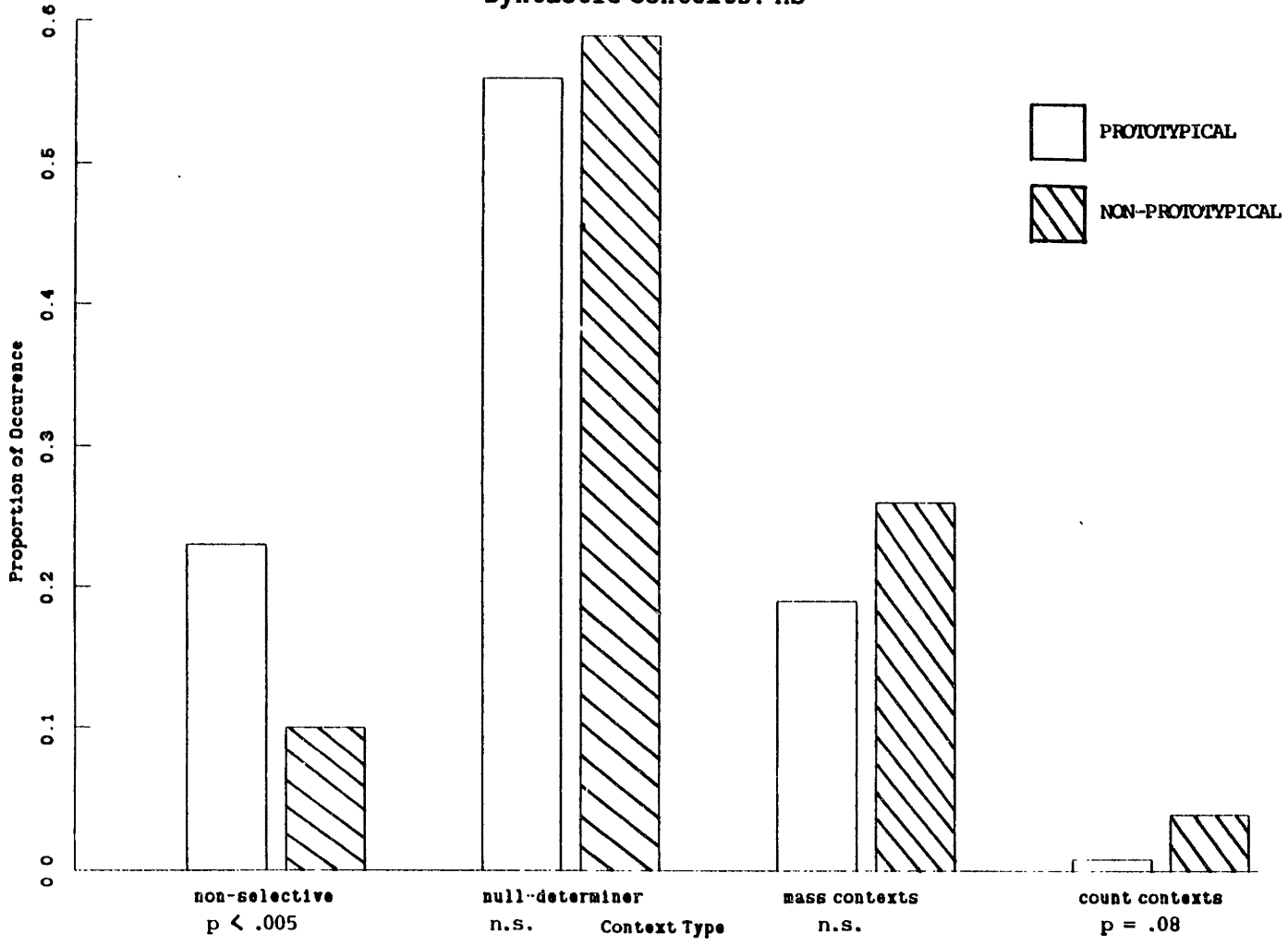


Fig4.1b Use of Prototypical vs Non-Prototypical Mass Nouns by Syntactic Contexts: HS



Discussion of the Mass Noun Data

The impression that one might get from these data is that something semantic seems to be going on, since there are certain differences between classes, but what they might amount to in terms of telling us about the epistemological status of mass nouns for these children is not at all clear. In attempting to account for these differences, let us first consider the strongest hypothesis, that the subjects really did have semantic categories that are defined over the referential properties of substances. For this to hold, one would expect the differences between prototypical and non-prototypical classes to be more consistent both within subjects and between subjects. Instead, what we have found are predicted differences in certain areas, but not in others, and furthermore there are equally many differences found that were not predicted and seem to have no coherent explanation at present.

Equally, a strictly syntactic account whereby semantic properties play no role also seems unjustified, since one would not expect any significant differences to occur between the semantic types. However, the kind of formal account that has been proposed within the body of this thesis is not one that excludes semantic analysis, but rather, one that allows such analysis in certain default cases. Remember, for example, that in Expt. IV children did perform better at subcategorizing new nouns if semantic properties did not conflict with linguistic context. Furthermore, in Expt. V, many children were able to subcategorize nouns in the absence of syntactic information, only utilizing semantic properties. In proposing that categories are essentially syntactic, the claim was simply that the basis of the representation was syntactic, not that the child would never use semantic cues.

Consider, that the child at this stage is learning an enourmous number of words (about nine per day according to Carey 1978). Unlike semantic (or rather, perceptual) properties that are continuously open to inspection in immediate referential situations, previous linguistic contexts are not so readily available to the child producing an utterance. Unless

the child has a very efficient means of immediately categorizing all new words she hears, there will be a considerable number of words that simply do not get categorized. Furthermore, there are many contexts that a child might hear a word in that simply do not distinguish its subcategorization (e.g., "Get me the celery"). Even when the word is heard in a distinguishing context there is no guarantee that it is not doubly subcategorized (e.g, *a pie, some pie*). Given these problems, the child may, in certain circumstances resort to some kind of semantic strategy to determine whether the noun in question should be quantified discretely or not. Obviously, fluids may be less prone to discrete quantification since they are not discrete in nature. Considering all of the barriers to a clear subcategorization, what is perhaps most surprising is that there were not more errors, especially on the non-prototypical classes.

We have still not accounted for the lack of similarity in the distribution of mass nouns for the two subjects. There can be little doubt that such idiosyncracies cannot be accounted for by universal claims about language-learning strategies. Rather, one must consider that there will be certain individual differences in the way in which certain constructions are employed by any particular child. Below I list a few possible reasons for such diferences:

(i) Construal of Discreteness

One major difference between HS and SM was that SM made more errors of the kind where a fluid was quantified discretely (e.g., **a juice*). SM made seven of these errors whereas HS made only one. What might account for this difference is that for SM, a cup of juice may have constituted a discrete entity, being bounded by the container, whereas for HS the focus was on the juice itself which did not constitute a bounded form. That is, the difference between the subjects may lie in the way in which the child construed the form of the fluid, thus leading to very low error rates for HS, but not for SM.

(ii) Differential Acquisition of Functors

The subjects could well differ in the rate at which they acquire the proper semantic function of the relevant functors and how that function links up, syntactically, to the count/mass distinction. For example, we have already noted in the experiments in Chapter II that the appropriate restrictions on *some* and *a* come in much earlier than those for *much, many* etc. In fact, the present data suggest strongly that for HS, pluralization is linked quite early to a syntactic distinction while for SM, the plural is much more prone to errors thus suggesting that it is not linked to the count/mass distinction proper at this stage (c.f., the investigation of plurals in Chapter II). Thus, if some forms are more delayed in being hooked-up to the count/mass distinction this would lead to a differential distributional pattern, depending on the current status of the forms in the child's grammar.

(iii) Spurious Effects of Practice of Forms

In examining a corpus quantitatively, one often finds that certain constructions seem to rise and fall in frequency. In particular, there seem to be periods in which a particular form is used intensively and then quite suddenly, the frequency of that form drops off again. The impression is that the child is concentrating on a particular form such as plural and is "practicing" it by using it as much as possible. The possible consequences are that he may commit many errors during the period of rampant use, but perhaps later, the appropriate restrictions might be much better learned. Any strategy of this sort would very likely to be of an idiosyncratic nature and thus be the cause of subjective differences.

(iv) Differences in Semantic Compatability

This final suggestion is less well formulated but relates to a claim by Bloom, Lifter & Hafitz (1980) that the use of tense and aspect marking on verbs is contingent on the

inherent aspectual properties of the verbs themselves. For example, she claims that appearance of -ed past tense marking comes in much earlier for verbs that are "punctate" and "completive" (e.g., *bash*) than those that are "durative" and "non-completive" (e.g., *like*). Extending this kind of analysis to nouns, we do know that certain nouns have idiosyncratic distributions. For example, one usually only says *the sun*, and *the moon*. Only in very specialised cases would one talk of *many suns* or *three moons*. What we have not considered is the possibility that such things as food and fluids may have similarly idiosyncratic distributions, if not in the adult language, then in the child language. Perhaps this may depend on how the child construes the function of a particular construction. Unfortunately, a full treatment of this suggestion would take us beyond the scope of the present work.

While this may not be a complete list of the possible causes for the inter-subject differences, one can see that there are ways of accounting for individual differences that might lead to a certain asynchronization between subjects in the acquisition process. Not only is there asynchrony between subjects, but also asynchrony between different forms in the development of their restrictions and the role they might play in the categorization process. The message from this section would seem to be a cautionary one when dealing with detailed analyses of speech corpora. This is not to say that such analyses are not possible, but to warn one not to take a single apparently significant result as validation for a sweeping universal statement. Rather, if one is to use this method one must at least require: (i) Cross-subject validation and (ii) Validation of all (or most) predictions generated by a hypothesis. For example, if we had found prototypicality effects for both subjects in both errors and use in mass noun constructions, then clearly a revision in the current position would be required. Such requirements may seem overly stringent, however as is clear from the previous analyses, one could otherwise find evidence for just about any hypothesis from an individual child.

Count Nouns

Bearing in mind the lessons from the previous section, we shall now turn to a brief examination of count nouns, again testing for evidence for the semantic hypothesis. We shall concentrate on two aspects: use of count nouns in null-determiner contexts and use in strictly count noun contexts.

Null-Determiner Contexts

One of the rules we have been particularly interested in in developing an account of the acquisition process has been the rule requiring that singular count nouns be preceded by a determiner. This rule was of interest in Chapter I since it had a more protracted course of development than the other rules and appeared to be less motivated by considerations of semantic properties of context. It was suggested that this rule in particular provided much stronger evidence for the existence of a true categorical distinction between count and mass nouns. It is of interest here since it provides an arena for showing that if there were a semantic basis for category induction and representation (viz objects vs substances), one could test whether that semantic category assignment functioned in a context that itself was less constrained by considerations such as discrete vs non-discrete quantification.

In other words, we have so far confounded two factors: (i) The child's knowledge of the individuating function of determiners and plurals and (ii) Whether the use of those functors with certain semantic types indicates category assignment based on semantic properties. Let us assume, justifiably I think, that the ungrammaticality of (4.1) does not turn on *car* being quantified as a discrete individual.

(4.1) *John drove car

We learned in chapter I that such constructions show a steady decline in use for singular count nouns but not for mass nouns or plurals (see figs 1.1 and 1.2). If we can show that this decline is accounted for primarily by prototypical count nouns (i.e., concrete objects), then there would be evidence that the category truly is semantic. In other words, having induced the count noun category over semantic properties of nouns, this category in turn, would be the basis for restricting use in contexts that were not a consequence of the mode of quantification.

In the present analysis we shall again employ a semantic classification of nouns. The prototypical class includes those nouns that denote discrete, concrete, inanimate objects such as *table, chair, bus.* Of these there were 1246 and 789 tokens for SM and HS respectively. Animate nouns were not included since there was some evidence that subjects used them as proper names (c.f., "nice doggie"). For similar reasons, place names were not included as they might also have lead to contamination from the proper noun category. Superordinates were dropped from the analysis as they often lend themselves to mass noun sucategorization (see previous section). The non-prototypical class included the Grind/Object class (all food terms e.g., *carrot, cookie, pancake*), Abstract Nouns (e.g., *story, way, idea* etc.), and Fluids (e.g., *Drink, Float*). There were 251 and 293 tokens of these for SM and HS respectively.

For reasons previously stated, children should have problems categorizing non-prototypical nouns if the count/mass distinction is semantic for them in the sense that Count nouns would be equated with something like Concrete Object. It will be recalled that in examining the development of the null-det rule, we found that singular count nouns showed a general decrease in proportion of occurence without determiners, reaching a 10% criterion at 2;5 for SM and 2;9 for HS. This development contrasted with that for plural count nouns and mass nouns which showed no significant decrease in use without determiners remaining at around 40 to 50% throughout. In other words, constructions such as

(4.2) decreased in frequency, while those like (4.3) and (4.4) exhibited no such trend.

(4.2) *I want car

(4.3) I want cars

(4.4) I want sand

If in learning the rule, rather than having a proper syntactic category of count noun, the child used a semantic category defined as "name of object", one would predict that during the time when the singular count nouns show a marked decline in use without determiners, the non-prototypical count nouns should show less of a decline, due to their indeterminacy with respect to semantic categorization. We are thus interested in the period of decline when singular count nouns first show differentiation from plural count nouns and mass nouns, up to the point where they reach the 10% criterion.

The relevant graphs are shown in figure 4.2a for SM and 4.2b for HS. Plotted on the graphs are the proportions of occurence of singular count nouns without determiners for prototypical and non-prototypical classes. The reader should bear in mind that the average total at each sample for the prototypical class is 155.7 (SM) and 112.7 (HS) whereas for the non-prototypical class the average is only 22.1 (SM) and 33.8 (HS). Thus the latter class is more prone to large fluctuations that are less likely to evoke significant effects.

Inspecting the figure for SM, one can see that there is almost no difference between the two curves. During the learning period (roughly 1;9 to 2;7) both curves show clear downward trends. The only significant difference occurs much later at 2;9 where the values for prototypical nouns do fall below levels for the non-prototypical class ($\chi^2 = 3.86$, $p = .05$). However, since this difference occurs after SM has evidenced learning of the appropriate rule, it cannot be argued that it reflects induction of the rule over a restricted semantic class.

Fig 4.2a. Proportion Use of Singular Count Nouns in Null-Det Contexts: SM

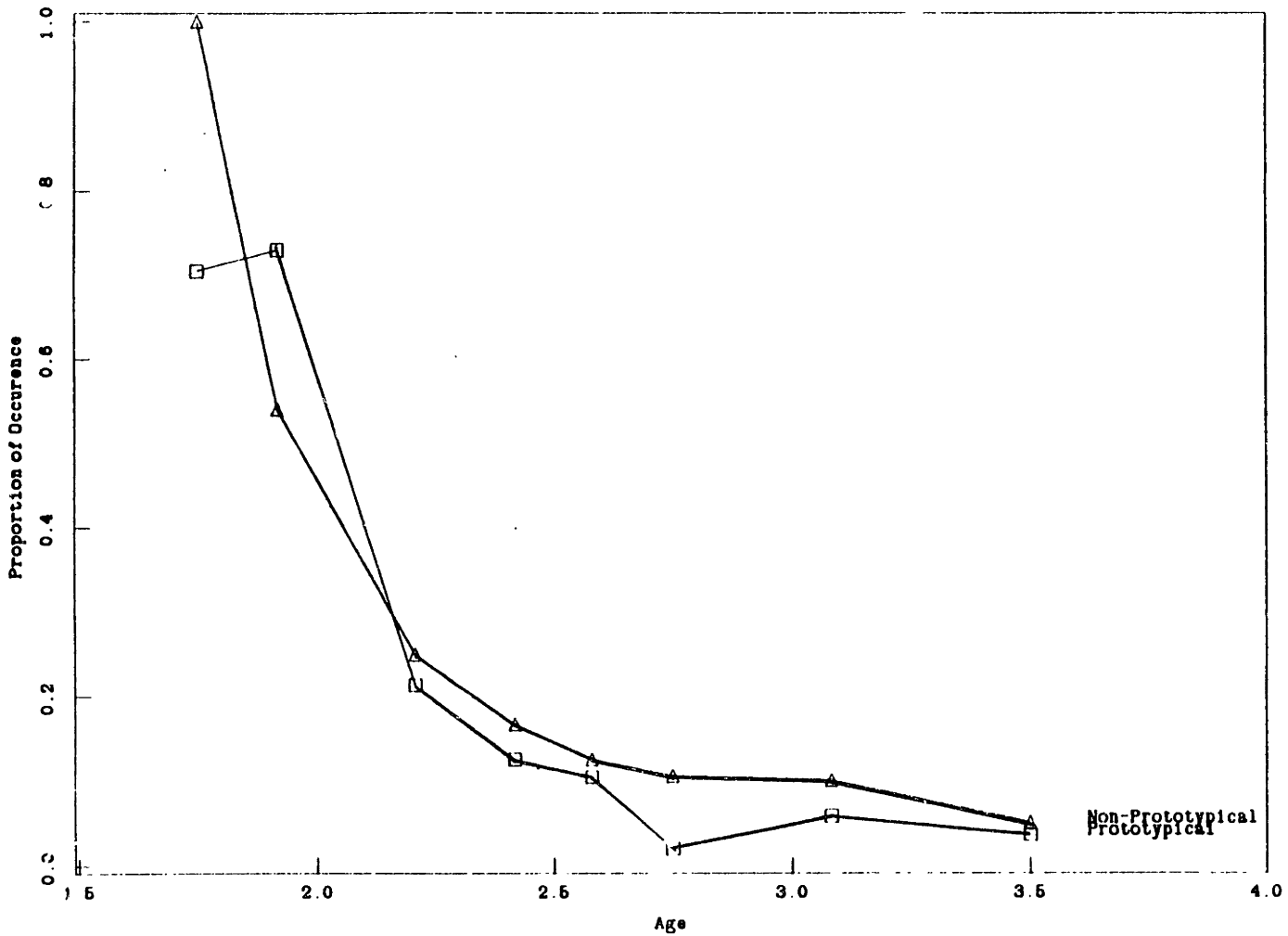
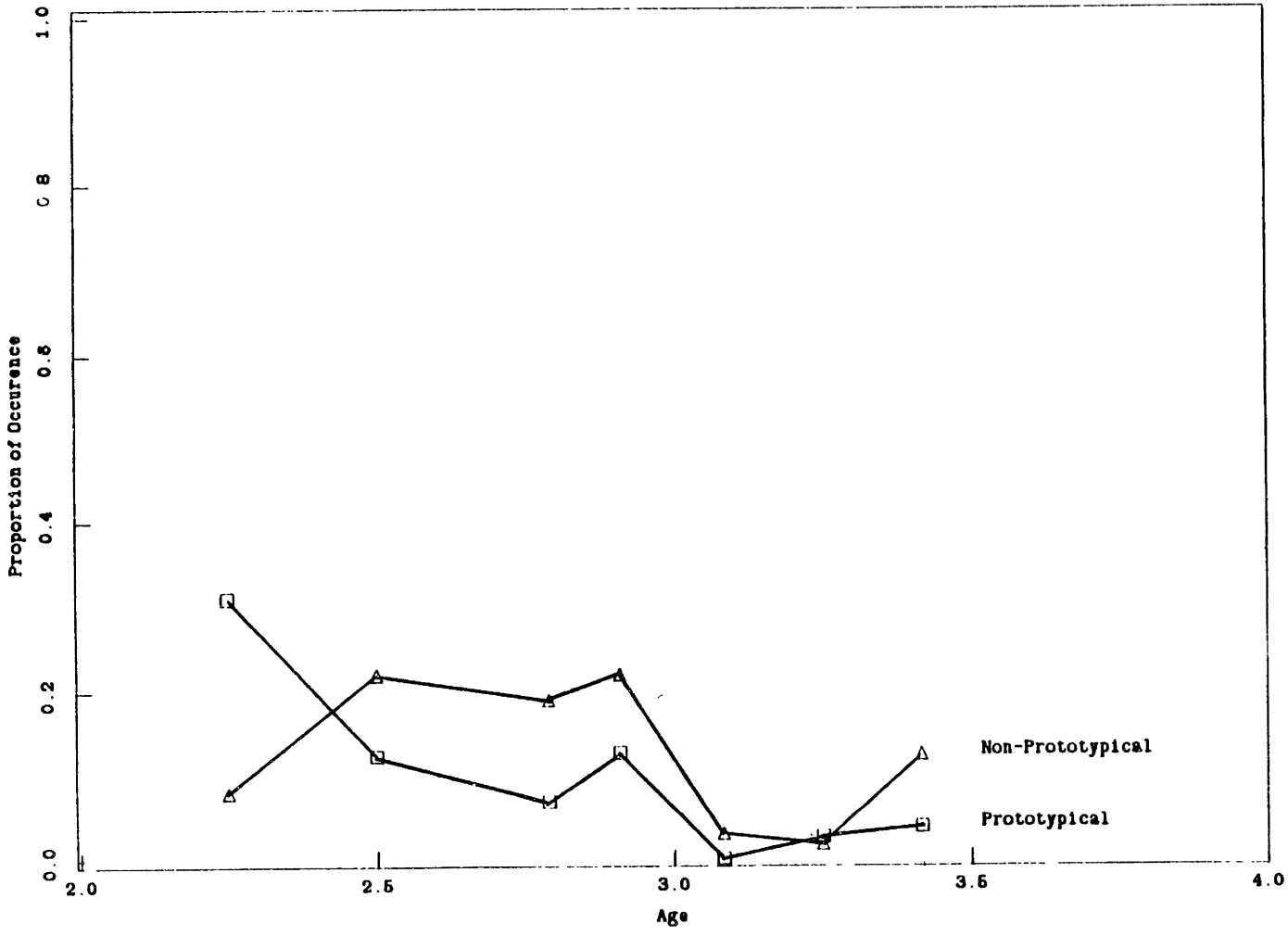


Fig 4.2b. Proportion Use of Singular Count Nouns in Null-Det Contexts: HS



The curves for HS exhibited no significant diferences at sample points between prototypical and non-prototypical count nouns. Since we are catching the development at a later stage than with SM, it is not possible to see whether the two curves decline at a similar rate. There does appear to be a difference between the curves from 2;6 to 2;11, however, none of these differences was beyond a p=.1 level of significance. Notice also that at the 2;2 sample, the difference is actually in the opposite direction.

For neither subject then, do we have any concrete evidence that the null-det rule for count nouns is induced over a restricted semantic class. However, some may still be skeptical and point to the slight, non-significant difference that did occur for HS. It does indeed occur at the time that we are interested in: when he is starting to show signs of not using singular count nouns in null-det contexts. Rather than leave the skeptics skeptical, we shall procede with one final analysis. If there is an induction over prototypical count nouns, then contexts that are restricted to use with count nouns only should show proportionately greater use with the prototypical class. This prediction will be tested in the next section.

Use in Strictly Count Noun Contexts by Semantic Type

For this analysis we examined the use of count nouns with functors that are demonstrably restricted to count nouns in the subjects' speech. *A, another,* numerals and plurals were shown to be well restricted to count nouns from the earliest samples (with a few minor errors). These functors were therefore examined in their use with prototypical and non-prototypical count nouns. If we were to find that the prototypical class showed proportionately greater use with these functors then this would provide prima facie evidence for the semantic basis of the count noun category. That is to say, if the restrictions on these functors are written over the count noun category and their use is restricted to a prototypical semantic subclass of the count nouns, then this would strongly suggest that "Count

Noun" for the child is equivalent to something like "Concrete Object".

The proportions of use of the two semantic classes in the strictly count noun contexts are plotted in fig. 4.3a for SM and 4.3b for HS. The curves quite clearly show that the semantic prediction is falsified. Non-prototypical count nouns participate proportionately more often in strictly count noun contexts than prototypical count nouns for nearly all age samples for both subjects. These differences, the only inter-subject trends we have found, are significant at many age-samples (significant differences are marked on figures as: * = ($p < .05$); ** = ($p < .01$), χ^2).

Discussion

In this final chapter we have painstakenly analysed two corpora in an attempt to evaluate the standing conclusions from the experimental data in the previous chapter. The little insignificant evidence that did appear to pose a problem for the syntactic hypothesis was neither corroborated by the other subject nor by further predictions. In fact the largest significant results have been obtained in total contradiction of the semantic hypothesis. While there may be some effects of semantics at certain stages, a proposal whereby the induction and representation of the count/mass distinction is parasitic on a semantic distinction between objects and substances seems quite untenable in light of the present evidence.

Summary and Conclusions

In these final two chapters we have found that there is no clear evidence that children initially acquire or represent the count/mass distinction as an equivalence relation to the semantic distinction between objects and substances. Rather, where there is clear evidence, it points to category assignment on a formal basis. We have allowed that semantic

Fig 4.3a. Proportion of Use in Strictly Count Noun Contexts: SM

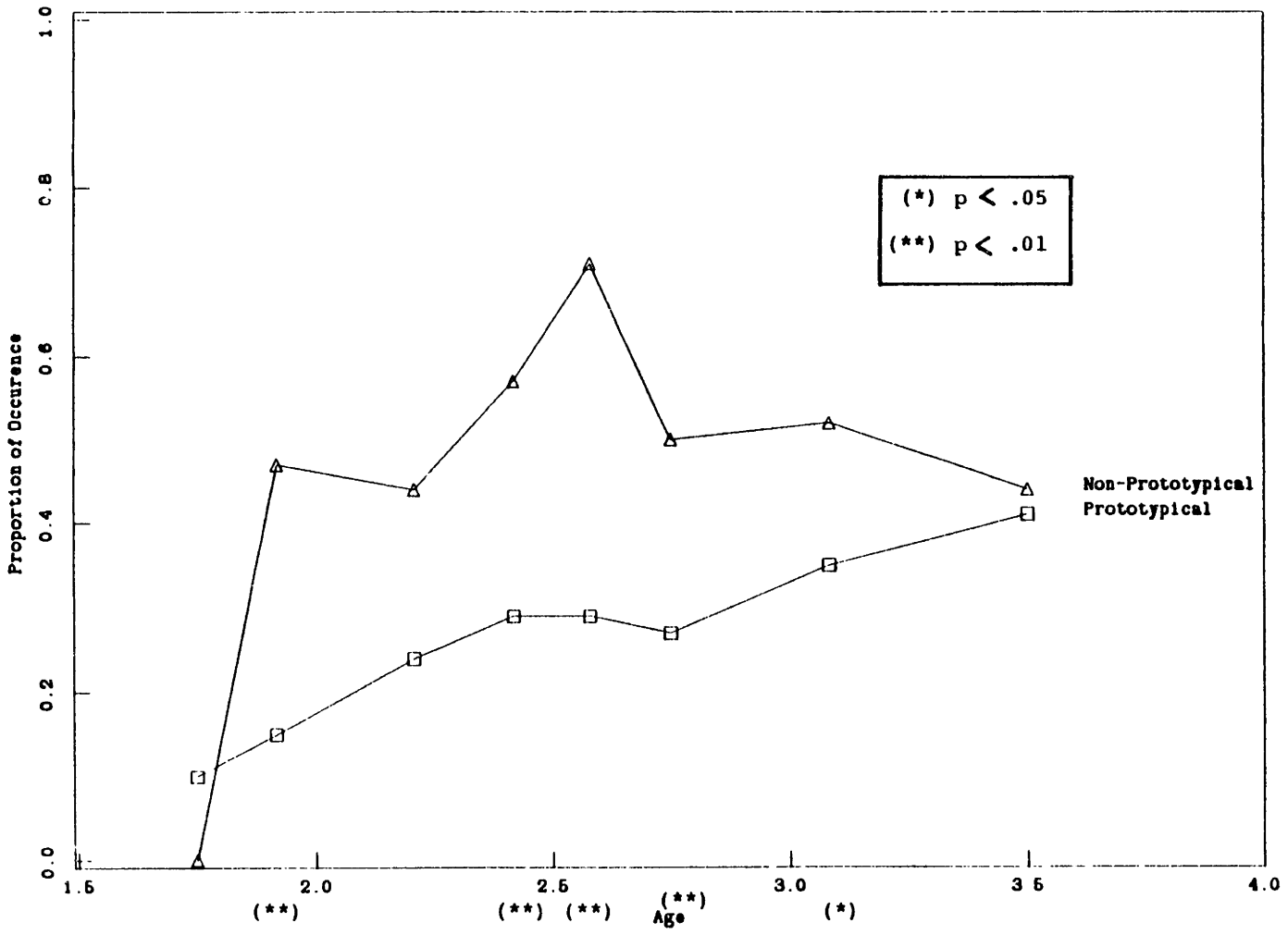
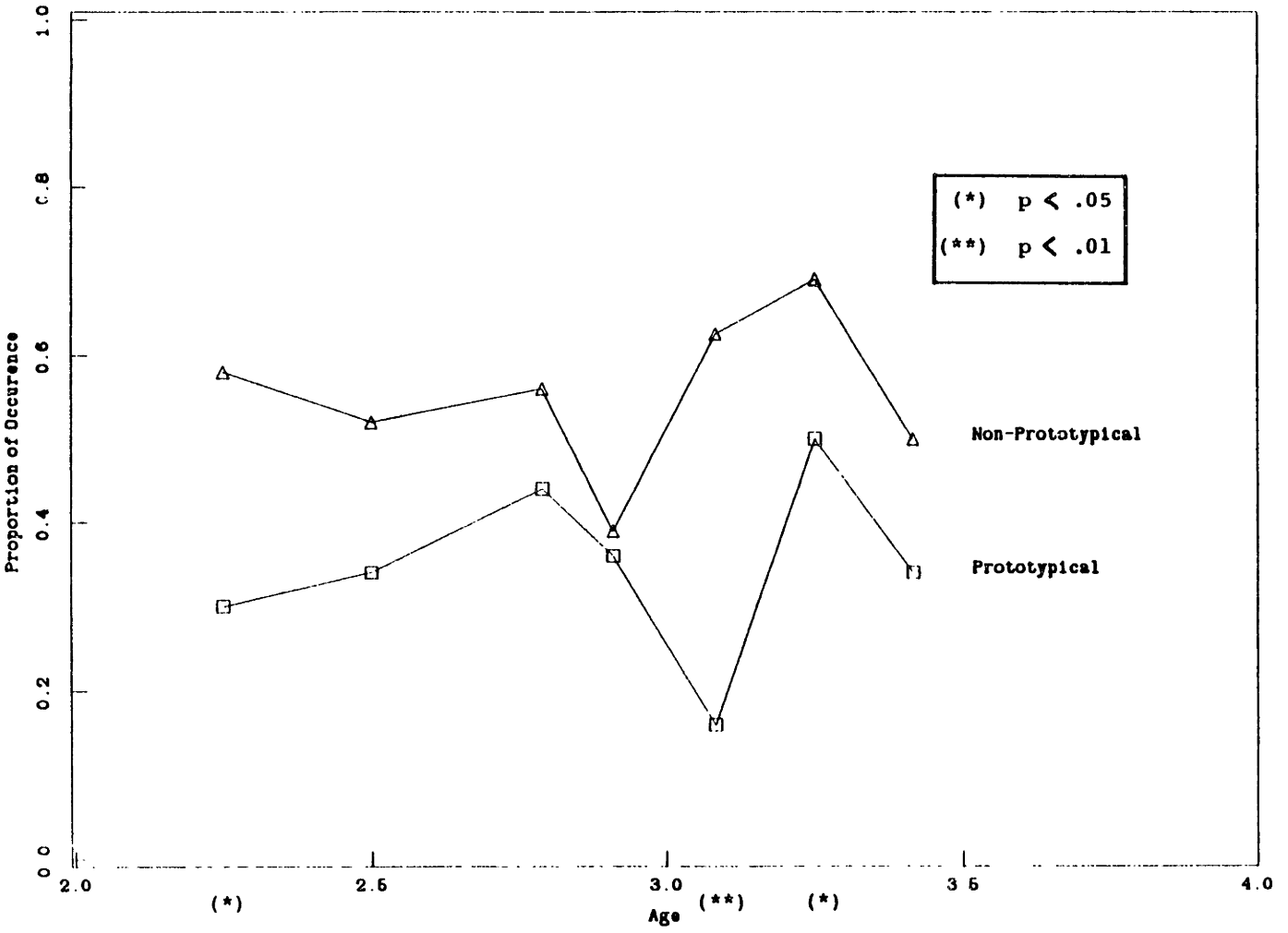


Fig 4.3b. Proportion of Use in Strictly Count Noun Contexts: HS



equivalences may be induced, but not as the essential basis for the syntactic distinction. Furthermore, we have tried to distinguish between the proper quantificational semantic function of the count/mass distinction and the erroneous strategy of actually encoding the categories as semantic types. We are not therefore proposing that categories develop in a vacuum, devoid of semantic considerations, but rather that there are different kinds of semantic properties to be distinguished. Furthermore, in essential respects one can consider the child's representation of categories as autonomous formal entities to the same extent that one can consider those of the adult to be similarly autonomous. That is, while categories (and syntactic rules in general) have semantic functions, they may not themselves be considered to be semantic entities.

It is worth comparing our results here to those of Katz, Baker & Macnamara (1974) with respect to the proper/common distinction. They showed that by 17 months, (female) children were able to use the presence or absence of an article as the basis for determining whether a noun was proper or common. Thus, they took *dax* to denote an individual doll and therefore chose the same doll as initially named when asked to "get dax". When the doll was called *the dax* however, the child was equally likely to pick any doll present, thus suggesting that *dax* denoted the class of dolls in this case. In a further condition, a box rather than a doll was used as the referent. In this case there was no tendency to use *dax* as a proper name regardless of the linguistic context.

Does this show that the proper/common distinction is semantic for young children? The answer is both yes and no depending on what one takes "semantic" to mean. If we take this to mean that a proper name denotes a unique individual for the child, then clearly the answer is yes. But this is also the case for the adult. Notice that "unique individual" is not an intrinsic property of some noun referent, it is a property of how that noun gets quantified, and hence, conceptualized. For example, besides proper names such as *Joe, Fred, Susie* etc. there are others such as *Rome, Paris, General Motors, M.I.T., Cosmopolitan* and

LISP. Young children do not only use proper names for people, but also for towns, cities and security blankets. None of these entities are coordinated at the level of semantic types, they are coordinated at the level of unique individuation, just as *furniture* and *water* are coordinated at the level of non-individuation.

The general claim then, is that a category may be involved in a semantic function such as quantification and it is likely that the child will pick up on that function. What we do not have evidence for is that children will assume that the category itself is defined by some restricted semantic type. I think that an analogous case could be made for the major categories. That is, while children may pick up on certain semantic functions such as nouns serving as arguments to verb predicates, this need not necessarily be carried over to claiming that nouns are equated with something like "concrete object". Pinker (1983) and others have postulated the latter strategy for very sound reasons including strong arguments that the child does require something above and beyond distributional correlations in order to acquire categories. [20] The question is, does that necessarily involve assuming a semantic correspondence of syntactic categories and semantic types, or can the same differentiation occur by more functionally oriented differences? The answers to such questions must of course lie in more careful study of the acquisition process with respect to the major categories.

Aside from the empirical questions, it is instructive to consider why categories in general do not tend to line up in simple correspondence to conceptual types (in adult grammars, at least); or if they do at some point, one tends to find diachronic changes in the

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[20] Pinker's main arguments against a Maratsos & Chalkley type model include: (i) The need for enourmous numbers of minimal pairs; (ii) the existence of non-complementary contexts for homophonic forms; (iv) given n words in a sentence, there would be $2^n - 1$ possible definitions of context; (v) a lack of universal category assignments, thus not allowing "universals" such as the Complex Noun Phrase Constraint to make reference to such things as nouns.

language resulting in movement away from such simple correspondences. [21] There are a few possible answers to this. One explanation invokes the autonomy hypothesis that syntax is independent of semantics (or rather, general cognition), and therefore will not long be constrained by cognitive, non-linguistic demands. A second point is that conceptual types are notoriously intractable very rarely being clearly defined (e.g., are foodstuffs objects or substances?). If, as much of linguistic study suggests, syntactic functions are characterized by strictly formal, well defined components, then it is unlikely that semantic definitions would provide stable enough classes to form the basis for syntactic categorization.

A final suggestion is one that hinges on what the functions of various levels of the grammar are. Clearly languages are for communicating within and about the world and must therefore involve some mapping between what is in the world and the functions of the various components of a grammar. However, it would seem that if one characterizes those functions, there is a real division of labor between different levels. Most relevantly, while the language does encode information about what kinds of things exist in the world, that encoding is almost exclusively at the lexical level. In other words, concepts map onto words,[22] not onto categories, phrases, phonemes or sentences. Extending this point, the fact that categories are defined by the *role* they play in some syntactic configuration, their semantic properties are going to be a function of that role in the semantics of the resulting syntactic construction. Thus, in the case of the count/mass distinction, the semantic properties are going to be a function of the role they play in either individuated or non-individuated modes of quantification in NP's.

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[21] This observation is due to Kathie Carpenter (personal communication) who has examined this question diachronically. I do not know of any well documented studies to back this up however.

[22] I am using "concepts" in a very narrow sense here to mean roughly the mental representations of entities, processes etc. that are usually lexicalized in languages. I shall resist extricating myself from the argument that the word "noun" presumably has an underlying concept.

Looking at the issues in this manner, one sees that there is good reason not to think that the child would rely on finding correspondences between conceptual types and syntactic categories since the direct evidence for this in the input is somewhat degenerate, whereas there is much clearer direct evidence for the semantic role of the category (if it has one), functioning in its relevant syntactic constructions. As we have pointed out previously, whether the child has semantic or formal categories, there is simply no getting around her learning the relevant syntactic properties that define the differential use of categories.

It has often been claimed that, while semantic types such as *object, substance, action* etc. do not define adult categories, they do form the "conceptual core" of such categories. In other words, it is no accident that the categories do seem to line up in a non-arbitary manner with what kinds of things there are. There is probably some truth to these claims. For example, acquiring a notion such as "individuation" may be derivative of prior acquisition of the concept of "object" at some pre-linguistic stage. Although, it could equally be the case that the two notions are acquired independently (or simply do not need to be acquired if innately specified). What one needs to remember, however, is to keep this kind of speculation very seperate from claims about the epistemological status of categories qua mental representations in the child's grammar.

Clearly, there are many avenues to be taken in extending the present findings; either examining the conceptual development that precedes linguistic use of functions such as individuation or examining other categories in a similar manner to the analyses presented here. In the past, claiming that categories are initially semantic has seemed a fairly innocuous affair. I hope that the least the reader may go away with is the feeling that there is perhaps more to this claim than meets the eye, and that for certain categories at least, it seems to be wrong.

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APPENDIX I

Sentence pairs from Experiment I

Practice Items:

She's standing Stands she was	That's some ham That's a hamses	That's some sausages Sausage that any is
They're green They're greended	That's two bottles That's bottle twos	It's a vacuum-cleaner It's a cleaner-vacuum
It's an oven It's ovening	It's a coffee-grinder It grind a coffee-er is	She's wearing a brown dress Is wear browning she dress
That's some cakes Caking that some is		

Test Items (contrasts indicated by italics):

Selection Errors:

There's *several/a lot of* corn here.*

There's too *much/many* donuts to fit in the oven.*

We'll have to use *each/all the* tea here.*

We'll have to use *every/all the* corn.**

That will be too *many/much* tea.**

Controls:

It's *a/some* sugar.*

There's *some/a* sink in the corner.**

E-Quantifier Overpluralsation:

We can use either *kettle/kettles*.*

Each *sack/sacks* has/have different stuff in it/them.*

Every *sack/sacks* has/have different stuff in it/them.**

Controls:

There's not enough *chair/chairs* for four people.*

There's a lot of *can/cans* on the shelf.*

We've got some *brownie/brownies*.*

We'll need more *chair/chairs* for four people.**

Let's see if we have any *donut/donuts*.**

Mass Noun Plurals:

We'll need more *soup/soups*.*

There isn't/arn't any *coffee/coffees* left.*

That's not enough *soup/soups* for four people.**

We've got a lot of *coffee/coffees*.**

It's some *sugar/sugars*.**

*Half the subjects received items marked: * and half received those marked: **.*

APPENDIX II

Items for Experiment II

Practice Items:

This is a nice ... <*house*>.

Hello there, Mrs. ... <*Potter*>.

It's a lovely ... <*dress*>.

They're very ... <*big*>.

They are hanging on the ... <*wall*>.

It's a very nice ... <*clock*>.

This one is much ... <*bigger*>.

We've got two big ... <*cakes*>.

Let's put them back in the ... <*oven*>.

There's all sorts of ... <*stuff*>.

Let's eat the ... <*donuts*>.

Test Items

E-Quantifier Overpluralization:

There's different stuff in each ... <*jar/s*>.*

We can use either ... <*kettle/s*>.*

There's something different in every ... <*sack/s*>.*

There's different stuff in each ... <*can/s*>.**

We can use either ... <*kettle*>.**

There's something different in every ... <*sack/s*>.**

Control:

If there's four people, we'll need more ... <*chair/s*>.*

Yes, we've got some ... <*can/s*>.*

If there's four people, that's not enough ... <*chair/s*>.**

We've got a lot of ... <*jar/s*>.**

Mass Noun Plurals:

We've got a lot of ... <*soup/s*>.*

If there's four people, that's not enough ... <*tea/s*>.*

We've got some ... <*tea/s*>.**

If there's four people, we'll need more ... <*soup/s*>.**

Possible completions indicated in angle brackets: < .. >

*Half the subjects received items marked: * and half received those marked: ***