The acquisition of the multiple senses of *with**

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Abstract

The present article reports on an investigation of one child's acquisition of the multiple senses of the preposition with from 2;0–4;0. Two competing claims regarding children's early representation and subsequent acquisition of with *were investigated. The ''multiple meanings'' hypothesis predicts that children form individual form-meaning pairings for* with *as separate lexical entries. The ''monosemy approach'' (McKercher 2001) claims that children apply a unitary meaning by abstracting core features early in acquisition. The child's (''Brian'') speech and his input were coded according to eight distinguishable senses of with. The results showed that Brian first acquired the senses that were most frequent in the input (accompaniment, attribute, and instrument). Less common senses took much longer to emerge. A detailed analysis of the input showed that a variety of clues are available that potentially enable the child to distinguish among high frequency senses. The acquisition data suggested that the child initially applied a restricted one-to-one form-meaning mapping for* with*, which is argued to reflect the spatial properties of the preposition. On the basis of these results it is argued that neither the monosemy nor the multiple meanings approach can fully explain the data, but that the results are best explained by a combination of word learning principles and children's ability to categorize the contextual properties of each sense's use in the ambient language.*

1. Introduction

Lexical ambiguity is a pervasive feature of natural languages. Whereas classical approaches to meaning tended to downplay the issues surrounding lexical ambiguity (e.g., Katz 1972), the representation of ambiguous forms has been a research focus in a number of fields, including computational linguistics, psycholinguistics, and cognitive linguistics (see

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Cuyckens and Zawada 2001; Ravin and Leacock 2000). Ambiguity comes in three forms: homonymy, polysemy, and vagueness. Whereas cases of homonymy tend to be clear cut, the distinction between polysemy and vagueness is less so.

Taylor (1995: 99) defines polysemy as "the association of two or more related senses with a single linguistic form." Take, for instance, the English verb *find*. In (1) the verb is used to mean 'to come upon', whereas in (2) it is used in its experiential sense to mean 'to perceive to be'. These senses are clearly related; the sense in (2) appears to be a metaphoric extension of (1).

(1) The professor found the book under some papers.
(2) The professor found the paper to be poorly written.

A polysemous treatment of *find* argues that the two senses are partly distinct, such that they are both represented in the lexicon. For instance, cognitive linguists argue for a network approach to the representation of polysemous forms, where related meanings are connected, usually to a core sense (e.g., Lakoff 1987). Such treatments have been accused of "rampant polysemy" — the overproliferation of senses that do not correspond to the distinctions made in the mind of the speaker (see Sandra and Rice 1995). An alternative has been to suggest that ambiguous words are represented in an underspecified form, and that senses are computed largely on the basis of context. This is ambiguity due to vagueness, or monosemy (see Tuggy 1993). The central claim of a monosemy approach is that all senses are contextual elaborations of a single core sense. The distinction between polysemy and monosemy is not clear cut (see Geeraerts 1993), but the issue is important because both are claims for rather different representational principles.

The present article considers the acquisition of the multiple senses of the ambiguous preposition of *with*. McKercher (2001) notes that the *Oxford English Dictionary* (2nd edition) lists 40 senses for *with*, many of which have multiple subsenses, resulting in over 100 potentially distinguishable senses of *with*. Consider sentences (3)–(6), which demonstrate four different senses of *with*.

(3) I ate the pasta with a fork. (Instrument)
(4) I ate the pasta with Rufus. (Accompaniment)
(5) I ate the pasta with meatballs. (Attribute/Modifier)
(6) I ate the pasta with gusto. (Manner)

There has been some debate over whether or not *with* is polysemous. For the most part, these arguments have concentrated on typological evidence

(for arguments focusing in case syncretism, see Nilsen 1973; Lakoff and Johnson 1980; Keenan and Faltz 1985; Croft 1991; Stolz 1997). In this article we contribute psycholinguistic evidence.

When acquiring language children must overcome what Clark (1993) refers to as the "mapping problem": they must establish a mapping between the phonological and semantic structure of a lexical item. Multiple one-to-many form-function mappings create a potential problem for the child language learner. It is well established that, all things being equal, children prefer to apply only one meaning to a lexical item. This is certainly true in the case of nouns (Clark 1993; for recent reviews, see Bloom 2000; Tomasello 2003). Research on children's acquisition of homonyms has shown that children as old as 3-and-a-half-years consistently refuse to accept nondominant senses of homonyms in experimental settings, despite possessing lexical entries for both senses of the homonym (Backscheider and Gelman 1995; Doherty 2000; Doherty and Perner 1998; Peters and Zaidel 1980). Additionally, children do not acquire the full range of senses of mental state verbs, which are inherently ambiguous, until well into their primary school-age years (Booth and Hall 1995; Schwanenflugel et al. 1996).

The acquisition of prepositions presents a particularly difficult version of the mapping problem for the child language learner. Individual prepositions can potentially encode a wide range of semantic roles (e.g., Lakoff 1987; Sandra and Rice 1995; Tyler and Evans 2001, 2003). Furthermore, since prepositions are function words, they lack the phonological salience of content words such as noun and verbs, which potentially creates a segmentation problem.

McKercher (2001) suggests two possible ways by which children learn the multiple senses of *with*. The first he calls the "multiple meanings" approach, which states that children assign different meanings to *with*. That is, they store separate lexical entries for each sense; for example, $with_{\mathrm{ACC}}$, $with_{\mathrm{INS}}$, $with_{\mathrm{ATT}}$, $with_{\mathrm{MAN}}$, and so on. This corresponds to "ambiguity due to homonymy" (see Tuggy 1993). On this approach, children would ultimately form links between these entries to form a connected prepositional network. This approach is broadly consistent with recent work on the early emergence of language from usage-based perspectives, where it has been argued that children build up their linguistic system around initially concrete lexical items that have simple one-to-one form-function mappings (e.g., Lieven et al. 2003; Tomasello 2003).

McKercher's second proposal is the "monosemy approach", which suggests that children derive a core meaning from the multiple senses of *with*. McKercher writes:

> Under this approach, children would need to notice the common properties of what gets named in *with*-phrases in the speech directed to them. In this case, they would learn one linguistic unit in which this general meaning is mapped to *with* … the monosemous meaning of *with* might be HAVING …. (McKercher 2001: 97)

The monosemy approach suggests that the ambiguity of *with* reduces to representational underspecification (or "vagueness" [see Tuggy 1993]). McKercher's (2001) suggestion is that children form an underspecified representation of *with* that subsumes its multiple senses. Although the status of monosemy as a general representational principle is debatable on both theoretical (Cruse 1992) and empirical grounds (Sandra and Rice 1995; Klein and Murphy 2001), the different senses of *with* appear to contain the core element of 'having'. The key issue is whether this core meaning is what is represented. The monosemy approach postulates a highly active learner: children must extract common features from the different uses of *with*, and abstract a monosemous sense over these different uses.

McKercher (2001) argues that the multiple meanings and the monosemy approaches make different predictions about children's early use of *with*. He suggests that the multiple meanings approach would predict that children will acquire each separate sense of *with* on a different developmental schedule; that is, they will acquire them item-by-item. In contrast, McKercher suggests that the monosemy approach predicts that children will use *with* to encode a range of senses from the beginning.[1]

Few researchers have investigated the acquisition of the multiple meanings of *with*. Tomasello (1987) charted the acquisition of prepositions by one child "T" throughout her second year. He showed that T first used *with* to mark accompaniment at 20 months, which was followed by instrumentals some months later. T's first use of *with* was preceded by a stage where she omitted the preposition in obligatory contexts. In all cases the omitted *with* would have expressed an instrumental role, as shown in (7)–(9) (ages shown in brackets).[2]

(7) Open it keys. (1;6.25)
(8) Wash it paper towel. (1;7.30)
(9) Clean this paper towel. (1;8.1)

Tomasello suggested the omission of the instrumental could be explained by a combination of the fact that *with* is plurifunctional (i.e., it marks different semantic roles) and the fact that instruments can be marked by other prepositions in English (e.g., using *by*). Since T also omitted *by* in obligatory contexts at around the same age, this explanation appears viable. The combination of these factors could potentially lead to uncertainty about the exact use of the item on behalf of the child. It is

important to note that although T made at least nine omissions of instrumental *with*, she never made omissions of accompaniment *with*. Tomasello suggested that T's acquisition of *with* was dependent on her input. The evidence cited for this position was that accompaniment *with* was modeled in much the same way as spatial prepositions that were acquired very early (*in – out*, *up – down*, *on – off*, *over – under*) and on which T did not make errors.

Since Tomasello's (1987) data do not extend beyond 2;0, his study can only suggest possible mechanisms by which children overcome the ambiguity of *with*. T only produced *with* to encode the accompaniment or instrumental roles, and since these senses were first used within months of each other, both the multiple meanings or monosemy explanations could explain the data. However, the difficulty T experienced in expressing the instrumental sense of *with*, compared to the relative ease in which the accompaniment sense was acquired, suggests that were the monosemy approach to be correct the process of extracting individual *sense* meaning, let alone core meaning, is a nontrivial process.

McKercher (2001) aimed to test the competing predictions of each approach by analyzing six children's first twenty uses of *with* and the use of *with* in their input. Using data from the CHILDES corpus (MacWhinney 2000), he showed that children encoded a range of semantic roles in their early speech, a finding that was argued to support the monosemy approach. There are several arguments against this strong conclusion. First, the children closely followed their input in their uses of *with*; a strong positive correlation between children's use of *with* and their input was observed.[3] Second, although the data were carefully sampled, most of the children were recorded at intervals that (weekly, bi-, or tri-weekly) suggest McKercher's sample did not represent the children's first uses (although they are a certainly a sample of them). Finally, since the data were not reported over developmental time, it is unclear which senses were used when.

A feature of both Tomasello (1987) and McKercher (2001) is that they did not report the linguistic contexts in which children used the different senses of *with*. It is certainly the case that adults use different senses in different linguistic contexts, and that context affects the construal of ambiguous words (e.g., Cruse 1986, 2000; Gibbs and Matlock 2001; Kishner and Gibbs 1996, see also MacDonald and Shillcock 2001). This work suggests that lexical items are not discrete entities, and that senses can be distinguished on the basis of usage patterns (Taylor 2003). Since words are rarely encountered in isolation, it is possible that children use contextual cues to acquire the multiple senses of *with*. This appears to be a task at which children are fairly adept: they have been shown to use

linguistic context to infer the meaning of both novel verbs (e.g., Fisher 1996; Naigles 1990) and nouns (e.g., Gelman and Taylor 1984). It would appear that, were stable contextual patterns available for children to infer different senses of an ambiguous word, then this would relieve much of the potential problems lexical ambiguity could pose to children.

In the current article we report evidence to suggest that this is the case. We present the results from a longitudinal study of one child, "Brian," who was intensely sampled from 2;0 to 3;2, and subsequently followed until 5;0. We present analyses of both Brian's uses of *with* and his maternal input for this period. The density of the sampling ensured that we could be sure that we were capturing (a) Brian's first uses of *with*, and (b) a representative sample of both his uses of *with* and the range of uses of *with* in his input. We had two aims. Our first aim was to examine the types of contextual information available to Brian in his maternal input that would potentially enable him to distinguish between the multiple senses of *with*. The second was to test both the multiple meanings and monosemy approaches by examining Brain's initial acquisition of the multiple senses of *with*. To reiterate, the monosemy approach predicts that Brian will use *with* to encode a range of senses from the beginning of his productions, since he would be argued to have induced a unitary basic sense. The multiple meanings approach predicts that Brian will acquire each sense individually, such that each sense will emerge on its own developmental schedule.

2. Method

2.1. *Participants*

Brian and his mother are both monolingual speakers of English from the Greater Manchester area, UK. Brian is an only child; during the study his mother was his primary caregiver. Brian was recorded for approximately one hour five days per week from age 2;0.12 to 3;1.30 (approximately 280 hours), and then five hours per month (five one hour sessions in one week) thereafter until age 4;11.20 (approximately 110 hours). The densely sampled portion of the data is estimated to have captured 8–10% of Brian's speech and his maternal input. Since we are concerned with Brian's first uses and subsequent acquisition of *with*, we are only reporting on analyses conducted from 2;0–4;0 (approximately 330 hours in total), although we do report on his errors after 4;0. He was recorded in a variety of settings in his home (e.g., play time, meal time). His mother

was employed as a part time research assistant for the duration of the study.

2.2. *Transcription*

A team of research assistants transcribed all the tapes into CHAT format using the CLAN program (MacWhinney 2000). Each transcript was subsequently linked to the sound file by a second transcriber. Any differences noted between the transcript and what the second transcriber could hear on the sound file were referred to the research coordinator for adjudication. Finally, the transcripts were run through the MOR program and any errors in morphemization corrected.

2.3. *Procedure*

All utterances containing *with* were extracted from the corpus for both Brian and his mother. All of Brian's *with*-phrases were coded according to the coding scheme in Table 1. The first six months of his input were coded. The coding scheme is a modified version of schemes used by McKercher (2001) and Snedeker and Trueswell (2004). The examples are taken from Brian's own productions. Any repetitions, idiomatic, or frozen phrases (i.e., phrases that were not productive) were removed from the corpus before any analyses were conducted. Following Clark and Carpenter (1989) and McKercher (2001), utterances containing *play with* were put into a separate category, since its use was frequent and it cannot be ruled out that this use patterns like a verb-particle construction.

The two authors each coded half of the target utterances produced by Brian and his mother. Ten percent of Brian's input sample was coded for

Table 1. *Coding scheme*

Sense	Example
ATTRIBUTE	"The one with the police car"
NOMINAL	"What's the problem with your snake"
INSTRUMENT	"I will do it with the paintbrush"
MANNER	"The fireman comes with his sirens flashing"
ACCOMPANIMENT	"I will share it with you"
CAUSE	"I'm happy with my yellow one"
TASK/REFERENCE	"Get on with your dinner"
OTHER	"What will you do with it?"

reliability. Agreement was high (Cohen's Kappa = .954). For Brian's data, both authors checked each other's coding and any discrepancies were agreed upon on a case-by-case basis.

2.4. *Analyses*

Firstly, in order to ascertain the frequency of the different senses of *with* used by Brian and his mother, an analysis of the overall distribution of each semantic role *with* encodes was conducted. The three most frequent senses, accompaniment (ACC), attribute (ATT), and instrument (INS), were then subjected to two further analyses: (a) a construction-based analysis, and (b) a semantic analysis of the verbs with which *with* co-occurred. The rationale for conducting these additional analyses stemmed from the pretheoretical observation that the construal of *with* depends on the surrounding linguistic context. Gibbs and Matlock (2001), for instance, have shown how different senses of the English verb *make* co-occur with particular syntactic frames. Additionally, Kidd (2003) and Snedeker and Trueswell (2004) have shown that verb semantics affects the construal of *with* in V-NP-PP sentence frames. We then present Brian's acquisition of each sense with reference to the constructions and verbs with which he uses the preposition. Finally, Brian's overregularization errors of *with* are presented.

3. Results

Overall, there were 346 *with*-phrases in Brian's sample and 3,513 *with*-phrases in the input sample. One hundred and thirteen of Brian's uses of *with* were removed because they were either repetitions, idiomatic, or frozen phrases. Brian produced very few *with*-phrases in the first three months of recording. He first used *with* at age 2;1.6 (*with Pooh bear*), but only produced two more tokens in the next two months. Since recording began at 2;0.12, we can be relatively sure we captured his first use of *with*. At age 2;4 he began to produce many more tokens.

The relative frequency of the different senses of *with* in both Brian's speech and his input is presented in Table 2.

Table 2 shows that the relative frequency of senses is very similar for Brian and his mother, suggesting that input plays an important role in the acquisition and subsequent use of with. A Spearman rank-order correlation was significant ($r = .916$, $p = .001$). This is similar to results reported by Clark and Carpenter (1989) and McKercher (2001).

Table 2. *Relative frequency of each sense of* with *in Brian's speech and his input*

Senses	Frequency			
	Brian (2;0–4;0)		Input (2;0–2;6)	
	No. of tokens	%	No. of tokens	%
Accompaniment	71	31	1742	50
Instrument	58	25	781	22
Attribute	36	16	443	13
play with	45	19	299	9
Cause	5	2	126	4
Nominal	5	2	33	1
Task	3	1	40	1
Manner	3	1	31	<1
Other	7	3	18	<1
Total	233	100	3513	100

3.1. *A construction-based analysis of Brian's input*

We conducted a construction-based analysis to investigate whether there were any systematic differences in the linguistic context within which the most frequent senses of *with* occur. The three most frequent senses were attribute, instrument, and accompaniment. For each of these senses the first 250 tokens were extracted from the input corpus and were coded for (i) construction type, and (ii) verb sense. Eighty-two percent of these three senses occurred in one of three constructions: (NP)-V-NP-*with*-NP (e.g., *He wiped the table with the cloth*) (50%), (NP)-V-*with*-NP (e.g., *She's sitting with us*) (27%), and (NP)-*with*-NP (e.g., *The bear with wheels*) (5%) (parentheses denote optionality). Table 3 presents the relative frequency within which each of the three senses of with occurred in these constructions.

Table 3. *The relative frequency of each sense in each construction type*

Construction	Sense		
	ACC	ATT	INS
(NP)-V-NP-*with*-NP	.16	.63	.61
(NP)-V-*with*-NP	.63	n/a	.17
(NP)-*with*-NP	n/a	.16	n/a
Total	.79	.79	.78

Table 4. *Type and token ratio of each semantic verb class for the frequent constructions containing verbs*

	Construction			
	NP-V-NP-*with*-NP		NP-V-*with*-NP	
	Type ratio	Token ratio	Type ratio	Token ratio
ACC				
Action	.35	.29	.81	.59
Light	.35	.54	.19	.41
Psych. and Per.	.30	.17	0	0
ATT				
Action	.58	.14	n/a	n/a
Light	.26	.78	n/a	n/a
Psych. and Per.	.16	.08	n/a	n/a
INS				
Action	.88	.82	.88	.87
Light	.10	.17	.06	.10
Psych. and Per.	.02	.09	.06	.03

Table 3 shows that each of the three frequent senses occurs most often in one construction: the accompaniment sense in the NP-V-*with*-NP construction, and both attribute and instrumental with in the NP-V-NP-*with*-NP construction. We refer to these as each sense's "prototypical" construction. Each verb within each construction type that contained verbs was coded according to the semantic classes in Levin (1993), and then, following Snedeker and Trueswell (2004), categorized according to the broader semantic classes of (i) action verbs, (ii) light verbs, and (iii) psychological predicates and verbs of perception. The type and token frequency of each verb type in the NP-V-NP-*with*-NP and NP-V-*with*-NP constructions are shown in Table 4.

Table 4 shows that, for the NP-V-NP-*with*-NP frame, type frequency is fairly evenly distributed for the ACC and ATT senses of *with*. However, for the INS sense action verbs clearly recorded the highest type frequency. With respect to token frequency, the ATT and INS senses, which most often occur in this frame, show asymmetry of verb type. For the ATT sense light verbs had the highest token frequency, whereas action verbs had the highest token frequency for the INS sense. For the ACC sense light verbs had the highest token frequency, although action verbs had a relatively high token frequency. A chi-square test of homogeneity on the token frequencies for the three most frequent senses in the NP-V-NP-*with*-NP construction showed a significant difference between

cell frequencies ($\chi^2 = 136.94$, $df = 4$, $p < .001$).[4] This suggests that the differences in the relative distribution of semantic classes of verbs within this construction are beyond the variation expected due to chance.

When action verbs occurred in this construction, sense type interacted with the aspectual features of the verb. In particular, when the INS sense occurred in this construction with an action verb, the verb overwhelmingly denoted punctual action ($60/91 = 66\%$), such as in verbs like *hit*, *cut*, *pick*, and *squash*. Conversely, when the ACC sense occurred in this construction with an action verb, the verb always denoted durative activity ($17/17 = 100\%$), such as in verbs like *share*, *play*, *bring*, and *drink*. The ATT sense patterned like the INS sense, where action verbs most often denoted punctual activity ($14/22 = 64\%$). However, when these frequency were compared across the three senses they were shown to be significantly different ($\chi^2 = 27.65$, $df = 2$, $p < .001$). This suggests that features of the event structure encoded by the verb provide a cue to children when the same construction is used to express multiple senses, as it inevitably will (see Appendix A).

For the NP-V-*with*-NP construction, action verbs were the most frequent verbs in both the ACC and INS senses, both in terms of type and token ratio. A chi-square test of homogeneity on the token frequencies for these two senses in the NP-V-*with*-NP construction showed a significant difference between cell frequencies ($\chi^2 = 13.29$, $df = 2$, $p < .01$). This suggests that, once again, the differences in the relative distribution of verb types within this construction for each verb sense is beyond the variation expected due to chance. Once again, when the ACC and INS senses occurred in this construction with action verbs, the senses could be reliably distinguished on the durative/punctual aspectual distinction, where the ACC sense most often occurred with verbs that denoted durative activity ($63/67 = 94\%$), and the INS sense, although occurring most often with verbs that denoted durative activity, did so less often ($20/26 = 77\%$) ($\chi^2 = 5.69$, $df = 1$, $p < .02$) (see Appendix B).

3.1.1. *Summary of input sample.* The input data shows that the language the child hears is not as puzzling as it potentially could be. If we exclude cases of *play with*, over 90% of the token of *with* Brian hears encode one of three roles: ACC, ATT, or INS. These roles can be distinguished on at least two dimensions: (i) the construction in which they most often appear, and (ii) verb semantics. Therefore, there are many clues available to the Brian in the input that could enable him to induce the meanings of the three most frequent senses. This suggests that the input relieves many potential problems the multiple senses of *with* could pose for the child.

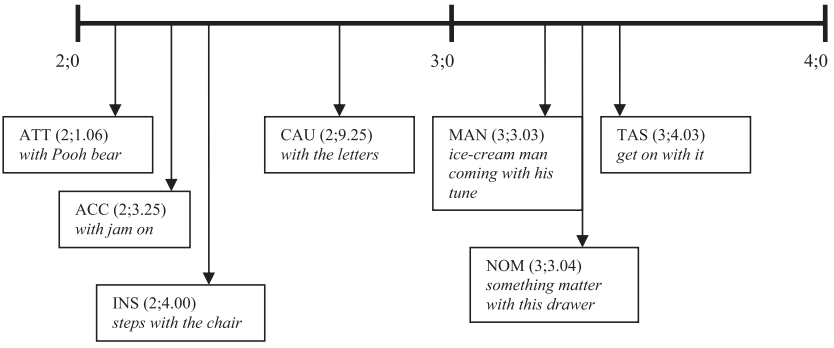

Figure 1. *The emergence of each sense of* with *in Brian's speech*

3.2. *A construction-based analysis of Brian's use of* with

The analyses of the input data suggests that the most frequent senses of *with* each occur in their own prototypical construction, and that verb semantics within a construction further restricts the potential interpretation of *with*. We now present the developmental trajectory of Brian's use of *with* with reference to the constructions in his input and the verbs that are used to express each sense. The emergence of each sense is discussed, followed by a construction-based analysis of the three most frequent senses. Figure 1 presents the emergence of each sense of *with* in Brian's speech.

Figure 1 shows that Brian first used the three most frequent senses of *with* in the four months following his second birthday. All of these first uses were expressed in fragments. Contrary to the predictions of the monosemy approach, Brian did not use *with* to encode a wide range of semantic roles in the few months following his first use of *with*. Less frequent senses took much longer to emerge, some not emerging until well over a year after his first use of the preposition.

A construction-based analysis of Brian's uses of *with* is now presented. The sample is divided into four four-month segments between 2;0–3;4, and a final eight month sample from 3;5–4;0. Brian was considered to use a construction-sense pair productively when he produced *two or more* tokens for a given sense in that construction. Since the frequency of *with* in Brian's speech is low, we report raw frequencies rather than percentages. The constructions Brian used in the first four months of recording are shown in Table 5.

As shown in Table 5, Brian's first uses of *with* consistent largely of fragments. In this time period Brian used *with* 10 times to express three

Table 5. *Brian's construction use from 2;0–2;4*

Sense	Constructions	Frequency
ACC	(NP)-*with*-NP	4
ATT	(NP)-*with*-NP	2

senses: ACC, ATT, and INS. He used only three verbs in these utterances: *share*, *be*, and *play*. He only used two more verbs in the next four months, suggesting that his main means of using *with* was by producing an isolated prepositional phrase. The restricted nature of Brian's first uses, combined with the fact he used very few verbs, suggests that he has a restricted representation for *with* that, unlike the adult model, does not yet distinguish between the multiple senses. Instead, we suggest that Brian uses *with* to denote SPATIAL PROXIMITY. Sentences (10)–(16) list some of Brian's first uses.

(10) with Pooh bear (2;1.06)
(11) with jam on (2;3.25)
(12) shoes with money (2;3.30)
(13) steps with the chair (2;4.00)
(14) food there with chicken (2;4.01)
(15) with steps on (2;4.13)
(16) with peas on (2;4.20)

All these uses relate to objects in Brian's immediate environment, and some are difficult to disambiguate even with the aid of context. The notion of a spatial meaning of *with* differs from a monosemous meaning. According to McKercher (2001), a monosemous meaning of *with* entails encoding of wide range of *adult* semantic roles in children's use of *with*-phrases. A SPATIAL PROXIMITY meaning suggests something subtly different: Brian's use of *with* simply encodes a spatial relation between the two NP referents in his (NP)-with-NP construction. This is a core meaning from which he can build up a network of differentiated senses, rather than an *abstracted* sense based on the extraction of core features. The distinction is that other senses are not yet available to Brian: he is only productively using the ACC and ATT senses, which have the most inherent spatial meanings of any sense of *with*. We take up this issue further in the discussion, where we discuss the notion of spatial proximity in relation to spatial ''proto-scenes'' discussed by Tyler and Evans (2003).

Table 6 shows the constructions used by Brian from age 2;5–2;8.

Between 2;5 and 2;8 Brian is still only using the fragment construction on a consistent basis, and is doing so productively to mark the instrument

Table 6. *Brian's construction use from 2;5–2;8*

Sense	Constructions	Frequency
ACC	(NP)-*with*-NP	1
ATT	(NP)-*with*-NP	4
INS	(NP)-*with*-NP	4
play with		4

Table 7. *Brian's construction use from 2;9–3;0*

Sense	Constructions	Frequency
ACC	(NP)-*with*-NP	5
	(NP)-V-NP-*with*-NP	2
	(NP)-V-*with*-NP	2
ATT	(NP)-*with*-NP	1
INS	(NP)-V-NP-*with*-NP	3
	(NP)-V-*with*-NP	2
play with		16

role. In this sampling period Brian only produced one prototypical instrumental phrase that contained a verb (17).

(17) chopping with a knife (2;5.06)

These were the kind of marked instrumental (NP)-V-*with*-NP constructions that occurred in his input (e.g., *kick with your foot*, *wipe with a cloth*), and which still have a definite, foregrounded spatial dimension.

Table 7 shows the constructions used by Brian from age 2;9–3;0.

Between 2;9 and 3;0 Brian begins to use *with* in a greater variety of constructions. He is using both the prototypical and nonprototypical constructions for the ACC and INS senses, but is still only expressing ATT in fragments. The verbs he uses when expressing the ACC and INS senses do not overlap. When expressing the ACC role, he exclusively uses verbs that denote continuous activity, as shown in (18)–(21). When expressing the INS role, he uses verbs that either denote bounded action (22) or continuous activity (23)–(24).

(18) going with this (2;8.06)
(19) more like go to sleep with (2;9.29)
(20) I not need share with you (2;10.23)
(21) Dustbinman stop and have little chatter with Mummy (2;11.14)
(22) I bang it with my hammer (2;9.11)
(23) build a track with it (2;9.29)
(24) wave my train off with some flags (3;00.15)

Table 8. *Brian's construction use from 3;1–3;4*

Sense	Constructions	Frequency
ACC	(NP)-V-*with*-NP	11
	(NP)-*with*-NP	3
	(NP)-V-NP-*with*-NP	0
ATT	(NP)-*with*-NP	3
	(NP)-V-NP-*with*-NP	2
INS	(NP)-V-NP-*with*-NP	7
	(NP)-V-*with*-NP	5
	(NP)-*with*-NP	2
TAS	get on *with* NP	3
play with		14

Table 8 shows the constructions used by Brian from age 3;1–3;4.

Table 8 shows that after his third birthday Brian began to use *with* more frequently. Furthermore, this sampling period sees the emergence of the dominant use of the prototypical constructions identified in the input sample: Brian is now using the prototypical (NP)-V-NP-*with*-NP construction to express the ATT role, and he uses the prototypical ACC and INS constructions most frequently when expressing these roles. Other than *play*, Brian's utterances with verbs consisted largely of light verbs and action verbs. When action verbs occurred in the (NP)-V-NP-*with*-NP and (NP)-V-*with*-NP construction, Brian showed signs of following the input model. For the INS sense, four of six action verbs encoded punctual activity (*smack*, *start*, *shout*, *mix*), whereas for the ACC sense two of three action verbs encoded durative activity (*play*, *run*).

Table 9 shows the constructions used by Brian from age 3;5–4;0.

Table 9 shows that Brian had largely converged on the adult construction model by 4;0, at which time he is using *with* to encode a variety of semantic roles, albeit still infrequently. He is using the prototypical constructions most often to express the ACC and INS roles, and although he is using the prototypical ATT construction, he is still most often using fragments to express modification. When action verbs occurred in the (NP)-V-NP-*with*-NP and (NP)-V-*with*-NP construction, Brian showed further signs of following the durative/punctual aspectual distinction used to express the INS and ACC senses in the input. For the INS sense, six of ten action verbs encoded punctual activity (*shoot*, *hit*, *scrape*, *slice*, *grab*, and *shoo*), whereas for the ACC sense six of eight action verbs encoded durative activity (*play*, *walk*, *bring*, *cry*, *run*, *share*).

3.2.1. *Brian's nonstandard uses of* with. Nonstandard uses of language provide a unique insight into children's linguistic representations; they

Table 9. *Brian's construction use from 3;5–4;0*

Sense	Constructions	Frequency
ACC	(NP)-V-*with*-NP	12
	(NP)-V-NP-*with*-NP	9
	(NP)-V-loc-*with*-NP	7
	(NP)-*with*-NP	2
ATT	(NP)-*with*-NP	16
	(NP)-V-NP-*with*-NP	5
INS	(NP)-V-NP-*with*-NP	19
	(NP)-V-*with*-NP	3
	(NP)-*with*-NP	2
TAS	get on *with* NP	0
MAN	NP-V-*with*-NP-X	3
NOM	What's X *with* NP?	4
play with		11

provide clear evidence that the child is abstracting over the input. Although seemingly transient, such overgeneralization errors tend to occur after a period of correct usage, which suggests reorganization of the linguistic system. For instance, Bowerman (1982) reported some of her daughter's verb argument structure overgeneralizations (e.g., *Don't giggle me*), which suggested an overgeneralized transitive construction. McKercher (2001) reported on three types of nonstandard uses of *with* from children in the CHILDES corpus: (i) when children put *with* before the complement of the verb (25), (ii) when children used with to mark the theme (26), and (iii) when *with* was used in place of a locative (27).

(25) Water is a thing that you drink with and fish swim in
(Ross: 4;4.18)
(26) Now read Mommy with another story, then you go sleep
(Nina: 2;3.18, pretending to read stories to her mother)
(27) I can reach with the ceiling
(Adam: 3;3.4, reaching toward\the ceiling with a measuring stick)

McKercher (2001) suggests that only the monosemy approach predicts that children will make over generalization errors using *with*. However, it is unlikely that any account of acquisition would deny the existence of generalization; even the most ardent lexicalists import mechanisms into their theories that attempt to explain overgeneralizations (e.g., Brooks and Tomasello 1999; Tomasello 2003). A better way to frame the question is to ask at what point in acquisition the multiple meanings and monosemy approaches would predict overgeneralizations. The monosemy approach, which postulates an active learner who induces an abstract

sense early in acquisition, presumably predicts overgeneralizations from the beginning. On the other hand, the multiple meanings approach would predict overgeneralizations to occur sometime following a period of conservative correct usage.

Brian produced a number of overgeneralization errors that go some way to deciding between these two hypotheses. Brian's first errors were when, following his third birthday, he used *with* to mark a location. He continued to produce these throughout his fourth year, as shown in (28)–(33).[5]

(28) I'm just saving them with my bus tin (3;1.15)
(Means 'in my bus tin')
(29) That man with the spaceship (3;1.16)
(Means 'in/from the spaceship')
(30) I'm going to got you with your stomach (3;2.5)
(Means 'in your stomach')
(31) I'm going with my Wellington boots (3;3.06)
(Means 'in my Wellington boots')
(32) We saw a wheel oil tanker with a big boat (3;4.01)
(Means 'in a big boat')
(33) Mummy, something happened with my tummy (3;5.03)
(Means 'to my tummy')

The locative-*with* error was the first error to occur, and was by far the most frequent error type (six in total). Brian produced four other nonstandard uses after 3;0, one that marked a theme (34), another where *with* was placed before the complement of the verb (35), another that seems to be an analogy from the English resultative construction (36) (e.g., *He's banging it flat*), and another which is a nonstandard expression of the instrumental (37), which appears to be an extension of prepositional stranding that is used in marked uses of the INS sense (e.g., *A knife is used for cutting with*).

(34) saw thirty legs with spiders (4;5.04)
(35) come on Mum make with these xxx (4;11.20)
(36) He's banging it with holes (3;2.11)
(Means 'making holes in X by banging' OR 'banging holes *in* it')
(37) No, it need to get people better with (3;6.01)
(Means 'A fire-engine is needed to make people better')

Brian's nonstandard uses provide a particularly rich data set from which hypotheses about his representation of *with* can be considered. The errors occurred during a period in which he was expanding his uses of *with*, both in terms of the senses he was encoding and the range of constructions he

was using *with* in. His first errors were when he substituted *with* for a locative preposition, most often the spatial locative *in*. We suggest that this provides support for our suggestion that Brian's initial representation for *with* related to spatial proximity. Brian did not produce the other two error types described by McKercher (2001) until over a year after he began producing *with*-locative errors. The status of these subsequent nonlocative error types is difficult to ascertain. Two (36) and (37) appear to be extensions from attested adult constructions; (35) is potentially the result of object ellipsis that, although ungrammatical in English, would be supported by the referential context. Sentence (34), where Brian uses *with* to mark a theme, was observed and discussed at length by McKercher. He observed this error in both children's spontaneous productions and elicited them in a production task, but only when children placed themes before instrumental *with*. He explained this error type by suggesting that children use *with* to mark things participants have in their possession, and took this as support for the monosemy approach. We argue that such an error can be equally explained by suggesting children are over applying a spatial sense of *with* that does not require a monosemous representation of the preposition.

The analysis of Brian's overgeneralization errors shows that he makes errors following a year-long period of correct usage, supporting an account of acquisition in which, at the very least, the initial representation of *with* is not highly abstract. Instead, it is more consistent with an approach where either (a) multiple senses are learned independently and links are made between the two, or (b) extensions are made from an initial prototype. It would appear that the present data are consistent with (b): We have argued that Brian's initial representation of *with* was related to spatial proximity, and that he expanded his knowledge of the individual senses on the basis of the constructions and verb types with which *with* co-occurred. In the process of acquiring less common senses of *with* Brian's representation for the preposition is likely to be in flux, thus resulting in overgeneralizations. An unexpected result is that Brian was still making errors at the end of recording (4;11.20). One potential explanation for this result is that he is still mastering the multiple senses of *with*, and that reorganization of the system of senses continues well into development.

4. Discussion

The present article considered two hypotheses regarding the manner in which children learn the multiple senses of the English preposition *with*.

Two competing accounts, as outlined by McKercher (2001), were tested using densely sampled corpora of one child's interactions with his mother. The results did not entirely support either the monosemy or multiple meanings approach to the acquisition of *with*. Instead, we have argued that our subject applied an initial meaning to *with* that encoded the spatial properties of the preposition — proximity (or co-location). We argued, on the basis of a fine-grained, developmental analysis of the constructions he used *with* in, the verbs that co-occurred in these constructions, and overgeneralization errors, that this was a one-to-one form-meaning mapping that was only later elaborated to represent other senses. We now reconsider the monosemy and multiple meanings approaches, and provide an alternative explanation in light of the current results.

We found little evidence in our data to support the monosemy approach. Recall that this hypothesis predicts that children will encode a range of uses of *with* soon after the preposition begins to be used. Brian used only the four senses of *with* during the first year following his first recorded use. Three of these were the highest frequency senses in the input, and the fourth, the causal role, appeared only once toward the end of the third year.

Although the multiple meanings approach predicts one-to-one form-meaning correspondences, it predicts that separate form-meaning pairings will be set up for individual senses. The analyses of the input data suggest that, at least for the three most frequent senses, there were many cues available to Brian that could enable him to make different lexical entries for these senses. However, Brian's initial use of these three senses appeared to be subsumed by the spatial proximity schema, which is not predicted by the multiple meanings approach.

On the basis of the results we suggest that Brian initially extracted *a* core feature of *with* and continued to use it in this manner for some time before extending the preposition's meaning. Unlike a Monosemous meaning, this core meaning was restricted in usage. An initial one-to-one form-meaning mapping is consistent with what is known about children's early word learning. Although certainly not a hard and fast rule of acquisition, children avoid applying multiple meanings to a single phonological form. For instance, Clark (1993) argues for the principle of lexical contrast, which states that children expect each form to have a different meaning. It is not unreasonable to suggest that children initially assume an ambiguous form has only one meaning. What are the conditions that could lead a child to induce a basic sense of a preposition?

In their discussion of the spatial properties of English prepositions, Tyler and Evans (2003: 50) introduce the notion of a ''proto-scene'': ''an abstract representation of a recurring real-world spatio-physical

configuration mediated by human conceptual processing.'' Prepositions (or spatial particles) are said to mediate between elements in the scene. Take, for instance, sentence (38).

(38) The infant is in the playpen.

According to Tyler and Evans, the preposition *in* designates a relation in which *the infant* (the *trajectory*) is enclosed by *the playpen* (the *landmark*). Thus containment relations denote the proto-scene for *in*. On the basis of Brian's data, we suggest that the proto-scene for *with* denotes spatial proximity or co-location. Therefore, to induce a basic sense Brain would have to notice the contingency between the use of *with* and the relationship between the entities in the proto-scene. Given the nature of young children's early lives, this suggestion has some import. Adult-child interaction is intimately tied to the ''here-and-now'' (Snow 1977). Thus the situations in which children will hear the most spatially encoded senses of *with* are consistently provided by the language learning context.

The child who learns an initial one-to-one form-function mapping for *with* must eventually elaborate this restricted meaning. The analyses presented here suggest that there are a number of cues provided by the input that enables children to both differentiate and subsequently use different senses. In particular, the construction-type, the semantic category of verb, and features of the event structure encoded by the verb provide the child with multiple cues from which to deduce the three most frequent senses of *with*. The combination of these cues could relieve many of the potential problems the ambiguity of *with* poses to the child. No individual cue is perfect, but their use in combination suggests that the different senses of *with* could be carved out over time on the basis of usage patterns. That is, senses become conventionalized in linguistic contexts in the process of acquiring more language — the tools that enable the child to navigate over semantic space. If sense meanings are carved out on the basis of usage patterns, then different senses will overlap (or be closely related) to the extent that their contextual representations are similar (see Schütze 2000). This approach argues for polysemous rather than monosemous treatment of *with*, since different senses will be sufficiently distinguished by the environment they inhabit to warrant representation in their own right.

4.1. *The polysemy of* with*: a dynamic constraints approach*

It is often stated in linguistics that natural languages avoid ambiguity to maximize communicative potential. However, this is simply not the case — ambiguity abounds. As a first approximation, polysemy aids economy

of storage, but the psycholinguistic motivations may go beyond storage. Polysemous items ground construal in a conceptual region from which a given sense can be derived from sentential, discourse, and extralinguistic context: although the meaning of a polysemous word may be ambiguous in isolation, it is rarely ambiguous in context. It is in this sense that polysemy in fact *maximizes* the communicative potential of individual lexical items by extracting maximum usage from a single phonological form. Rather than being a design *fault* in the system, we suggest it is a design *feature* that gains its power from the considerably powerful ability of the human language faculty to perform rapid componential analysis of incoming language.

Work in psycholinguistic studies of sentence processing in both children and adults support this suggestion. For instance, Kidd (2003) has shown that children as young as five years pursue different interpretations of *with* in sentences containing ambiguity of PP-attachment, depending on the semantics of the verb. Children were presented with sentences such as (39) and (40).

(39) The girl hit the boy with the book.
(40) The lady listened to the man with the hearing aid.

Sentence (39) contains an action verb, whereas (40) contains a verb of perception. Kidd showed that even the youngest children pursued different interpretations for these sentences based on the semantics of the verb. When the test sentences contained action verbs the children most often applied an instrumental analysis to the ambiguous *with*-phrase, whereas when the test sentences contained verbs of perception the children most often applied an attribute analysis. The results were argued to derive from the fact that the semantic properties of the verbs result in complementary distribution of the INS and ATT senses: actions often require instruments whereas perceptual events, by and large, do not. This asymmetry is reflected in children's input (see also Snedeker and Trueswell 2004). This result was consistent with adult psycholinguistic research reported by Spivey-Knowlton and Sedivy (1995). Furthermore, such effects stretch beyond the construal of polysemous prepositions: Hare et al. (2003, 2004) report on corpora and experimental studies showing that different senses of polysemous verbs correlate highly with different argument structure probabilities, and that sentential contexts that bias one sense construal over another effectively prime argument structure preference in sentences that contain temporary direct object/sentential complement ambiguity.

A dynamically construed approach to lexical representation is consistent with a number of accounts of lexical meaning. Rumelhart (1979) has suggested that words do not have meaning; rather, they are *cues* to

meaning. Similarly, Cruse (1994, 2000) has argued for fluidity in semantic structure, suggesting that sense units are computed "online" at the moment of use. Instead of bounded semantic structure, Croft and Cruse (2004) suggest that lexical items possess "purport": raw semantic material contributed by the word to the process of construal. Finally, Elman (2004) has suggested that lexical items act directly on mental states: lexical items act as sign posts to construal through semantic space.

Work by Sandra and Rice (1995) and Tyler and Evans (2001, 2003) suggests that, although speakers do not make fine-grained distinctions that concur with linguists intuitions (which result in elaborate networks of senses — e.g., Lakoff 1987), they do encode prominent abstract properties of prepositions. The required work for *with* is yet to done, but we can offer one property that we suggest will feature in the mind of the speaker — proximity. Further to this, we argue that it is difficult to separate senses from their linguistic environment, such that senses are associated with their defining contextual information. Only when such information is considered can a full account of polysemy be given.

As stated earlier, since we have presented production data we can only indirectly infer the content of Brian's representations. Furthermore, it is important to note that we have presented data from only one mother-child dyad. It is therefore possible that our results do not generalize to all children, since differences in learning styles and input will certainly affect acquisition. Future research is needed to test the conclusions drawn from this article. To corroborate our arguments experimental evidence from young children is needed, potentially using high resolution techniques such as preferential looking and eye-tracking. The results from the present study provide a number of predictions that could be easily tested using these techniques. Furthermore, our analyses could be applied to adult corpora, from which hypotheses could be formulated to test representation in the adult state.

5. Conclusion

In this article we used densely collected data from one child and his mother to test two competing predictions regarding the manner in which children acquire the multiple senses of the polysemous English preposition *with*. We argued that our data supported neither approach, and instead that the data is explained by a combination of early lexical learning principles and dynamic approaches to lexical representation. A dynamic constraints approach to polysemy suggests that meaning is derived from the confluence of cues available in the speech stream. Following this

approach, we suggested that our subject acquired the multiple senses of *with* through the categorization of usage patterns in his input language, both at the construction and lexical level.

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Appendix A

Note: The verbs in the input were coded according to the semantics of the event they encoded. Three broad classes were identified: (i) verbs denoting physical actions and activities, (ii) light verbs, and (iii) psychological predicates and verbs of perception. The information in brackets in the 'Semantics' column denotes the verb class as listed in Levin (1993). The analyses reported for the aspectual features of the verb compare action versus activity verbs (block letters), where action verbs encode instantaneous punctual events, and activity verbs encode continuous durative events. These correspond roughly to the distinction between semelfactive and activity situation types drawn by Smith (1991).

Table A. *Semantic coding of verbs for input sample: NP-V-NP-with-NP construction where* with *encodes ACC*

ACC		Semantics
bring	2	ACTIVITY (sending and carrying)
copula be	5	LIGHT
do	1	LIGHT
drink	1	ACTIVITY (ingestion)
finish	1	ACTIVITY (aspectual: begin verbs)
get	3	LIGHT (obtaining)
have	13	LIGHT (containment)
leave	1	ACTIVITY
like	2	PSYCH (admiration)
look at	3	PSYCH (perception)
make	1	LIGHT (build/creation/transformation)
play	1	ACTIVITY (social interaction)
put	6	LIGHT (putting verbs)
see	2	PSYCH (perception)
share	9	ACTIVITY (social interaction)
sort out	1	ACTIVITY
take	3	LIGHT (sending/carrying)
watch	2	PSYCH (sight/perception)
wear	1	ACTIVITY (grooming and bodily care: dressing)
would like	1	PSYCH (desire/obtaining)
Total	59	

Table B. *Semantic coding of verbs for input sample: NP-V-NP-with-NP construction where* with *encodes ATT*

ATT		Semantics
buy	1	ACTIVITY (obtaining: get verbs)
copula be	91	LIGHT
crush	1	ACTION (change of state: break verbs)
draw	1	ACTIVITY (image creation)
eat	1	ACTIVITY (ingestion)
find	2	ACTIVITY (change of possession: obtaining: get verbs)
get	11	LIGHT
have	15	LIGHT
hit	1	ACTION (contact by impact)
imitate	1	ACTIVITY
keep	1	ACTION (hold and keep verbs)
like	3	PSYCH (admire verbs)
look	3	PSYCH (perception)
looks like	1	PSYCH (perception)
make	1	LIGHT
need	2	LIGHT
pick up	2	ACTION (change of possession: obtaining: get verbs)
point out	1	ACTION (verbs involving body: gesture: wink verbs)
pop	1	ACTION (change of state: other)
remember	1	PSYCH (predicative comp verbs: characterize verbs)
see	5	PSYCH (perception: see verbs)
sell	1	ACTION (change of possession: give verbs)
sent	1	ACTION (sending and carrying: send verbs)
show	1	ACTION (communication: transfer of message)
stack	1	ACTION (putting: spray/load verbs)
stick	1	ACTION (combining and attaching: shake verbs)
tip	2	ACTION (throwing verbs)
want	1	LIGHT
want	1	LIGHT
wear	2	ACTIVITY (grooming and bodily care: dressing verbs)
Total	157	

Table C. *Semantic coding of verbs for input sample: NP-V-NP-with-NP construction where* with *encodes INS*

INS		Semantics
bang	1	ACTION (contact by impact)
brush	4	ACTION (wipe verbs: instrument subclass)
catch	7	ACTION (verb of obtaining)
change	1	ACTION (verbs of change of possession: exchange)
chase	1	ACTIVITY (assuming a position)
cover	2	ACTION (existence/contiguous location)
crunch	1	ACTION (sound emission/ingestion)
cut	7	ACTION (verbs of cutting)

Table C (*Continued*)

INS		Semantics
cut down	1	ACTION (verbs of cutting)
decorate	2	ACTIVITY (image creation)
do	10	LIGHT
draw	2	ACTIVITY (image creation)
dry	3	ACTIVITY (alternating change of state)
dust	1	ACTIVITY (wipe: manner subclass)
eat	1	ACTIVITY (ingestion)
fill	8	ACTIVITY (change of state)
get	1	LIGHT
give	1	LIGHT (transfer)
hit	4	ACTION (contact by impact)
hold	1	ACTIVITY (hold verbs)
hook	1	ACTION (combining and attaching: tape verbs)
kick	1	ACTION (contact by impact)
lock	1	ACTION (combining and attaching: tape verbs)
look	1	PSYCH (perception)
make	6	LIGHT (build/creation/transformation)
mix	2	ACTIVITY (creation and transformation: preparing verbs)
paint	1	ACTIVITY (image creation: scribble verbs)
peel	2	ACTIVITY (removing: pit verbs)
pick	3	ACTION (change of possession: get verbs)
poke	1	ACTION (poke verbs)
pull	1	ACTION (exerting force: push/pull verbs)
push	1	ACTION (exerting force: push/pull verbs)
rinse	1	ACTIVITY (removing/wipe verbs/manner subclass)
roll	1	ACTION
run	2	ACTIVITY (manner of motion)
run over	1	ACTION (contact by impact)
slice	2	ACTION (contact by impact)
splash	1	ACTION (emission: sound emission)
squash	1	ACTION (contact by impact)
stir	1	ACTIVITY (existence: modes of being involving ACTION)
take	1	LIGHT (sending and carrying: take and bring verbs)
tidy	2	ACTIVITY
touch	1	ACTION (contact)
walk	1	ACTIVITY (motion: run verbs)
wash water	1	ACTIVITY (grooming and bodily care: preparing verbs)
water	4	ACTION (verbs of putting: butter verbs)
wet	1	ACTION
wind	1	ACTION (creation and transformation: knead verbs)
wipe	9	ACTION (removing: wipe verbs)
Total	111	

Appendix B

Table D. *Semantic coding of verbs for input sample: NP-V-with-NP construction where* with *encodes ACC*

ACC		Semantics
come	18	LIGHT
copula be	6	LIGHT
count	2	ACTIVITY (categorize verbs)
do	5	LIGHT
drive	1	ACTIVITY (sending and carrying: drive verbs)
drive off	1	ACTION (verbs of motion using a vehicle)
fight	3	ACTIVITY (social interaction: fight)
go	16	LIGHT
have	2	LIGHT
joke	1	ACTIVITY (social interaction: correspond verbs)
jump	2	ACTION (change of state: calibratable change verbs)
lie	1	ACTIVITY (verbs of existence: spatial configuration verbs)
live	1	ACTIVITY (verbs of existence)
play	19	ACTIVITY (social interaction: meet verbs)
run	2	ACTIVITY (manner of motion)
sit	13	ACTIVITY (putting: spatial configuration verbs)
sleep	5	ACTIVITY (involving body: snooze verbs)
stay	11	ACTIVITY (lodge verbs)
talk	1	ACTIVITY (communication: talk verbs)
walk	2	ACTIVITY (motion/manner/run verbs)
water	1	ACTION (verbs of putting: butter verbs)
Total	113	

Table E. *Semantic coding of verbs for input sample: NP-V-with-NP construction where* with *encodes INS*

INS		Semantics
(could) do	3	LIGHT (desire: want verbs)
begin	1	ACTIVITY (aspectual: begin verbs)
brush	1	ACTION (wipe verbs: instrument subclass)
draw	1	ACTIVITY (image creation)
drink	2	ACTIVITY (ingestion)
fall out	1	ACTIVITY (social interaction)
fill up	2	ACTIVITY (change of state)
finish	8	ACTIVITY (aspectual) (begin verbs)
fish	1	ACTIVITY (searching: hunt verbs)
help	1	ACTIVITY
listen	1	PSYCH (perception)
mix	1	ACTIVITY (creation and transformation: preparing verbs)
pay	1	ACTION (change of possession: give verbs)
press down	1	ACTION (exerting force: push/pull verbs)
wash	2	ACTIVITY (grooming and bodily care: preparing verbs)
wipe	3	ACTION (removing: wipe verbs)
Total	30	

Notes

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1. Some further qualification on the nature of these predictions is needed. Both the multiple meanings approach and the monosemy approach are hypotheses about children's initial *representation(s)* of *with*, and usage is an indirect function of representation. It is entirely possible that a child could learn different senses of *with* via the multiple meanings approach, and still use different senses at similar time points in development. We will return to this issue in the discussion.
2. Age notations follow the standard for the discipline: years-months-days.
3. Somewhat paradoxically, McKercher also presents a Chi-square analysis which shows a significant difference between the children and adults, and on the basis of this argued that the children's uses are not correlated with their input. However, the children only differed substantially from the adults in their use of one sense: Reference (e.g., *Rufus is unpopular with his peers*), which is arguably an adult, idiomatic usage. When this sense is removed from the analysis the result is not significant ($\chi^2 = 8.13$, $df = 5$, $p > .10$).
4. Analyses were conducted on token frequencies only, since an analysis of type frequency on the broad semantic classes would not be informative.
5. The transcribers for the corpus were trained to identify Brian's nonstandard uses, and marked them in the transcripts. Thus, although some of his nonstandard uses of *with* sound acceptable in isolation, we can be sure that each constitutes a nonstandard use of the preposition.

References

Backsheider, Andrea, G. and Gelman, Susan A. (1995). Children's understanding of homonyms. *Journal of Child Language* 22, 107–127.

Bloom, Paul (2000). *How Children Learn the Meaning of Words*. Cambridge, MA: MIT Press.

Booth, James, R. and Hall, William, S. (1995). Development of the understanding of the polysemous meanings of the mental-state verb *know*. *Cognitive Development* 10, 529–549.

Bowerman, Melissa (1982). Reorganizational processes in lexical and syntactic development. In *Language Acquisition: The State of the Art*, Eric Wanner and Lila Gleitman (eds.), 319–346. Cambridge: Cambridge University Press.

Brooks, Patricia and Tomasello, Michael (1999). How young children constrain their argument structure constructions. *Language* 75, 720–738.

Clark, Eve V. (1993). *The Lexicon in Acquisition*. Cambridge: Cambridge University Press.

—and Carpenter, Kathie L. (1989). The notion of source in language acquisition. *Language* 65, 1–30.

Croft, William (1991). *Syntactic Categories and Grammatical Relations*. Chicago: University of Chicago Press.
—and Cruse, D. Alan (2004). *Cognitive Linguistics*. Cambridge: Cambridge University Press.
Cruse, D. Alan (1986). *Lexical Semantics*. Cambridge: Cambridge University Press.
—(2000). Aspects of the micro-structure of word meanings. In *Polysemy: Theoretical and Computational Approaches*, Yael Ravin and Claudia Leacock (eds.), 30–51. Oxford: Oxford University Press.
—(1992). Monosemy vs. polysemy. *Linguistics* 30, 577–599.
—(1994). Prototype theory and lexical relations. *Rivista di Linguistica* 6, 167–188.
Cuyckens, Hubert and Zawada, Britta (eds.) (2001). *Polysemy in Cognitive Linguistics: Selected Papers from the International Cognitive Linguistics Conference, Amsterdam, 1997*. Amsterdam: John Benjamins.
Doherty, Martin J. (2000). Children's understanding of homonymy: metalinguistics awareness and false belief. *Journal of Child Language* 27, 367–392.
—and Perner, Joseph (1998). Metalinguistic awareness and theory of mind: just two words for the same thing? *Cognitive Development* 13, 279–305.
Elman, Jeffrey L. (2004). An alternative view of the mental lexicon. *Trends in Cognitive Sciences* 8, 301–306.
Fisher, Cynthia (1996). Structural limits on verb mapping: the role of analogy in children's interpretations of sentences. *Cognitive Psychology* 31, 41–81.
Geeraerts, Dirk (1993). Vagueness's puzzles, polysemy's vagaries. *Cognitive Linguistics* 4, 223–272.
Gelman, Susan A. and Taylor, Marjorie (1984). How two-year-old children interpret proper and common names for unfamiliar objects. *Child Development* 55, 1535–1540.
Gibbs, Raymond, Jr. and Matlock, Teenie (2001). Psycholinguistic perspectives on polysemy. In *Polysemy in Cognitive Linguistics: Selected Papers from the International Cognitive Linguistics Conference, Amsterdam, 1997*, Hubert Cuyckens and Britta E. Zawada (eds.), 213–236. Amsterdam: John Benjamins.
Hare, Mary; McRae, Ken; and Elman, Jeffrey (2003). Sense and structure: meaning as a determinant of verb subcategorization preferences. *Journal of Memory and Language* 48, 281–303.
—; McRae, Ken; and Elman, Jeffrey (2004). Admitting that admitting sense into corpus analyses makes sense. *Language and Cognitive Processes* 19, 181–224.
Katz, Jerold J. (1972). *Semantic Theory*. New York: Harper and Row.
Keenan, Edward and Faltz, Leonard M. (1995). *Boolean Semantics for Natural Language*. Dordrecht: Reidel.
Kidd, Evan (2003). An investigation into children's sentence processing: a developmental perspective. Unpublished doctoral dissertation, La Trobe University.
Kishner, Jeffrey and Gibbs, Raymond, W. Jr. (1996). How *just* gets its meanings: polysemy and context in psychological semantics. *Language and Speech* 39, 19–36.
Klein, Devorah, E. and Murphy, Gregory L. (2001). The representation of polysemous words. *Journal of Memory and Language* 45, 259–282.
Lakoff, George (1987). *Women, Fire, and Dangerous Things*. Chicago: University of Chicago Press.
—and Johnson, Mark (1980). *Metaphors We Live By*. Chicago: University of Chicago Press.
Levin, Beth (1993). *English Verb Classes and Alternations: A Preliminary Investigation*. Chicago: University of Chicago Press.
Lieven, Elena; Behrens, Heike; Spears, Jennifer; and Tomasello, Michael (2003). Early syntactic creativity: a usage-based approach. *Journal of Child Language* 30, 333–370.

MacDonald, Scott, A. and Shillcock, Richard C. (2001). Rethinking the word frequency effect: the neglected role of distributional information in lexical processing. *Language and Speech* 44, 295–323.

MacWhinney, Brian (2000). *The CHILDES Project: Tools for Analyzing Talk, Vol. 1*. Mahwah, NJ: Erlbaum.

McKercher, David A. (2001). The polysemy of *with* in first language acquisition. Unpublished doctoral dissertation, Stanford University.

Naigles, Letitia (1990). Children use syntax to learn verb meanings. *Journal of Child Language* 17, 357–374.

Nilsen, Don L. F. (1973). *The Instrumental Case in English: Syntactic and Semantic Considerations*. Janua Linguarum series minor 156. The Hague: Mouton.

Peters, Ann M. and Zaidel, Eran (1980). The acquisition of homonymy. *Cognition* 8, 187–207.

Ravin, Yael and Leacock, Claudia (eds.) (2000). *Polysemy: Theoretical and Computational Approaches*. Oxford: Oxford University Press.

Rumelhardt, David, E. (1979). Some problems with the notion that words have literal meanings. In *Metaphor and Thought*, Andrew Ortony (ed.), 71–82. Cambridge: Cambridge University Press.

Sandra, Dominiek and Rice, Sally (1995). Network analyses of prepositional meaning: mirroring whose mind — the linguist's or the language user's? *Cognitive Linguistics* 6, 89–130.

Schütze, Hinrich (2000). Disambiguation and connectionism. In *Polysemy: Theoretical and Computational Approaches*, Yael Ravin and Claudia Leacock (eds.), 205–219. Oxford: Oxford University Press.

Schwanenflugel, Paula, J.; Fabricus, William V.; and Noyes, Caroline R. (1996). Developing organization of mental verbs: evidence for the development of a constructivist theory of mind in middle childhood. *Cognitive Development* 11, 265–294.

Smith, Carlota S. (1991). *The Parameter of Aspect*. Dordrecht: Kluwer.

Snedeker, Jesse and Trueswell, John C. (2004). The developing constraints on parsing decisions: the role of lexical-biases and referential scenes in child and adult sentence processing. *Cognitive Psychology* 49, 238–299.

Snow, Catherine (1977). The development of conversation between mothers and babies. *Journal of Child Language* 4, 1–22.

Spivey-Knowlton, M. and Sedivy, J. C. (1995). Resolving attachment ambiguities with multiple constraints. *Cognition* 55, 227–267.

Stolz, Thomas (1997). Some instruments are good companions — some are not: on syncretism and the typology of instrumentals and comitatives. *Theoretical Linguistics* 23, 113–200.

Taylor, John (1995). *Linguistic Categorization: Prototypes in Linguistic Theory*. Oxford: Oxford Clarendon Press.

—(2003). Polysemy's paradoxes. *Language Sciences* 25, 637–655.

Tomasello, Michael (1987). Learning to use prepositions: a case study. *Journal of Child Language* 14, 79–98.

—(2003). *Constructing a Language: A Usage-Based Theory of Language Acquisition*. Cambridge, MA: Harvard University Press.

Tuggy, David (1993). Ambiguity, polysemy, and vagueness. *Cognitive Linguistics* 4, 273–290.

Tyler, Andrea and Evans, Vyvyan (2001). Reconsidering prepositional polysemy networks: the case of *over*. *Language* 77, 724–765.

—and Evans, Vyvyan (2003). *The Semantics of English Prepositions*. Cambridge: Cambridge University Press.