ELSEVIER

Cognition 86 (2002) 157–199

COGNITION

www.elsevier.com/locate/cognit

Form is easy, meaning is hard: resolving a paradox in early child language

Letitia R. Naigles

Department of Psychology, University of Connecticut, 406 Babbidge Road, U-20, Storrs, CT 06269-1020, USA

Received 12 November 2001; received in revised form 16 April 2002; accepted 20 August 2002

Abstract

A developmental paradox is discussed: studies of infant processing of language and language-like stimuli indicate considerable ability to abstract patterns over specific items and to distinguish natural from unnatural English sentences. In contrast, studies of toddler language production find little ability to generalize patterns over specific English words or constructions. Thus, infants appear to be abstract auditory or language processors whereas toddlers appear to be non-abstract, item-specific language users. Three resolutions are offered to this paradox. The first, that no resolution is necessary because only the toddler findings come from language use in a communicative context and so only the toddler findings are relevant to linguistic knowledge, is rejected. The second, that the contradictions are rooted in the differing methodologies of the two sets of studies (comprehension vs. production), is found to explain important aspects of the contradictory findings. The third, that the contractions come from the differing *content* of the stimuli in the studies, is also found to be explanatory and is argued to carry greater weight. Resolution 3 suggests that the patterns that infants extract from their linguistic input are not yet tied to meaning; thus, toddlers do not lose these earlier-abstracted forms but their use of them is limited until they have been integrated with meaning. It is argued that in language acquisition, learning form is easy but learning meaning, and especially linking meanings and forms, is hard. © 2002 Elsevier Science B.V. All rights reserved.

Keywords: Form; Meaning; Early child language

1. Introduction

Recent research in early child language acquisition has yielded two seemingly contradictory sets of findings. On the one hand, research with pre-verbal and barely verbal human infants has demonstrated robust abilities to abstract both specific and general patterns of varying complexity from auditory (both linguistic and language-like) stimuli (e.g. Gómez & Gerken, 1999; Marcus, Vijayan, Bandi Rao, & Vishton, 1999; Saffran, Aslin, &

E-mail address: naigles@uconnvm.uconn.edu (L.R. Naigles).

0010-0277/02/$ - see front matter © 2002 Elsevier Science B.V. All rights reserved.
PII: S0010-0277(02)00177-4

Newport, 1996; Santelmann & Jusczyk, 1998; Shady, Gerken, & Jusczyk, 1995). On the other hand, research with human toddlers has demonstrated weak or non-existent evidence of general or complex patterns in actual language use (e.g. Akhtar, 1999; Akhtar & Tomasello, 1997; Olguin & Tomasello, 1993; Pine, Lieven, & Rowland, 1998; Tomasello, 1992a). Thus, infants appear to be abstract auditory or language processors whereas toddlers appear to be non-abstract, item-specific language users. Moreover, some evidence from infants suggests that they have already acquired certain aspects of their language-specific grammatical patterns, whereas other evidence from toddlers finds they have little grasp of their language-specific grammatical patterns. One consequence of these disparate sets of findings is the continuing bifurcation of theoretical approaches to language learning: those who hold that abstract linguistic knowledge is present early or innately in children and that some language-specific grammatical knowledge is acquired early can point to the infancy findings for support (e.g. Aslin, Saffran, & Newport, 1999; Jusczyk, 1997; Maratsos, 1998; Newport & Aslin, 2000; Pinker, 1994b), whereas those who hold that abstract linguistic knowledge and even basic language-specific grammatical knowledge develops later can point to the toddler findings for support (e.g. Bloom, 1998; Snow, 1999; Tomasello, 2000). Both approaches agree that language learners must formulate abstract linguistic generalizations specific to the language they are acquiring; the issue becomes when in the life of the learner this is begun. If both sets of findings are taken at face value, it appears as if toddlers have lost some of their earlier abstracting abilities and language-specific knowledge. The purpose of this paper is to describe a more satisfactory resolution for the contradictory findings and to sketch a theoretical approach to language acquisition that draws from this resolution.

The plan of the paper is as follows. Section 2 presents the two sets of contradictory findings. I begin with a summary of five studies in which pre-verbal and barely verbal infants display considerable abilities to process and extract generalizations from auditory linguistic or pseudo-linguistic stimuli. Next I summarize five studies in which 1- and 2-year-old children are shown to *not* display linguistic generalizations in their spontaneous and elicited speech. I then highlight some specific findings in the two sets that are in almost direct contradiction. Section 3 considers three possible resolutions to these contradictory findings. First, that no resolution is necessary because only the toddler findings come from language use in a communicative context and so only the toddler findings are relevant to linguistic knowledge. Second, that the contradictions are rooted in the differing methodologies of the two sets of studies, as the infancy findings come from assessments of comprehension whereas the toddler findings primarily come from assessments of production. Third, that the contradictions come from the differing *content* of the stimuli in the studies, as the infants generalized across forms devoid of content whereas the toddlers were asked to generalize forms that included novel content.

Resolution 1 will be shown to be unsatisfactory; in contrast, Resolutions 2 and 3 will each be shown to explain important aspects of the contradictory findings, with greater weight given to Resolution 3. That is, natural language is composed of abstract patterns of units, patterns which are conditioned by the meanings they distinguish. Resolution 3 suggests that the patterns that infants extract from their linguistic input may revolve around specific lexical items, may be generalized across lexical items, and may be hierarchically organized, but they are not yet tied to meaning, be it communicative,

referential, or propositional. Toddlers do not then lose these earlier-abstracted forms; however, their use of them is limited until they have been integrated with meaning. My contention will be that the task of determining the meanings of the forms is so complex and difficult that toddlers' existing formal generalizations may become masked or overshadowed during the process. In short, in language acquisition, learning form is easy (even an infant can do it), but learning meaning, and especially linking meanings and forms, is hard.

2. Two sets of findings: infants can make abstract generalizations but toddlers cannot

2.1. The infancy studies

2.1.1. Saffran et al. (1996)

Much of the speech produced in the presence of pre-verbal infants is continuous, in that there are few pauses between words. The question arises, then, how does the infant *segment the input*, so as to extract words from this stream of speech? Saffran and her colleagues (Aslin et al., 1999; Saffran et al., 1996) postulated that infants (and indeed, older children and adults) could exploit the varying *transitional probabilities* between syllables to help perform this segmentation. That is, within a corpus of speech, the probability that one syllable is followed by a second is higher when these syllables are part of the same word than when they are not. For example, in the phrase *pretty baby*, the transitional probabilities between the syllables *pre* and *ty* and between *ba* and *by* are higher than that between *ty* and *ba*, which comprise the boundary between the two words. The transitional probability differences between within-word and cross-word syllables are not categorical (i.e. absolute); however, the former are consistently statistically higher than the latter.

Saffran and her colleagues demonstrated that 8-month-old infants are sensitive to these transitional probabilities in verbal and tonal stimulus sets, and can use them to extract recurring sequences. First, they presented four three-syllable pseudowords to the infants repeatedly in random order for 3 min. Within this presentation, the probability that one syllable would follow another was higher when the two syllables were part of the same pseudoword (e.g. *ro* and *da* in *tudaro*) than when they were adjacent parts of two different pseudowords (e.g. *pa* and *bi* in *budopa bikuti*). Immediately after this presentation, the infants heard two different strings of syllables. One string was comprised of two of the "old" pseudowords from the presentation set (e.g. *tudaro*) whereas the other string was comprised of two new three-syllable pseudowords which contained two syllables from one "old" pseudoword plus one syllable from another "old" pseudoword (e.g. *pabiku*). Thus, the infants had already heard both types of stimuli; however, the transitional probabilities of the presentation set had facilitated the segmentation of the stimuli into the "old" pseudowords but not the "new" pseudowords. If the infants were able to use the transitional probabilities, they should behave differently with the two types of pseudowords. And indeed they did: given the choice of which to listen to (in the Head-Turn-Procedure, cf. Jusczyk & Aslin, 1995; Kemler Nelson et al., 1995), the infants consistently preferred the "new" pseudowords over the "old" ones. Subsequent studies

(summarized in Aslin et al., 1999) demonstrated that this effect could not be attributed to different frequencies of the "old" and "new" pseudowords in the presentation set, and that infants' sensitivity to transitional probabilities holds when the stimuli are comprised of pure tones instead of CV syllables.

These studies reveal how well pre-verbal infants can analyze auditory stimuli. That is, they can compute some kind of transitional probability across multiple syllables in ongoing auditory input. Moreover, they appear to remember those sequences of syllables, whose transitional probabilities were high, as coherent units. Thus, these studies provide evidence of infants' sensitivity to co-occurrence relations between syllables, which could be of use in other aspects of language development (e.g. Cartwright & Brent, 1997; Maratsos & Chalkley, 1980).

2.1.2. *Marcus et al. (1999)*

The findings of Saffran and her colleagues were lexically specific; that is, the infants were evidently able to recognize the same sequences of syllables (depending on their transitional probabilities) in the test set that they had heard in the presentation set. Can infants take account of more abstract patterns, not just between specific syllables of an utterance but also between specific *places* or *relations* in an utterance? Marcus and his colleagues (Marcus, 1999a,b; Marcus et al., 1999) conjectured that infants could learn simple rules; that is, "open-ended abstract relationships for which we can substitute arbitrary items" (p. 77). The "rules" which Marcus et al. taught the infants were not the specific rules of any natural human language, but rather some simpler abstract patterns of same vs. different syllables.

Marcus and his colleagues demonstrated that 7-month-old infants who were given a series of three-syllable sequences in one pattern would indeed recognize that pattern when it was manifested by entirely new syllables. First, they presented two different series of sequences to two groups of infants. One group heard a series of sequences that were all of the pattern ABA (e.g. *ga ti ga*); the other group heard the same syllables, now in sequences of the pattern ABB (e.g. *ga ti ti*). Following these presentation sets, both groups heard more sequences consisting of entirely new syllables following the ABA (*wo fe wo*) and ABB (*wo fe fe*) patterns. Marcus et al. (1999) found that both groups discriminated the pattern they had previously heard from the new patterns; both groups preferred to listen to the new pattern. Follow-up and subsequent studies demonstrated that this pattern discrimination was not attributable to phonetic properties of the presentation or test sequences, nor to the presence of reduplicated syllables in one pattern but not in the other, nor to the infants processing only the sameness vs. difference of the final two syllables of each sequence rather than the pattern captured by all three syllables (e.g. Eimas, 1999; Marcus, 1999b,c).

These findings provide compelling evidence that pre-verbal infants can generalize an auditory pattern beyond specific syllabic stimuli.[1] That is, even though the infants only

[1] Debate continues concerning the specifically *algebraic* nature of the infant's representation; however, there is agreement that these representations were composed of abstract patterns (McClelland & Plaut, 1999; Sirois, Buckingham, & Shultz, 2000).

heard limited examples of each pattern, they were apparently able to recognize it when it was instantiated by an entirely new set of syllables.

2.1.3. Gómez and Gerken (1999)

The type of pattern or rule that Marcus et al.'s infants learned was extremely simple, involving only two variables which had limited privileges of occurrence. Can infants learn more complex patterns and privileges of occurrence as well? Gómez and Gerken (1999) hypothesized that somewhat older infants (12 months of age) would be sensitive to the configurations of an artificial grammar that was essentially order-based but also included some recursive elements, making it more similar to natural language than the stimuli of Marcus et al. (1999) (i.e. a finite-state grammar). Moreover, they predicted that infants would also be able to abstract these configurations beyond the specific utterances in which they were learned.

Gómez and Gerken conducted four experiments in which infants were first exposed to 2 min samples of connected CVC syllables configured according to the strings of a finite-state grammar, and then tested on new strings of syllables which either did or did not follow the dictates of the grammar. In the first three experiments, the test syllables were identical to the training syllables, and the test violations consisted of switching the first and last syllables in the string (Experiment 1), switching pairs of syllables within the string (Experiment 2), or presenting an entirely new grammatical configuration within the string (Experiment 3). In all three cases, infants during the test phase discriminated the two types of strings; specifically, they listened longer to the new strings that adhered to the training grammar than to the new strings that did not. The infants in these experiments could have made these distinctions based on the transitional probabilities of specific words (i.e. *vot* can begin a string but *jic* cannot, *pel* can precede *rud* but not follow it); however, it is important to point out that the difference between these probabilities in the grammatical vs. ungrammatical test strings was not large (e.g. not 1.0 vs. 0 or 0.3, as in the Saffran et al. (1996) studies). Thus, the findings of these three experiments support the notion that pre-verbal infants are sensitive to the transitional probabilities between words in more complex configurations and in ranges closer to those of natural languages than were studied by Saffran et al. (1996) and Aslin et al. (1999).

Gómez and Gerken's final experiment went one step further, and asked whether infants could have *abstracted* any knowledge of the training grammar that was not dependent on the specific syllables. In this experiment, the syllables used in the training set were completely different from those used in the test sets; each test syllable mapped onto a training syllable in a one-to-one fashion. After hearing the strings of the training set, the infants heard one warm-up string which included the new syllables either adhering to the training grammar or to the "violations" grammar. Then they heard more strings with the new syllables, some of which adhered to the training grammar and some of which did not. Infants significantly preferred to listen to the strings that were consistent with the training grammar (even with new vocabulary) than to those that were not. Thus, this experiment demonstrated that 12-month-old infants are capable of abstracting *configurations of units* rather than just specific word pairs or transitional probabilities. That is, they remembered

something about the structure of the training syllables, not just their ordering, and were able to transfer that structure to a new set of items.

2.1.4. Shady et al. (1995) and Shady (1996)

All of the above studies have investigated infants' acquisition of auditory patterns that were considerably simpler than those of natural human languages. The last two sets of studies examined older infants' acquisition of specifically *English* patterns. The logic was as follows: if pre-verbal infants can process linguistic stimuli in at least some of the ways that they have been shown to process pseudo-language stimuli, then it seems likely that by their second year they will have performed a number of analyses on their actual linguistic input. The next two sets of studies assess what they might have learned.

Shady et al. (1995) first demonstrated that 10.5-month-old infants distinguished English passages where the determiner and noun were reversed (e.g. *House the is red*) from those where these terms were in the proper order (*The house is red*). This distinction in these young infants, though, could be based on the anomalous presence of sequences of grammatical morphemes rather than on an understanding of specific privileges of specific grammatical items. Shady (1996) investigated the development of this latter understanding in infants from 12 to 16 months of age. She presented them with English passages that either adhered to English word order (*The kitten was hiding*), or scrambled English word order by switching some closed-class items (*Was kitten the hiding*). Synthetically-created stimuli ensured that the prosodic characteristics of the passages were identical. Shady found that 16-month-olds, but not 12- or 14-month-olds, preferred to listen to the passages with English word order as opposed to those with scrambled word order. Thus, by this age English-learning infants seem to have learned some specific properties of English, such as the necessity of question prosody for a sentence beginning with a verb (or "was") and the placement of "the" to precede a noun/object word rather than follow it. Any likely explanation, though, would have to assume some knowledge on the part of the infants about the arrangement of specific English lexical items which the infants themselves are not yet producing (e.g. "the" and "was").

2.1.5. Santelmann and Jusczyk (1998)

This final study to be reviewed assessed another aspect of English morphosyntax; namely, the discontinuous dependency between a form of the auxiliary verb *be* and the progressive form of the following verb. The presence of *be* mandates the progressive aspect on the following verb, regardless of how many words or phrases separate the two (e.g. *She IS runnING*, *WASn't the girl with the soccer ball runnING quickly?*) Santelmann and Jusczyk investigated when infants become sensitive to this dependency and how distant the two elements can be and still be recognized as dependent.

Fifteen-month-olds and 18-month-olds were presented with two types of English passages. Both types included verbs in the progressive aspect; they differed on whether the accompanying auxiliary was a form of *be* or *can* (e.g. *She is running* vs. **She can running*). Santelmann and Jusczyk found no evidence that the 15-month-olds distinguished the two types of passages; however, the 18-month-olds consistently preferred the Natural passages (i.e. with the *be* auxiliaries) over the Unnatural passages (with the *can* auxiliaries). Interestingly, this held when the auxiliary and matrix verb were adjacent

(*be* and *ing* separated by only one syllable, the matrix verb) and when a one- or two-syllable adverb was interposed between the auxiliary and the matrix verb (e.g. *She is now/ always running*). However, greater distances between the two elements, whether composed of single polysyllabic adverbs or combinations of monosyllabic adverbs, yielded no significant preferences for either passage from the 18-month-olds.

These findings demonstrate that infants who are just beginning to talk are sensitive to one of the specific morphosyntactic dependencies of English. Moreover, this is a dependency that cannot be gleaned from pairwise analysis of linguistic elements, but must have been abstracted from a wider analysis of discontinuous elements and generalized over numerous English verbs. That doing this required considerable exposure to and analysis of English can be seen in two ways. First, the 15-month-olds, with 3 months less exposure, showed no sign of mastering this dependency yet. Second, post-hoc comparisons based on the 18-month-olds' language production (by maternal report) revealed that only those infants who were already producing words in combination showed the significant preference for the Natural over the Unnatural passages.

These five studies paint a picture of the human infant as an adept processor of linguistic and language-like auditory stimuli. The infants in these studies were sensitive to the probabilities of adjacent syllables and words, to the patterns of non-adjacent words, and very possibly to some higher-order patterns manifested by finite-state grammars. They were clearly able to recognize the patterns even when the specific words in which the patterns had been taught were changed. These abilities should stand infants in good stead as they become users of the language of their community; however, as we shall see below, these abilities are not always evident in toddlers.

2.2. The toddler studies

2.2.1. Tomasello (1992a)

Children's early noun use is frequently in single-word utterances; however, by the time they are producing many verbs, they have begun to use these latter word types in multi-word utterances. How are these first verbs used in combination with nouns, with function words, and with inflections? Tomasello kept a diary of his daughter's verb uses during her second year of life, which yielded a total of 1200 + multi-word utterances that made use of over 150 verbs.

This 1-year-old child tended to use her verbs in only one construction type (i.e. one frame); for example, she might say "Mommy break" and "Daddy break" but not "Break cup" or "Break with stick". Fewer than one-third of her verbs were used in more than two construction types over the span of her second year. Moreover, growth in grammatical complexity appeared to proceed on a verb-by-verb basis rather than being manifested across a number of verbs. For example, the first occurrences of one verb (e.g. *draw*) with post-verbal prepositional phrases and/or full SVO frames did not coincide with that for any other verb, even those that were similar in meaning and/or were of equal frequency and history in the child's lexicon (e.g. *cut*). Likewise, the child was uneven in her production of lexical subjects and morphological markers; lexical subjects were produced consistently for some verbs (*take*, *get*) but not for others (*put*), and some

verbs received tense markers, others aspect markers, but very few received both (see also Tomasello, 2000).

These findings suggest a fairly conservative language user who applied syntactic forms to verbs as isolated units rather than to verbs as instances of a unified grammatical category. There is little indication that this child had a mental representation of an abstract SVO frame in which verbs of many types can fit, nor indeed of any frame (VO, VPP). In her speech, each verb appeared in its own unique construction and the structural overlap between verbs was minimal.

2.2.2. *Pine et al. (1998)*

Tomasello's findings could be unique to the one child he studied; therefore, it is of crucial importance to investigate the early grammatical flexibility (or lack thereof) of a larger sample of children. Pine et al. (1998) examined the language of 12 children whose spontaneous speech during lunchtime and toy play was taped monthly for 6 months, beginning at the onset of multi-word speech. The children ranged from 15 to 24 months at the beginning of the study. Rather than creating a single corpus of the speech of all 12 children (e.g. Valian, 1986), Pine et al. created a mini-corpus for each child, which was examined for syntactic and morphological productivity across lexical items.

The analysis of morphological use revealed that eight of the 12 children produced verbs in both their unmarked form and with the present progressive inflection, thus providing some indication of productivity. However, only two children showed the same productivity with the past tense (-ed) and third person singular (-s) forms. Furthermore, none of the children across the 6 month span of the study produced any verbs that appeared with more than one type of marker; for example, none produced a verb both in the progressive and in the third person singular. Thus, it appears as if the inflections have not been generalized across verbs; each seems specific to a subclass (see also Bloom, Lifter, & Hafitz, 1980, for an earlier demonstration of toddlers' lexically restricted use of verb morphology). Similar results were obtained from the analysis of auxiliary verb use: whereas each of the children used between three and seven different auxiliaries, each auxiliary's use was restricted to a subclass of verbs and there was little if any overlap between the verbs used with one auxiliary and those used with another. The analysis of the children's subject–verb utterances revealed that an average of 75% of these could be accounted for by idiosyncratic patterns that revolved around specific lexical items rather than general patterns that held across the class of intransitive verbs. The children's transitive sentences seemed similarly conservative: only three of the 12 children produced a significant number of nouns that appeared in both subject and object positions whereas the other children's subjects and objects fell into non-overlapping groups (e.g. a given child might use "Mommy" only in subject position and "doggie" only in object position).

The Pine et al. (1998) analyses paint a picture of the system that underlies early morphology as lexically-specific rather than general to all items in a grammatical class. Specifically, these children used their morphological markers and auxiliaries with unique sets of verbs rather than extending them across their entire verb lexicon. Their sentence constructions showed similar restrictions, in that their intransitive sentences seemed to

revolve around specific lexical items and the nouns of their transitive sentences seemed confined to either subject or object position, but rarely both.

2.2.3. Olguin and Tomasello (1993)

Pine et al. (1998) investigated whether children's first multi-word utterances exhibited the type of productivity in which a grammatical element or frame is used with a variety of lexical items. Olguin and Tomasello (1993) investigated another type of productivity, in which an individual lexical item is used in multiple grammatical frames or with multiple grammatical elements (i.e. in both the present and past tense, or in both transitive and intransitive frames). Specifically, they wondered when children could use a novel verb in a canonical transitive frame (i.e. agent in subject position and patient in object position) even when that verb had been taught with one or two "missing" arguments.

Olguin and Tomasello (1993) investigated children who were 23 months of age at the onset of the study, and fluent multi-word speakers. They taught the children eight different novel causative verbs; for example, *chamming*, to refer to Cookie Monster pushing Big Bird down a hole or Ernie jumping on a seesaw causing Bert (on the other end of the seesaw) to fly into the air. Two verbs were taught in each of four frames: Full transitive (e.g. *Ernie's chamming Bert*), Agent-only (*Ernie's chamming*), Patient-only (*Chamming Bert*), and Verb-only (*Chamming*). Four verbs were taught and reviewed bi-weekly over the first 4 weeks, then the next four verbs were taught in the same fashion over the second 4 weeks. The children were encouraged to perform the actions themselves and to talk about the actions (e.g. "What happened?", "What's going on?"). The crucial question was, would the children who were not taught the verb in the full transitive frame ever produce the verb in that frame? By and large, the answer was no – children were able to talk about new agents and new patients involved in the actions, but if they had been taught about *chamming* in the Agent-only condition, they either used the verb with a pre-verbal noun, mostly as the agent, or without any arguments at all. If they had been taught the verb in the Patient-only condition, they almost always used the verb only with a post-verbal argument, usually the patient, or without any arguments at all. Moreover, when the children were asked to act out the verbs with new agents and new patients at the end of the 8 week training period, they were unable to do so in any consistent SVO order. Thus, these young 2-year-olds appeared to be unable to generalize the novel verbs they had learned in "partial" frames to a full transitive frame; instead, they slavishly adhered to the frame in which the verb had been taught.

2.2.4. Akhtar and Tomasello (1997)

Akhtar and Tomasello also investigated the question of whether children's uses of sentence frames were generalized to members of the form class 'verb' or specific to those verbs in which the frames were attested. They first performed the Olguin and Tomasello (1993) novel verb training sessions with children aged 3;1 (teaching them four novel verbs instead of eight), and they were able to elicit considerably more productivity than had been found with the younger children. Specifically, children who heard a novel verb used only with a pre-verbal agent did produce that verb with a (usually

pronominal) post-verbal patient, and children who heard a verb used only with a post-verbal patient did produce the verb with a (again usually pronominal) pre-verbal agent. Performance on the SVO comprehension test was also better; interestingly, the children who were better comprehenders were also the ones who were more productive in their speech.

Akhtar and Tomasello then turned to older 2-year-olds (mean age 2;9) and gave them more explicit training in producing SVO sentences. First, the children were prompted to produce SVO sentences when describing the familiar action of pushing, then they were taught one of the novel verbs without any arguments and prompted to describe its action with SVO sentences (via imitation of the experimenter). Finally, a second novel verb was taught without any arguments, and the children were asked to describe its action without any specific prompting for SVO frames. Only two of the ten children produced any SVO sentences with this second novel verb; the rest of the children produced the verb without any arguments, as it had been taught. Moreover, the 2-year-olds' enactments of the novel verb in SVO sentences ("Make Ernie cham Bert") were as likely to be performed in reverse as in correct word order. A follow-up study that just focused on the comprehension task trained older 2-year-olds by saying either "Watch what Ernie is going to do to Bert" or "Watch what is going to happen" while performing one of two novel actions; no novel verbs were used. The children then were asked to enact SVO sentences containing novel verbs; their clue as to which action was to be performed was given by the appropriate apparatus being set out. The children performed correctly only 55–58% of the time.

These results indicate that 2-year-olds have great difficulty with two types of grammatical productivity: producing novel verbs in frames in which they haven't been heard and understanding how those verbs are to be instantiated in SVO sentences. Akhtar and Tomasello concluded that 2-year-olds in general do not have an abstract notion of a transitive frame which is independent of the specific verbs in which they have heard it used.

2.2.5. *Akhtar (1999)*

All of the studies reviewed above explored toddlers' grasp of syntax by assessing how general their notion of transitive and intransitive sentence frames was. Akhtar (1999) took a different approach; she investigated the extent to which American toddlers and preschoolers had learned that their transitive sentences were ordered SVO rather than SOV or VSO. That is, Akhtar examined when children had learned enough about English to realize that all transitive sentences, even those with novel verbs, had to adhere to SVO order.

Akhtar taught children three novel verbs for three novel causative actions, one each in SVO (*Elmo dacking the car*), SOV (*Elmo the car gopping*), and VSO (*Tamming Elmo the car*) order. Each verb was modeled in both the present progressive and the past tense, without auxiliary verbs; hence the sentences in the progressive were all somewhat aberrant. Each verb/action pair was modeled a total of 80 times. To elicit the children's productions, 20 instances of each action were performed without the accompanying verb, and the children were asked "What's going to happen now?" or "What happened?". If the children had acquired their language-specific word order, they should have uniformly used SVO order even for those verbs taught in the other orders. This was the

case for the 4-year-olds; however, for the 2-year-olds the results were mixed. On the one hand, the toddlers' frequency of responding was dramatically different for the verb they had heard in SVO order (29% responses, all SVO) than for the verbs they had heard in the other two orders (13.7% responses), indicating that they (a) could distinguish the two types of orders and (b) preferred to respond in their language-specific order (cf. Gerken & MacIntosh, 1993). Moreover, half of their responses with the verbs they had heard in non-canonical orders were corrections to SVO order. On the other hand, six of the 2-year-olds did make at least one response that followed the (non-canonical) order in which the verb had been taught, and the total number of non-SVO responses of the 2-year-olds was significantly greater than that of the 4-year-olds. Therefore, Akhtar (1999) concluded that 2-year-olds did not possess as general and abstract an understanding of English word order as they would eventually manage, and that they still constructed their sentences in a bottom-up, data-driven fashion that was based on the ways they had heard specific verbs, rather than in a top-down, abstract fashion based on a lexically-general understanding of the syntax of English.

In contrast to the first five studies, these second five studies paint a picture of the toddler (18–36 months of age) as a conservative, data-driven, and item-specific language user. Analyses of spontaneous production reveal that toddlers use verbs only in a subset of their possible frames and with limited if any generality across function morphemes. Individual frames and function morphemes seem likewise restricted to use with a subset of possible content words. Even when spontaneous production becomes less restrictive, analyses of elicited production with novel (nonsense) verbs implicate a toddler who is reluctant to extend verbs to frames that were as yet unheard, especially the full SVO frame. And toddlers' mastery of the transitive construction as an abstract frame seems shaky in comprehension tasks with novel verbs; they are just as likely to enact SVO sentences using the first argument as the patient as they are using the first noun as the agent.

2.3. Some specific contradictions

In sum, infants who were so adept at finding the patterns in input and generalizing beyond what they had heard seem to have metamorphosed into toddlers who stay close to the speech they have experienced in their actual language use. Two specific developmental paradoxes can be noted in the above studies. First, Marcus et al. (1999) and Gómez and Gerken (1999) find that their pre-verbal infants (7–12 months of age) can listen to a more-or-less complex auditory pattern instantiated in one set of syllables and then recognize it (as evidenced by preferential listening) even when it is instantiated in an entirely new set of syllables. Something about the pattern seems to have been abstracted from the specific items. In contrast, Tomasello (1992a) and Pine et al. (1998) find that their English-speaking toddlers can only use a frame, auxiliary verb, or verbal inflection with a verb limited set of lexical items; evidently, the pattern is still based on those items and has not yet been abstracted. Olguin and Tomasello (1993) and Akhtar and Tomasello (1997) also find that their English-speaking toddlers, after listening to a number of presentations of novel verb A in sentence type B, and novel verb C in sentence type D, are unable to use verb A in sentence D or verb C in sentence B. Their sentence types seem specific to the verbs (although not the nouns) with which they were learned.

A second developmental paradox can be seen in how sensitive children are to language-specific patterns. Santelmann and Jusczyk (1997) found that their 18-month-olds had learned enough about English to realize that the two morphological elements *be* and *-ing* are co-dependent. In contrast, Akhtar (1999) found that her 2-year-olds had NOT learned enough about English to realize that SVO is the *only* allowable word order; they produced some SOV and VSO sentences when these had been modeled 80 times by a friendly experimenter. Of course, these are two different grammatical patterns of English; however, it seems odd that the one which involves less salient closed class items and more obscure semantics (cf. Gleitman & Wanner, 1984) should be acquired before the one which involves the major noun phrase arguments of the sentence and the basic semantics of the sentence. It is as if the toddler has lost her ability to abstract across individual items and to recognize complex patterns, and is reduced to using grammatical frames and inflectional patterns on an item-by-item basis. The abstract frames which appeared easily recognizable in infancy, and the morphological sensitivity which was emerging in young 1-year-olds, seem quite absent in toddlerhood. How can this developmental contradiction be resolved?

3. Three possible resolutions

3.1. Resolution 1: the infancy findings do not pertain to language and language development whereas the toddler findings do

One possible resolution might point to the difference in communicative contexts between the two sets of findings, and suggest that the infancy findings, because they were obtained outside of a communicative environment, do not pertain to language or language development. Recall that the infancy findings come from a context in which the infant sits facing outward on his or her parent's lap, the parent is unresponsive to the ambient auditory stimuli because s/he is wearing earphones that play masking music, and the infants simply look at blinking lights to their front or sides in showing preferences for one type of auditory stimuli over another – all in all, a situation in which the infant is quite removed from any kind of communication. In contrast, the context of the toddler findings involved the child interacting, more or less freely, in a playroom or home setting with at least one responsive adult – a situation which the child could very easily construe as communicative. If language and language development are considered to be strictly social phenomena, inextricably tied to the social/communicative context (e.g. Akhtar & Tomasello, 2000; Tomasello et al., 1990; see also Bloom, 1998), then the infancy findings would not seem to come within their purview, but the toddler findings would. More specifically, to the extent that "young children can learn new pieces of language only by entering into some type of joint attentional focus with a mature language user" (Tomasello & Akhtar, 1995, p. 201), the auditory processing described in the infancy findings could not apply, because the infant processor was not involved with any other person. Thus, the infancy and toddler findings would not be in contradiction because the latter pertain to language and the former to other kinds of processing that infants do when they are socially isolated.

There are two reasons, though, for dissatisfaction with this resolution, both of which draw from findings that this view of language and language development – as fundamentally a social communicative phenomenon for the child – is too narrow. The first reason is that language acquisition does not always and only depend on the language-learning child being part of a communicative context. Children do not learn language solely from speech addressed to them (cf. Bloom, 1998). This is particularly evident in cultures where preverbal infants are not considered fellow communicators; for example, among the Kaluli of Papua New Guinea, children are not spoken to until they begin to speak, themselves, with the result that "in the first 18 months or so very little sustained dyadic verbal exchange occurs between adult and infant" (Schiefflin, 1985, p. 531). Furthermore, among the Warlpiri of Australia, children under the age of 2 or so are not expected to contribute verbally to the ongoing conversation. The children are not engaged in communicative interactions yet they begin to acquire the language of the community all the same (Bavin, 1992). It seems likely that they began to learn their language from *overhearing* conversations rather than from *participating* in them.

Evidence also exists that children from Western or more technological cultures learn aspects of their language from overhearing. For example, children seem to learn about the shifting reference of personal pronouns from conversations they overhear, not from conversations in which they are direct participants. Oshima-Takane (1988) has documented that 1-year-olds who *overheard* their parents using first and second person pronouns in a series of games used "me" correctly more frequently than their peers who were only *participants* in the same games. Moreover, Oshima-Takane, Goodz, and Derevensy (1996) found that second-born children who were otherwise identical to first-borns in their productive language at 21 and 24 months of age nonetheless used first-person pronouns correctly significantly more often than the first-borns did; interestingly, the second-borns were exposed to significantly more personal pronouns in overheard speech between their mother and older sibling than in child-directed speech to themselves. With respect to another aspect of language, there are recurring anecdotal reports of children who call their parents by the parents' first names even when the family convention is to use variations of "mom" and "dad" (e.g. Naigles, 2000), which also implicate overheard conversation as a significant source of language learning input (see also Akhtar, Jipson, & Callanan, 2001, for evidence of 2-year-olds' novel noun and verb learning in overhearing contexts). In some ways, then, the infants in the studies described in Section 2.1 may be considered to be overhearers as well, in that they are processing language that is not addressed to them. One analogy might be of an infant being pushed in a stroller while his or her caregiver talks to various people in the neighborhood; the conversation is not directed to the infant, and may not even be about the infant, yet one could picture the infant avidly listening, all the same.

Of course, in all of these examples of infants and toddlers learning from overheard speech, they are *observing* language use in a communicative context, even if they are not *participants* in that communicative context, whereas the infants in the studies described in Section 2.1 were processing language or language-like stimuli in a context that was deliberately stripped of communicative intent (disembodied voice, non-responsive adult). So the first resolution might still hold: language-like stimuli presented outside of a communicative context might not be processed as language. The second reason to reject

this resolution, though, comes from ample evidence that infants do treat the auditory stimuli that are projected in a small booth and are distinctly non-communicative just as they would language stimuli coming from humans communicating with them or with each other. There are numerous findings which suggest that, indeed, infants do bring the language they hear in communicative contexts to bear when processing auditory stimuli in non-communicative contexts.

A prime example of this carryover from communicative context to laboratory context comes from the developmental changes seen in infants' discrimination of speech contrasts during the first year. Infants under 5 months of age have been shown, via laboratory tests with habituation and head-turn procedures, to distinguish a wide variety of consonantal and vocalic contrasts, including both those in their exposure languages and those to which they have never been exposed (e.g. Laskey, Syrdal-Lasky, & Klein, 1975; Polka & Werker, 1994; Trehub, 1976). In contrast, infants over 10 months of age, given the exact same procedures, respond quite differently: they continue to discriminate those contrasts which are phonemic in the language of their community, but no longer distinguish most segmental contrasts unique to other languages (Best & McRoberts, 1989; Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992; Werker & Tees, 1984). Similar changes in infants' discrimination of native vs. non-native phonotactic, syllabic, and prosodic contrasts have been observed across the first year; in the vast majority of cases, infants proceed from discriminating a language-general set of contrasts to discriminating only a set that is specific to their language (e.g. Jusczyk, Cutler, & Redanz, 1993; Jusczyk, Friederici, Wessels, Svenkerud, & Jusczyk, 1993; see Jusczyk, 1997, for more discussion). What is happening is that as the infants hear more and more of the language of their community – in communicative contexts – they lose their earlier sensitivities to "possible language contrasts" and only maintain sensitivity to "actual language contrasts". The fact that this developmental change is seen in laboratory studies, where the situation has minimal communicative context much like those described in Section 2.1 above, provides a clear indication that the infants are processing speech in the laboratory much as they would outside the laboratory. Contrasts not heard outside the laboratory are no longer routinely discriminated inside the laboratory.

A second example of such carryover from speech heard in communicative contexts to disembodied speech heard in the laboratory is more idiosyncratic, and so in some ways more compelling. Mandel, Jusczyk, and Pisoni (1995) demonstrated that 4.5-month-old infants can recognize their own name over another name that is similar in stress pattern (e.g. "Katie" vs. "Kevin"). Clearly, the infants had *heard* their own names outside the laboratory, presumably in numerous rich communicative contexts where the name has some social or affective value, but they had no trouble *recognizing* this name inside the laboratory, in contexts bereft of any communicative intent (see also Saffran, 2001, for evidence that 8-month-old infants treat the output of their statistical learning as English-relevant items).

In sum, infants do not seem to process language and language-like stimuli differently when heard inside or outside the laboratory, inside or outside of communicative contexts. Consequently, the evidence that pre-verbal and barely verbal infants perform sophisticated and abstract processing of linguistic stimuli in laboratory contexts allows us to conjecture that they are performing the same types of processing on their "real" linguistic

input, outside the laboratory. Note that the claim is not that specific *content* learned in the laboratory will be utilized in communicative language use, but that the *processes* used to learn the content in the laboratory will also be exploited in communicative language use and learning. These processes should lead the young language learner to extract patterns from "real" linguistic stimuli just as they led them to extract patterns from pseudo-language stimuli. Yet the performance of the toddlers highlighted in Section 2.2 has led to claims that they are not yet capable of extracting abstract forms over multiple instances. Therefore, we are still left with contradictory findings between infants' and toddlers' abilities to make abstract linguistic generalizations. Appealing to the different communicative contexts of the two sets of studies did not satisfactorily resolve the contradiction.

3.2. Resolution 2: the infancy findings were obtained from perception or recognition tasks whereas the toddler findings were primarily obtained from spontaneous or elicited production

A second possible resolution to this developmental paradox, in which young infants seem more advanced, linguistically, than toddlers, draws from the nature of the tasks which produced the findings. Broadly speaking, the toddler findings of little generalization and abstraction come from spontaneous speech or from tasks involving elicited production, whereas the infant findings of significant generalization and abstraction come from tasks involving language comprehension, or at least discrimination. What is there in the tasks that could facilitate and/or inhibit children's demonstration of generalization and abstraction?

In the toddler studies, the assumption was made that the child participants must produce a novel form (e.g. a familiar verb in an unattested frame) in order to get "credit" for productivity, that is, for realizing that the verb and the frame are separate linguistic units. In the majority of the studies, only production of the novel forms counted; the forms produced had to be novel to rule out the possibility that they were imitations of adult uses. Thus, in the absence of such productions, the researchers came to the conclusion that the abstracting-generalizing aspect of the ability to make such productions was not yet present in their toddler participants. In the infancy studies, in contrast, the assumption was made that the infants' looking patterns would reveal their recognition of some forms as novel and others as familiar. So, for example, when the Marcus et al. (1999) infants, who had been trained on an ABA pattern of syllables, looked preferentially (i.e. statistically longer) at a CDD pattern over a CDC pattern, two conclusions were made: (a) that the infants distinguished the CDD string and the CDC string; and (b) that the infants viewed the new CDD string as more different from the original ABA than the new CDC string. Moreover, because the difference between CDD and CDC is not at the level of the sound but rather the pattern of sounds, the conclusion is drawn that the infants have some realization that the similarity between ABA and CDC is on the level of a somewhat abstract pattern of syllables (see also Gómez & Gerken, 2000; Marcus, 1999c; McClelland & Plaut, 1999).

How justifiable are these assumptions and conclusions? As discussed below, we find especially problematic the assumption in the toddler studies, that if abstraction or generalization is not seen in children's production then it isn't present in children's representation.

Basically, there are four issues: (a) sampling; (b) the communicative contexts of production; (c) the processes of language production; and (d) the record of empirical differences between production and comprehension of the same forms. We consider each in turn.

3.2.1. Sampling

Given the volume of speech that children produce over the course of a single day, let alone a week or a month, it is practically impossible to capture their every utterance (Ingram, 1988). Most researchers employ a *sampling* technique, where they record a child's speech for anywhere from 5 min (e.g. Choi, 2000) to several hours (e.g. Brown, 1973) at a time. The recording sessions can be repeated over shorter or longer intervals to capture how the child's speech changes as s/he develops. The utterances produced during the recording session form the basis for researchers' conjectures about what the child has or has not learned about the language, and the amount of positive evidence one can glean for a particular construction is often robust. However, given that these utterances comprise just a very small sample of what the child actually has said, many researchers caution against drawing conclusions about those words, morphemes and syntactic constructions that were not included (Demuth, 1996; Stromswold, 1996). Given such concerns about sampling, the conclusions of Pine et al. (1998) might seem to be too strong – recall that they found no evidence that their participants, at the onset of multi-word speech, were using either grammatical morphemes, auxiliaries, or syntactic frames with a diverse set of verbs; instead, each grammatical construction appeared with only a proper subset of the verbs the children could produce. Notice that Pine et al. were not claiming that the children were not using these grammatical constructions *at all*; clearly, the constructions themselves were attested. But the issue concerned how general or specific the constructions were, and this determination rested on how many different and overlapping verbs each construction was used with. Thus, shorter sessions, fewer utterances from a given child in a given session, and/or a restricted set of props or activities might plausibly lead to fewer verb types used in any given construction (e.g. Lieven, Behrens, & Tomasello, 2001). In this way, sampling may have played a role in the finding that many constructions – both syntactic and morphological – appeared with a restricted set of verbs.

3.2.2. Communicative context of production

Young children do not produce language with the intent of showing adults how much English, Basque, Mandarin Chinese, 'K'iche, or Xhosa they have learned. Instead, they produce language in order to relay some information, communicate a desire or thought, or respond to a message from someone else. In other words, to engage in discourse (Clark, 1996). As engagers in discourse, they take into account (with greater or lesser degrees of sophistication) such elements of conversation as who the participants are, what their common ground is (i.e. shared social and cognitive knowledge base), and what action sequences (i.e. utterances) are needed to achieve their goal. Each of these elements influences the other; for example, familiar participants share more common ground than unfamiliar ones. In a conversation between a toddler and her mother, the toddler can assume a vast amount of shared knowledge between the two participants, knowledge which does not need to be articulated. Moreover, the utterances the toddler needs to achieve a goal might vary from the simple if mom is present and attending to the more

complex if mom is not present and/or not attending. Thus, the form and content of the utterances the child produces are governed by her engagement in the discourse as well as by her knowledge of the language. Hirsh-Pasek and Golinkoff (1996) hypothesize that

> since children talk in environments that are rich in contextual and social supports, it is likely that their productions under-represent their grammatical knowledge. That is, children typically select speech topics from the "here and now". Because of this, and because of talking with adults who interpret for them, children can often get away with saying less, and saying it in a less sophisticated manner, to achieve their goals. (p. 54)

Indeed, Budwig (1995) found that toddlers' mean length of utterance (MLUs) varied considerably, depending on whether they were calculated from interactions just with caregivers or just with peers (in the same setting). Specifically, the children's MLU was consistently higher during peer interactions than during caregiver interactions.

In sum, the analyses of spontaneous child speech described above may not accurately report what the child "really" knows, because children's speech in any given context need not reveal everything they know. The speech need only convey enough of the message to achieve the child's communicative goals. This explanation may also be relevant to the findings from the elicited production studies: children may produce the novel verbs in the same frame(s) as used by the experimenter because they have learned that those frames are sufficient to convey the *experimenter's* communicative intent in describing the actions. Given that the situation of the children's production of the verbs is identical to that of the experimenter's (i.e. simple description), the children would seem justified in assuming that those same frames should be sufficient to convey their own communicative intent as well.

3.2.3. Language processing and language production

Language production is subject to other influences besides the deliberate communicative intent of the participants. For example, research on conversation has found that adult speakers typically follow the topic and word choices of preceding speakers; this behavior may be considered to be deliberate in that the speaker is demonstrating his/her adherence to Gricean maxims and his/her acknowledgement of the common ground that is being co-constructed (Clark, 1996; Levelt, 1989). However, language production is also subject to less conscious or deliberate factors. For example, Bock and her colleagues have found that speakers' choice of syntactic frame in a picture description task is influenced by syntactic frames they themselves have recently produced (Bock, 1990; Bock, Loebell, & Morey, 1992) and Pickering and his colleagues have extended this priming effect to sentences heard rather than spoken (Pickering & Branigan, 1998). Bock has called this phenomenon *syntactic priming*, and has argued that it shows the powerful effect of abstract structure on speakers' less-deliberate language production processes.

Recently, Fisher (2002) has argued that the failure of the toddlers in elicited production studies to generalize verbs to new frames may be considered an example of syntactic priming in children. Moreover, the adherence of the 2-year-olds, in Akhtar (1999), to the non-SVO order of their training condition might, likewise, be attributed to syntactic priming. That is, children's language processors may be subject to the same conversational influences as adults', such that if a specific syntactic frame is presented over and over in

the preceding conversation, children may quite naturally produce that same syntactic frame in their own subsequent productions (see Fisher & Song, 2001, for experimental evidence of such priming effects in toddlers' speech). Thus, adherence to the frame that the experimenter uses need not be considered evidence of children's inability to use verbs in unattested frames or their ignorance of English SVO order; after all, even adults show sensitivity to the linguistic history of verbs and frames used in recent conversation. Syntactic priming could also be at least partially responsible for toddlers' imitation of mothers' sentence frames during naturalistic interactions (e.g. Theakston, Lieven, Pine, & Rowland, 2001). In sum, there are clearly many processes operating during toddlers' language production, and the absence of substantial productivity can be attributed, at least in part, to some of these other processes: communicative intent (the need to say just enough to get the point across) and syntactic priming (the less-than-deliberate tendency to use the same syntactic frame(s) within a conversation but across speakers).

3.2.4. Empirical differences between language production and language comprehension

Other limitations of relying solely on children's language production as evidence for their ability to abstract patterns or rules over items can be seen when children's productions are compared to their comprehension. Researchers over the past 40 years have generated numerous findings showing that while children's language production and language comprehension are clearly related, they are also separable processes at several different levels from the beginning of acquisition. Moreover, comprehension tasks almost invariably reveal greater linguistic sophistication than production tasks at a given age. Why might this be so?

A detailed examination of this question is beyond the scope of this paper (but see Hirsh-Pasek & Golinkoff, 1996; McDaniel, McKee, & Cairns, 1996, for discussion); recall that the primary issue here concerns the extent to which young language learners can make generalizations over specific lexical items to a more general pattern. When this ability is assessed via a recognition task, different demands from those involving production come into play. The issue becomes not whether the children can produce a generalized form but whether they can understand it, or distinguish it from what has been heard before. In the sense that comprehension or recognition requires only that the child *access* a stored representation (i.e. a pattern abstracted from specific lexical items) based on a perceived sound or sign whereas production requires as well a successful *generation* of that representation based on the desire to express a more-or-less well-formed meaning (Huttenlocher, 1974), comprehension, of course, seems easier. A plethora of findings, of which those described below are only a subset, have provided ample evidence that children's ability to access their stored representations in a comprehension task appears earlier than – or differently from – their ability to generate those representations for the purpose of language production.

Reznick, Corley, and Robinson (1997) compared the development of the production and comprehension of English words in monozygotic and dizygotic twins over the second year of life, using both parental report and a preferential looking study of object word comprehension. They found that the majority of the variance in both expressive and receptive language scores came from factors that were *not* shared by the two processes. Moreover, significant genetic components to the children's receptive vs. expressive scores emerged at

different ages. Dapretto and Bjork (2000) have also found that toddlers' word retrieval skills are frequently not indicative of their word knowledge. The children participated in an object retrieval task ("Where's the ____?") and a word retrieval task ("What's inside this box?"). All children performed at ceiling on the object retrieval task (i.e. comprehension); however, performance on the word retrieval task (i.e. production) varied according to whether the children had passed a vocabulary spurt, were currently within a vocabulary spurt, or had not yet experienced a spurt. These findings dramatize how children may know a label (as evidenced by both parental report and performance on the comprehension task) yet still be unable to retrieve it when the situation calls for production. More recent research by Gershkoff-Stowe and Hahn (2001) and Goodman (2001), among others (note that Huttenlocher (1974) was among the first to document this effect), has consistently found a developmental lag between toddlers' understanding of specific words and their spontaneous or elicited production of them. Importantly, because verbs form the core of sentences, Goodman (2001) has found that the developmental lag between successful production and comprehension is much greater for action words (an average of 8.9 months) than for object words (an average of 4.7 months). Taken together, these findings implicate a robust dissociation between the production and comprehension of words, at least, early in language development.

Similar findings can be adduced for children's behavior with *sentences*. For example, Shipley, Smith, and Gleitman (1969) provided some of the first evidence that children's comprehension of sentences was in advance of their production. Shipley et al. compared telegraphic speakers' performance with commands that were either similar to their own speech (i.e. two-word utterances, missing grammatical morphemes, e.g. "Give ball") or more sophisticated than their own speech (i.e. multi-word utterances including English grammatical morphemes, e.g. "Give me the ball"). The children showed their best performance when they heard commands with grammatical morphemes. Gerken and her colleagues (Gerken & MacIntosh, 1993; Gerken & Shady, 1996; Shady & Gerken, 1999) have extended this work by asking toddlers (with mean MLUs below 1.5) to carry out sentences that varied on the presence, absence, or placement of a grammatical morpheme. Even the single-word speakers showed better performance with grammatical sentences than with sentences containing an ungrammatical or nonsense morpheme. Thus, although they were not *producing* grammatical morphemes in their spontaneous speech, the toddlers in these studies had clearly learned enough about them to be sensitive to their presence, absence, and placement. Moreover, Hirsh-Pasek and Golinkoff (1996) have demonstrated 17-month-olds' comprehension of English word order using the intermodal preferential looking (IPL) paradigm. Children viewed side-by-side videos of transitive events which differed only by the identity of the agent and patient, i.e. one video showed Big Bird tickling Cookie Monster whereas the other video showed Cookie Monster tickling Big Bird. The audio matched only one of the videos, and the dependent variable measured how long the children looked at the matching vs. non-matching screen. Hirsh-Pasek and Golinkoff found (a) that the children looked significantly longer at the matching screen, and (b) that this understanding of word order held regardless of whether or not the children were producing word combinations in their spontaneous speech (see Fisher, 2000, for similar evidence from 1-year-olds tested with novel verbs).

In sum, the argument from the toddler studies was that because children don't produce some linguistic constructions across a variety of items, their representations of those constructions is therefore item-specific; in this section, this argument has been shown to be unacceptable. First, the possibility always exists that analyses of spontaneous speech have simply missed the relevant utterances because of sampling limitations. Second, children may not produce utterances that reveal the extent of their knowledge in conversation because typically they are conversing with a familiar adult who can fill in many omissions because of shared common ground. Third, children's utterances may appear to mimic those of adults because the utterances already spoken in the conversation may selectively prime some frames over others. Fourth, children's production of words and sentences cannot be taken as encompassing all of their knowledge because numerous studies have demonstrated that children understand aspects of their native language that have not yet appeared in their speech.

The contrast between production and comprehension, then, provides at least a partial resolution to the contradictory findings summarized in Section 2. That is, one reason the infants performed with seemingly more sophistication than the toddlers was because the infants were participating in comprehension (or perception/recognition) tasks whereas the toddlers were participating in production tasks. Nonetheless, there are still several discrepancies between the two sets of studies that are unresolved. First, as Tomasello (2000) pointed out, toddlers who are taught novel *nouns* have no difficulty using them in unattested frames; for example, they can add the plural marker to nouns taught only in the singular. Thus, the communicative intent and syntactic priming processes do not fully explain why the toddlers didn't generalize the novel verbs. Second, Akhtar and Tomasello (1997) did ask toddlers to comprehend, via an enactment task, novel verbs in full sentences and found consistently poor performance. And finally, grouping the original five infancy studies under the rubric of "comprehension" is somewhat of a misnomer, because none of these studies involved any comprehension of language per se. That is, none of them asked the infants to match the forms of the utterances with meanings. My conjecture is that the absence of any context or meaning in the infant studies provided the infants with the opportunity to display their knowledge of form without the added burden of meaning. This role for meaning in resolving the infancy–toddler paradox is considered in more detail in the next section.

3.3. Resolution 3: the infancy studies assessed generalizations only over form, whereas the toddler studies assessed generalizations over form AND meaning

The infancy and toddler studies also differ in terms of the content – or lack thereof – of their stimuli, and hence of the "tasks" that the children were to perform. Specifically, many of the infants were presented with strings of pseudo-linguistic stimuli which had no content or meaning. Strings of /golatu/ or /ma ti ma/ were heard bereft of an accompanying scene or referential/propositional context; they were simply strings of sounds. Even those stimuli that *were* linguistic (e.g. the English sentences used by Santelmann & Jusczyk, 1998) were presented unpaired with their contents: the task was not to pair the sentences with their meanings, but just to distinguish pairs of sentences in and of themselves. Thus,

the infancy studies assessed how well infants could make generalizations across auditory form, irrespective of possible meaning.

In contrast, the toddlers in the experimental studies were presented with auditory stimuli that were consistently and explicitly paired with meaning. For example, every new verb presented by Olguin and Tomasello (1993), Akhtar and Tomasello (1997), and Akhtar (1999) was produced in conjunction with a specific novel action; moreover, various comprehension and elicitation trials reinforced the fact that the task involved learning the pairing between the word and its action. Thus, when the children were prompted to extend a novel verb to an unattested frame, they not only had to demonstrate that they had abstracted the frames from the verbs with which they had been heard (similar to the task of the infants), but also remember the meaning of the verb (so that they used the correct verb in conjunction with the correct action) and use that meaning to convey a message in production (i.e. Section 3.2 above). The extraction of an abstract frame from patterns of specific items is similar across both types of studies; however, the toddler studies have added to this the necessity of understanding the meaning of the verb enough to use it to convey a message.

The toddler studies based on spontaneous speech (Pine et al., 1998; Tomasello, 1992a) did not, of course, explicitly teach children novel words. However, the substance of the difference between the infancy and toddler studies remains: during naturalistic interaction, toddlers use words whose meanings they know, at least to some extent, to convey a message or intention. Thus, prior to using those words they must have learned something about their meanings, and these meanings (i.e. choosing the correct words) are crucial to the message being conveyed. Children's production of speech within naturalistic interaction is heavily oriented towards expressing meanings and intents; as mentioned earlier, children do not converse simply to "show off" the linguistic forms they have acquired (see also Bloom, 1998). The hypothesis that will be explored in this section is that the findings of toddlers' "regression" from being able to abstract patterns over linguistic stimuli as infants can be attributed to their problems with *meaning*, not their problems with abstract linguistic *form*.

3.3.1. The complexity of discerning meaning

The reason why the addition of meaning to the experimental and naturalistic paradigms creates problems is because the discernment of the meaning of a speaker is a complex and difficult process, especially for children who do not yet have all of the tools of the adult in efficient working order. Arguments that discovering "speaker-meaning" is nontrivial comes from a variety of sources, both theoretical and empirical. Both Wittgenstein (1953) and Quine (1960) discussed at length the difficulties of figuring out just what a speaker means, especially when the language is little-known to the listener (the so-called "gavagai" problem). Briefly, if a speaker utters the word "gavagai" while pointing to a running rabbit, is the listener to conjecture that the word refers to the rabbit itself, or its running, its ears, its color, its tail or other body parts, its softness, its likelihood as a meal, etc.? Especially for the initial interaction between unacquainted members of a dyad, a completely open-minded listener would have only chance likelihood of coming up with the same meaning as that intended by the speaker. Of course, across multiple interactions, by members of a dyad who are familiar with each others' routines and who engage in joint

attention, coupled with some preferences of one's own, the listener is much more likely to hit upon the same meaning as that intended by the speaker (Tomasello, 1992b, 2001; Woodward & Markman, 1998). The empirical literature teaches us, though, that even such well-supported communications are neither extremely frequent nor uniformly successful.

Children's social interactions with adults must surely help them in discovering the meanings of the adults' utterances. An important part of adult–child interactions that has been shown experimentally to enable children to discover adult meaning is joint attention. That is, in experimental situations when children and adults are jointly attending to visible objects or events, or to the locations of invisible objects, children over 16 months of age can assign the referent of a novel word to those objects or events (e.g. Baldwin, 1993; Hollich, Hirsh-Pasek, & Golinkoff, 2000; Tomasello & Barton, 1994). Moreover, infants aged 12–15 months who engage in more joint attention with their mothers also have been found to have larger vocabularies, both concurrently and subsequently (see Hoff & Naigles, 2002, for a review of this literature).

However, analyses of naturalistic studies of mother–child interactions have found that joint attention episodes do not occur frequently, at least during the toy play sessions that have been analyzed. For example, the episodes of joint attention studied by Tomasello and Todd (1983), Carpenter, Nagell, and Tomasello (1998), Hoff-Ginsberg (1987, 1991), Akhtar, Dunham, and Dunham (1991), and Tomasello and Farrar (1986) each comprised fewer than one-quarter of the time spent interacting; moreover, fewer than one-third of maternal utterances were of the type (i.e. follow-in) in which mothers followed their child's focus of attention. Furthermore, studies of adult–child communication have revealed that even adults, with their hugely greater memories and situational understanding, are not perfect in discerning what their children are intending to communicate. For example, Tomasello, Conti-Ramsden, and Ewert (1990) reported that communicative breakdowns in parent–child interactions occurred in roughly 10–20% of maternal turns and 20–30% of paternal turns, and Golinkoff (1986) found that only 31% of pre-verbal infants' communicative signals led to immediate successful comprehension by the mother (see Hoff & Naigles, 2002, for a detailed review).

Taken together, these findings indicate that joint attention is important for children's ascertaining of adult meaning and yet episodes of joint attention are not frequent in toddler–adult naturalistic interactions. Moreover, given the degree to which parents misunderstand their young children's communicated intentions, young children are also likely to find intention- or meaning-divination difficult, especially if they attempt to achieve understanding while circumventing the linguistic utterance. In sum, one conclusion that can be drawn is that children's ability to discover the meanings of words and sentences from social interactions during this early period must be fragile and not consistently supported. Hence, they may take a long time to learn the meaning of the language addressed to them. And the findings of Pine et al. (1998) and Tomasello (1992a,b) (and Theakston et al., 2001), that toddlers rarely use verbs productively, may be partially attributable to the children's incomplete representations of the meanings for these verbs. The less complete the meaning representation is, the less likely children may be to use the verb in novel grammatical constructions because, as discussed in more detail below, the productivity of a given verb depends crucially on its meaning.

The above findings might help explain why children in natural situations need to take

some time to learn a word "well enough" to use it in conversation at all, let alone in frames or constructions that may be different from those used by others. But the experimental tasks of Olguin and Tomasello and Akhtar and her colleagues were deliberately set up to include many of these relevant communicative parameters: the experimenters engaged in joint attention with the child participants whenever the new verb was produced, many repetitions of the action–word pairing were provided, with a variety of actors and patients (so that the children would not restrict the enactment of an action to specific characters), and the routines of enacting the action, producing the verb in describing the action, and enacting the action in response to a sentence produced by the experimenter were all well-rehearsed and understood by the children. Nonetheless, evidence from these studies suggests that the children did in fact have difficulties with the meanings of the novel verbs. Recall that both Olguin and Tomasello (1993: OT) and Akhtar and Tomasello (1997: AT) asked their toddlers to enact the novel verbs in transitive frames following the completion of the production assessment; both found extremely poor performance. AT further found that those children who were unlikely to use a novel verb in an unattested frame were the same children who performed poorly on the enactment task. Apparently, the children had not learned the verbs well enough to (a) select the correct prop for each action, (b) perform the correct action on that prop, and/or (c) select the correct agent and patient for the action. Thus, there has already been shown to be a link between the children's level of understanding of the verbs, as evidenced by their performance on enactment tasks, and their ability to generalize the verbs to unheard frames. A more detailed analysis of the myriad of ways that events, even more than objects, may be interpreted and talked about reveals more meaning-based reasons why the children had difficulty with the verb–action mapping and the expression of verbs in sentences.

3.3.2. Specific challenges for meaning discernment

The Quine (1960) "gavagai" example is typically used in reference to learning about the meanings of nouns; however, learning the meanings of verbs and how to use verbs in sentences is subject to even more challenges. These emerge because (a) the same event can be referred to by different verbs if different perspectives are taken on the event, (b) the same event can be referred to differently depending on the language that is being learned, and (c) the way the verbs are used in sentences depends intricately on the meaning that is adduced for the verb. These points are considered in great detail in Gleitman (1990), Gillette, Gleitman, Gleitman, and Lederer (1999), Fisher (2002), and Hohenstein, Naigles, and Eisenberg (in press). In the next two sections, I summarize those of their points which are relevant for this paper and demonstrate how these can explain the poor generalizability displayed in OT and AT.

Events have both spatial and temporal coherence for toddlers (Baldwin & Bland, 2001); however, they can be talked about in different ways depending on the perspective the speaker chooses to take. For example, the event of 'a child brings a doll to Grandma' can be referred to as *carrying* (if the child's manner of bringing is key), *bringing* (if the child's manner is not key), *giving* (if the child's transfer to Grandma is key), *getting* or *taking* (if Grandma's receipt of the doll is key) and *coming* or *arriving* (if the doll's motion is key). Thus, different aspects of the event are highlighted, depending on which verb is used. This

of course begs the question of how the child determines the meaning of an unfamiliar verb. Recent research with adults, who are presumably very good at problem solving, has revealed that they have enormous difficulty – and are almost always incorrect – in determining the meaning of a nonsense verb when all they have experienced are six events during which the verb was uttered (Gillette et al., 1999).

Many of the experimental actions taught by OT and AT were quite complex. For example, the following action was introduced to OT's and AT's toddlers as "chamming": an Ernie doll jumps onto one end of a seesaw, sending a Bert doll, who was sitting on the other end of the seesaw, flying. As with many causative actions, this one can be viewed as having multiple components, including (a) Ernie's jumping, (b) the effect of Ernie's jumping in moving the ends of the seesaw and dislodging Bert, and (c) Bert's flying off of the seesaw. Which component should be the meaning of "cham"? How should that meaning be expressed in a sentence?[2] For the condition where the verb was presented in isolation, each (and all) components were possible and children would have reason to be uncertain about the verb's meaning. And if children are not sure whether the verb is a (potentially) causative one, they indeed *should* be conservative in generalizing its frames. Thus, a child who hears "chamming" may not produce the verb in a sentence because she is not sure whether "cham" refers to *jump* (in which case "Ernie is chamming" is appropriate), or the *seesaw movement* (in which case "The seesaw is chamming" is appropriate), or indeed, *cause to fly off the seesaw* (in which case "Ernie is chamming Bert" is appropriate). As Bavin and Kidd (2000) put it,

> If infants are more conservative in using a new verb, it is reasonable to assume that they are not yet sure enough of its meaning to be able to fit it into a subcategory and so generate it to other constructions… thus, a verb's perceived meaning will influence whether a child generalizes it in production. (p. 5)

Furthermore, children cannot come to the verb learning task with initial assumptions about the meanings verbs map onto (as has been proposed for nouns, e.g. Bloom, 2000; Golinkoff, Mervis, & Hirsh-Pasek, 1994; Markman, 1989), because languages vary in the types of meanings they conflate with verbs. For example, Spanish and English differ concerning the elements of motion events that are conflated with motion verbs: English-type languages are more likely to include verbs that refer to manners of motion, whereas Spanish-type languages are more likely to include verbs that refer to paths of motion (Berman & Slobin, 1994; Naigles, Eisenberg, Kako, Highter, & McGraw, 1998; Talmy, 1985). Thus, if children were to begin with the assumption that, say, manners of motion are the default referents for motion verbs (e.g. *jump* in the OT and AT situations), then many language learners would begin with incorrect verb-meaning mappings, and there is little to indicate how they might recover from these mistaken pairings.

Finally, the meanings of verbs impact directly on the sentence types used with them.

[2] Given the indirect nature of this causative event, the simple transitive frame may not be the best descriptor. As discussed in detail by Fodor (1970), Bowerman (1982), Jackendoff (1983, 1990), Levin (1993), and Levin and Rappoport Hovav (1994), indirect causation is better captured by the periphrastic causative construction (*Ernie makes Bert cham*) than by the simple lexical causative (*Ernie chams Bert*). At least half of the actions taught by OT and AT involved indirect rather than direct causation.

That is, one cannot use a given verb in any type of sentence; instead, verbs and sentences are related in predictable, albeit not absolute ways. Some verbs involve only one character, such as an experiencer or theme, and so only appear with one noun phrase or *argument* (*the girl laughed*, *the boy fell*, *the doll arrived*). These single-argument verbs typically cannot appear with direct objects. Other verbs require direct objects as well as subjects (*the child carried the doll*, *the child held the doll*); if the object is missing, the sentence is ungrammatical. A third class of verbs requires direct objects and strongly recommends goal or source phrases as well; these are verbs of transfer (*the child brought/gave the doll to Grandma*, *Grandma took the doll from the child*, *the girl put the flowers on the table*). Finally, a fourth class of verbs – with many subclasses (Levin, 1993) – sometimes appears with direct objects and/or objects of prepositions, but does not always require them; these have been called alternating verbs. These different sentence frames are linked with different types of meaning – inchoativeness with intransitives, causation and/or object affectedness with transitives, and transfer with ditransitives (e.g. Fisher, Gleitman, & Gleitman, 1991; Gropen, Pinker, Hollander, & Goldberg, 1991). The subclasses of verbs that alternate also have different semantic properties; for example, verbs that alternate such that the object of the transitive and the subject of the intransitive are the same, frequently include the element of causation in the transitive. In contrast, verbs that alternate such that the subject of transitive and intransitive are the same frequently include the notion of contact or activity (Dixon, 1991; Levin, 1993; Naigles, 1996, 1998).

Note that this type of syntactic variability is not nearly so pervasive for nouns, and so not nearly as much of a problem for early noun learning. That is, although a novel noun could have diverse interpretations in reference to a given unfamiliar object, the possibilities are mainly count nouns which share syntactic privileges of occurrence (e.g. *animal*, *dog*, *collie*). Thus, a misinterpretation of a noun's meaning is less likely to yield an attendant mistake in that noun's syntax. In contrast, verb meaning is a much stronger predictor of syntactic form. If children misinterpret verb meanings, they will also behave contrary to prediction with verb forms.

3.3.3. A meaning-based reinterpretation of the experimental (novel verb) findings

In this section, I will provide a re-evaluation of the Olguin and Tomasello (1993) and Akhtar and Tomasello (1997) findings in terms of the meaning-based demands of their tasks. In particular, I will demonstrate that the findings which purportedly show that toddlers cannot generalize a novel verb to an unattested frame can be reinterpreted to show that toddlers' reluctance to generalize (and some of their "errors" in generalizing) is better attributed to difficulties with meaning discernment rather than difficulties with abstracting syntactic frames.

Let us first recall the logic of their argument. All complete sentences include a word that has the grammatical category *verb*. According to traditional grammatical theories, the category *verb* is the same – in many respects – across sentence types. For example, in both the transitive and intransitive frames, the verb must agree with the subject noun in number/person (in other languages, this agreement can extend to the gender and case of the noun as well); moreover, in both frames, the verb can be inflected for tense and/or aspect. Thus, the argument goes, if the child has abstracted the grammatical category *verb*, the way(s) s/he uses any given verb in the transitive frame should also be evident in the

intransitive frame (and vice versa). It is in this sense that the frame is eventually abstracted across the configurations observed with individual lexical items that are all *verbs*. It is important to acknowledge that the evidence that has been cited of abstraction in infants (Gómez & Gerken, 1999; Marcus et al., 1999) is not exactly at this level (see also Gómez & Gerken, 2000). That is, Marcus et al. and Gómez and Gerken have demonstrated that infants can abstract patterns across specific items, but not (yet, at least) across *categories* of items. We do not (yet) know that an infant trained on *ga ti ga*, *lo sa lo*, *mu pi mu*, etc. puts *ga*, *lo*, and *mu* in one category and *ti*, *sa*, and *pi* in another category, such that these two sets of items should consistently have different privileges of occurrence. However, what the contrast between the infancy abstraction studies and the toddler non-abstraction studies does show is how dependent on meaning the type of generalization sought by Tomasello and colleagues is. That is, suppose a child *had* abstracted the categories A and B in the Marcus et al. task, and learned that these followed an ABA order. Why should that child – trained on *ga ti ga* – be expected to generalize to or accept *mu ti* unless something about the meaning or distribution of these terms rendered the generalization appropriate? Analogously, a child who was taught *chamming* in one type of sentence frame should not be expected to generalize it to another type of sentence frame if their meaning of *cham* doesn't fit that sentence frame. As described below, OT and AT seemed to have just this (unwarranted) expectation.

For three of the training conditions of OT and AT, the verb was presented in a syntactic frame. The frame itself partially constrains the meaning of the verb (i.e. syntactic bootstrapping); for example, a verb in a transitive frame is more likely to include a causative meaning than a verb in an intransitive frame (Gleitman, 1990; Landau & Gleitman, 1985; Naigles, Gleitman, & Gleitman, 1993; see also Lasnik, 1989). Thus, the verb's meaning in these conditions may have been clearer to the child than in the verb-only condition; however, crucially, that meaning may not be appropriate for all sentence frames that are elicited. AT and OT presented each verb in one of two 'partial' (non-SVO) frames: intransitive with agent in subject position, and intransitive with patient in object position. These teaching frames may have constrained the children's interpretations such that, in some cases, they would be unable to generalize the verb to other frames.

Under *agent–subject only* training, the child hears "Ernie is chamming". In this case, the focus of the sentence – and hence the verb – is just on what Ernie is doing, which is *jumping onto the seesaw*. If this is the interpretation that the children have, then how should they respond when asked "what is happening to Bert?" It makes sense that they are reluctant to say "Ernie is chamming Bert", because Ernie is NOT jumping Bert, nor is he causing Bert to jump. Ernie's action, as implicated by the intransitive frame, does not involve Bert, and the verb used to describe Ernie's action should not be used to describe whatever is happening to Bert. And yet that is precisely what OT and AT expected of the children, and what forms the basis of their claim that the toddlers could not generalize the novel verb to unheard frames.

Furthermore, under *patient–object only* training, the child hears "chamming Bert". In this case, similar problems arise. Lacking the subject and the auxiliary verb, this is not a grammatically correct English sentence, and might be interpreted as a gerund or adjective–noun construction, analogous to "smiling Bert". This construction shifts the focus to what Bert is doing, which is *flying through the air* (i.e. "flying Bert"). Once again, this inter-

pretation renders the "Ernie chamming Bert" transitive frame implausible, because Ernie is NOT flying Bert (as in flying a kite, which involves much more direct control than Ernie is given), although Ernie can be seen as causing Bert to fly. However, if the children are simply focussing on what Bert is doing, without noticing what caused him to do it, then "cham" might only mean *fly through the air*. Without interpreting "cham" as causal, there is no reason to produce it in a transitive utterance with Ernie as the subject. Moreover, there should be *no* reason to say "Ernie is chamming" (another frame elicited by OT), because the meaning of "cham" is *fly through the air*, and Ernie is not doing that. And so, again, what OT and AT expected of the children is actually quite unlikely to occur, not because of the children's inability to generalize per se but because the children did not come up with the meaning that would allow them to generalize in the way(s) that OT and AT expected. This explanation also accounts for the apparent lack of productivity in a more recent study in this series (Tomasello & Brooks, 1998, as cited in Tomasello, 2000).[3]

Further evidence for the importance of meaning in the generalization task set by OT and AT comes from a more recent paper by Brooks and Tomasello (1999: BT). In this paper, BT report a study in which toddlers (aged 2;6) did succeed in producing novel verbs in unattested frames, both transitive and intransitive. BT note with little comment that these children were considerably more productive than those of earlier studies; however, there

[3] More direct evidence that the children, indeed, experienced difficulty with meaning discernment in the OT and AT studies comes from the children's so-called errors. For example, consider the following two patterns of training and elicited production:

(1) Training: Ernie is chamming Bert
Production A: Ernie is chamming
Production B: Bert is chamming

(2) Training: Ernie is chamming
Production A: (Someone) is chamming Bert
Production B: (Someone) is chamming Ernie

In OT and AT's coding, utterances such as 1A and 2A were included as generalizations, either from the transitive frame to the intransitive (1A) or from the intransitive to the transitive (2A). Both OT and AT found that 1A was rare and 2A practically nonexistent. In contrast, utterances such as 1B and 2B, while also uncommon, were produced in nontrivial numbers (e.g. almost 20% of utterances in OT); however, they were excluded from the count of generalizations because they placed the patient in subject position (1B) or the agent in object position (2B).OT and AT claim that such placements are errors because they run counter to the English pattern of SVO sentences, and counter to the intended meanings of the verbs. However, these latter utterances actually demonstrate toddler syntactic productivity in three ways. First, their very existence demonstrates that toddlers CAN produce novel verbs in unattested frames. Second, their existence could be demonstrating a fairly sophisticated knowledge of the frames and alternations in which causative verbs can be placed in English. That is, as mentioned in Section 3.3.2, causative verbs alternate between transitive and intransitive frames such that the object of the verb in the transitive appears as the subject in the intransitive (e.g. *Adam drops the ball/The ball drops*). The toddlers who produced 1B may have been following just this alternation pattern; if so, their productions should have been counted as robustly general rather than errorful or conservative. The third reason pertains to utterance 2B, which was disallowed as productive because Ernie is the agent of the action and agents do not appear in direct object position in English sentences. However, if the children were trained on (2) (as were those who produced two-thirds of these utterances in AT), then producing 2B maintains the meaning of the verb better than 2A does: training sentence (2) implicates a meaning for "cham" of something like *jump*, with the subject as experiencer of the action. Thus, Ernie is not viewed as an agent, but rather as an experiencer of the action of jumping. Then if the children wanted to focus on theirs or the experimenter's causation of Ernie's jumping, then a production of "(someone's) chamming Ernie" keeps the meaning consistent and shows productivity with the frame – a shift from intransitive to transitive – which is just what OT and AT claimed wouldn't occur with toddlers.

were four critical differences between this study and the earlier ones, which can help explain the discrepancy and which support the points made in the current paper. First, these toddlers were asked to learn only two novel verbs, rather than the eight of OT or the four of AT. Fewer verbs to learn translates to less confusion about which verb refers to which event or aspect of event, and so better learning of each. Second, the events that were paired with the novel verbs were more straightforward than those used by OT and AT. For example, although one event did involve indirect causation and so was subject to the issues raised in Section 3.3.2 (and see footnote 2), the other event more clearly involved direct causation: a puppet swinging a toy, where the puppet's action of swinging coincided with the toy's action of swinging. Thus, there was really only one motion going on with this event, rather than the dual motions (what the agent does and what the patient does) used pervasively by OT and AT. A third difference was that BT included as generalizations utterances in which patients appeared in subject position (see footnote 3). And fourthly, BT included a condition in which the toddlers were trained on two frames rather than just one. These toddlers were more productive – even with frames not in the training set – than those who just heard one frame. The addition of another frame might have helped the toddlers figure out the authors' intended meaning of the verb (i.e. syntactic bootstrapping with multiple frames, which has been shown to facilitate toddlers' production and comprehension of verbs; Gleitman, 1990; Landau & Gleitman, 1985; Naigles, 1996, 1998; Naigles & Hoff-Ginsberg, 1998). Moreover, it effectively demonstrated to the children that each verb could be produced in more than one way; this variability could have helped overcome the production problems detailed in Section 3.2 above.

To summarize: I have elaborated how the "meaning discernment" part of the experimental studies of OT and AT was a nontrivial task for the children, and how problems with this aspect of the task can explain why the children who participated in those studies failed to use the just-taught verbs in the frames desired by the experimenters.[4] First, the actions themselves were complex and multidimensional, enabling multiple interpretations. If the children were unsure about which aspect of the action mapped onto the novel verb, then they might also be unsure about which frame(s) that verb might lawfully be used in. Second, if the children mapped *unintended* (by the experimenters) aspects of the action onto the novel verb, their propensity to use the verb in the frame(s) desired by the experimenters *should* be severely limited. Finally, the children's "errors", though not frequent, strongly suggest that they had adduced unintended meanings for the verbs; these errors implicate just the productivity that the toddlers were not given credit for. In a more recent study, when the actions were simplified and reduced in number, 2-year-olds did in fact demonstrate substantial syntactic productivity.

These meaning-based issues can also explain why toddlers are more reluctant to gener-

[4] Difficulties with meaning discernment can also provide an account for the children's low performance in the comprehension tasks. For example, toddlers who heard "cham" produced as "Ernie is chamming" or just "chamming" (in training) had probably adduced the interpretation that "chamming" means *jump onto the seesaw*, for the reasons discussed in Section 3.3.2. When these children are asked to "Make Cookie Monster cham Big Bird" (i.e. with different characters than during the training phase), even if they have abstracted the transitive frame and assigned some kind of causal interpretation to it, they are still faced with having to show how Cookie Monster might make Big Bird jump onto the seesaw. Whatever the complete enactment, Big Bird is going to end up in Ernie's old role as the jumper onto the seesaw, which would be interpreted as a reversal of the desired SVO roles.

alize verbs across different frames than to generalize nouns across different frames (cf. Tomasello et al. 1997; Tomasello & Olguin, 1993): changes in children's perspectives on events and actions can have dramatic effects on the types of frames in which the referent verbs can appear (i.e. causal interpretations permit transitive frames but non-causal ones do not), whereas changes in children's perspectives on objects either impact noun frames not at all (i.e. *dog* and *spaniel* have identical syntactic privileges) or more minimally (e.g. determiners are required for singular count nouns but not for proper nouns).

3.3.4. Evidence for a discontinuity in the acquisition of forms and meanings from existing findings in language acquisition

With the above reinterpretation, the infancy and toddler findings now implicate a coherent developmental path to language acquisition where children first grapple with the sounds and forms of language, at least somewhat independently of their meanings (a point also made by Gómez & Gerken, 2000), and only later work on integrating these forms with their meanings. Infants seem capable of abstracting patterns from linguistic input, and applying these patterns to new items. Crucially, for the infants, these items, and the patterns instantiated by them, carry no referential nor propositional meaning, nor any communicative function. My argument is that when meaning *does* get mapped onto these – and other – forms, which begins to happen in toddlerhood, the toddler's ability or disposition to extend *meaningful* items to new forms or frames or patterns decreases, *because each item/word's ability to be extended to a new frame may depend on that word's meaning*. That is, the problem with toddlers' productivity is not in the child's disposition to abstract across items, which is robust in infancy, but in the child's knowledge of which items can be generalized to which forms. This knowledge is fragmentary in toddlerhood because the children's understanding of the meanings of the items, and possibly the way(s) that generalization depends on meaning, is initially fragmentary (for more discussion, see Naigles, Fowler, & Helm, 1992; Naigles et al., 1993; Pinker, 1989).

There is a growing set of studies in other aspects of language acquisition which point to the same conclusion: children find it easy to learn the forms of language when these are in some way dissociated from the meanings; however, mapping those meanings onto the forms appears, consistently, later in development. Moreover, they find it easier to demonstrate that they have learned the forms when the meanings mapped onto these forms are minimal, or deliberately made easily discernable. The studies I will discuss here come from a range of linguistic constructions, including grammatical gender, third person singular marking on English verbs, phonological minimal pairs, and the syntactic frames of verbs and adjectives.

Grammatical gender is meaningful only when applied to animate nouns; for the most part, the categorization of inanimate nouns as masculine or feminine in a given language is made irrespective of semantic gender (e.g. *le crayon* in French (= the pencil) is no more intrinsically masculine than *la plume* (= the pen) is intrinsically feminine). The survey by Levy (1983) of children's acquisition of grammatical gender in languages that are highly "gender-loaded" (i.e. include several instantiations of grammatical gender, such as Russian, Polish, Hebrew, and German) revealed that young 2-year-olds have little difficulty – and make few errors – using the correct gender markings with pronouns referring to

inanimate nouns, and with verbs that must be inflected for gender. Interestingly, where Russian child learners do make errors is with nouns that are semantically masculine but end in the usually-feminine [-a] (e.g. "dyodya" = grandfather). What this type of error shows, though, is the greater importance of form than meaning to these children, because the phonological correlates to the gender marking, which are purely formal, prove more salient to the children than the semantic correlates, which are meaningful. Levy (1983) reported similar findings from her extensive study of grammatical gender acquisition in Hebrew. Of course, the grammatical gender system *is* a purely formal system for all nouns that are not animates; at some level, there is no "meaning" to be acquired, even later in development. However, there are some hints that older children and adults do eventually attach some kind of semantic gender to inanimate nouns; for speakers of at least one highly gender-loaded language, this seems based on the grammatical gender categorization of the nouns. For example, Sera, Berge, and Pintado (1994) found that 7-year-old Spanish learners and Spanish-speaking adults can conceptualize a gender for inanimate objects "if they should come to life", and this gender corresponds closely to the grammatical gender category of the noun. English speakers can also conceptualize a gender for inanimate objects, but their masculine and feminine categories differ significantly from those of the Spanish speakers (i.e. nouns describing natural kinds are feminine, nouns describing artifacts are masculine). Importantly, 5-year-old Spanish learners do not show the adult pattern of either language, even though they are using grammatical gender productively in their speech (see also Martinez & Shatz, 1996). Thus, it appears that the formal aspects of the grammatical gender system are acquired prior to the meaningful aspects (see Batman-Ratyosyan & Stromswold, 2002; Maratsos, 1998, for additional examples of early acquisition of formal aspects of language).

Children's acquisition of the third person singular form of English verbs in the present indicative ("-s") presents another example of a formal aspect of language that seems to be acquired by children before they can demonstrate understanding of its meaning. The third person [s] serves as an overt marker of the semantic distinction of singular vs. plural, as it appears with verbs with singular subjects but not with verbs with plural subjects (Fromkin & Rodman, 1988). Research on children's language production (e.g. Brown, 1973; deVilliers & deVilliers, 1973) has found that children over 3.5 years consistently use it as such, with verbs with singular subjects but not plural ones. Perhaps surprisingly, though, a recent study has found that children have apparently not conceptualized this meaning until they are between 5 and 6 years of age. Johnson, deVilliers, and Seymour (1998) (see also deVilliers & Johnson, 2001) gave children from 3 to 6 years of age a picture comprehension task, where they were to select the appropriate picture based on the accompanying sentence. The sentences were differentiated solely on the basis of the presence or absence of "-s" on the verb; crucially, all verbs began with "s" so that the plural form of the noun, when it appeared, was masked. For example, children heard either (a) "The cat sleeps on the bed" or (b) "The cats sleep on the bed". Johnson et al. found that only the 5- and 6-year-olds responded correctly (i.e. pointed to the correct picture) at levels above chance when they heard sentence (a). Thus, it appears that these children have mastered the *form* of the verb before they fully understanding the *meaning* that it maps onto.

Werker and her colleagues have adduced even more striking evidence that pre-verbal

and barely verbal infants dissociate form and meaning in their early language development. Infants' ability to discriminate syllables that differ only in one segment (minimal pairs, e.g. [bi] and [di]) is well known, and is firmly in place by 2 months of age (e.g. Eimas, Miller, & Jusczyk, 1987; Eimas, Siqueland, Vigorito, & Jusczyk, 1971). These discriminations are akin to those of the infancy studies reported earlier, in that they involve sounds that are not related to meaning or communicative function. Werker and her colleagues (Stager & Werker, 1997; Werker, Corcoran, Fennell, & Stager, 2002) have been investigating when in development infants can map pairs of words that differ only in one segment onto different objects; that is, when the minimally-paired words could be distinguished enough to be mapped onto different meanings. Stager and Werker found that 14-month-olds were able to map pairs of syllables that differed on all their segments (i.e. [lif] and [nem]) onto different objects, but not syllables that differed only on one segment (i.e. [bih] and [dih]). Importantly, the 14-month-olds were able to discriminate the latter two syllables when only viewing a checkerboard pattern; that is, when mapping the words onto different meanings or objects was not required. Werker et al. (2002) concluded that infants at this age "have insufficient computational resources to allow them to attend to the fine phonetic detail" (p. 12) *when they are engaged in a task that involves attending to meaning as well*. Again, distinguishing the forms themselves is easy; infants can make these distinctions for monosyllabic contrasts in their native language by 12 months of age. However, distinguishing the forms while learning their referents – a meaning-based task – is more difficult; Werker et al. find that it emerges by 17 months of age (see also Swingley, 2001, for a related finding).

Werker et al.'s explanation can also account for the contrast between the infancy findings of Jusczyk and his colleagues, that barely verbal infants can distinguish between grammatical and ungrammatical strings of words in English, and the toddler findings of Akhtar, that 2-year-old English learners still accept non-SVO word orders. The key is that the infancy studies did not include a meaning component; the grammatical and ungrammatical strings were simply presented to the participants with no accompanying meaning or reference or communicative function to draw away, in Werker et al.'s terminology, computational resources. The infants concentrated solely on the forms of the utterances. In contrast, the toddler study required the participants to learn three novel verb–action pairs, and subjected them to 20 questions in which they were required to (a) remember the actions, (b) remember the correct novel verb, and (c) describe the action using the verb in a complete sentence. Akhtar's finding that the 2-year-olds in the non-SVO conditions answered significantly fewer questions than their peers in the SVO condition provides an index of the strain on computational resources that ensues when required to learn a novel verb for a new action in an unconventional (at least) sentence frame.

Finally, studies exist in which toddlers do show productive use of transitive and intransitive frames; that is, they demonstrate that the frames function independently of the verbs with which they appear. Importantly, these studies have made the "meaning discernment" part of the task quite easy. Naigles et al. (1993) have found that toddlers (mean age 2;9) can re-interpret a familiar verb in accord with the novel (to adults, ungrammatical) frame in which it has been placed. For example, toddlers consistently enact "*The zebra goes the lion" as *The zebra makes the lion go* (but not *the lion makes the zebra go*), showing understanding that transitive frames implicate causative meanings

in which the pre-verbal noun acts as the agent and the post-verbal noun the patient. Why were these toddlers able to use their knowledge of the semantic implications of the transitive frame to enact the sentences while the toddlers in OT and AT were not able to enact transitive sentences correctly? One crucial difference may have been that the verbs used by Naigles et al. (1993) were already extremely familiar – *go*, *come*, *fall*, *stay* – whereas those used by OT and AT were novel and had only just been taught. That familiarity makes a difference can be seen in the contrast between *go* and *cham*. The children in Naigles et al.'s study had already heard "go" produced literally thousands of times and in multiple frames (Naigles & Hoff-Ginsberg, 1995), had already produced it themselves, and were probably already firmly aware that it refers (among other things) to directed motion. Things and people can go places, and people and things can also be made to go places. Thus, if the children had abstracted a transitive frame and assigned some kind of causal interpretation to it, then "go" in such a frame, especially with animate subjects and objects, is likely to mean *cause-to-go* (Goldberg, 1995; Levin, 1993) (see also footnote 4). It is probably not coincidental that "go" is among the earliest verbs to be overgeneralized as a causative in production (Bowerman, 1974; Pinker, 1989).

When toddlers are asked to interpret novel verbs in different syntactic frames, they can also demonstrate considerable grammatical sophistication, as long as the "meaning discernment" part of the task is greatly simplified. Using the IPL paradigm, my collaborators and I have presented young 2-year-olds with two simultaneously-enacted novel actions, paired with a single novel verb in a syntactic frame (typically, one of the actions is causative and the other is non-causative; the frames are either transitive or intransitive; Hirsh-Pasek, Golinkoff, & Naigles, 1996; Naigles, 1990, 1996, 1998; Naigles & Kako, 1993). For the test, the two actions are presented on separate screens and the children are asked to find the referent of the novel verb. That their choice of action follows the frame of the verb (e.g. those who hear the transitive frames target the causative action and those who hear the intransitive frames – in several manifestations[5] – target the non-causative action) indicates that the frame carries its own meaning for these children, independently

[5] Controversy has arisen concerning whether these toddlers distinguished the transitive and intransitive conditions as different syntactic frames or simply as different configurations of nouns in pre-verbal position (e.g. Akhtar & Tomasello, 1997; Olguin & Tomasello, 1993; Pinker, 1994a; Tomasello, 2000). Specifically, because the transitive and intransitive frames in the earlier studies (Naigles, 1990; Naigles & Kako, 1993) differed in the number of nouns in subject position (i.e. one for the transitive frame (NVN) and two for the intransitive frame (N and N V)), concerns were raised whether the children in the intransitive condition chose the non-causative action because two characters were moving while those in the transitive condition chose the causative action because only one character was moving. In fact, these concerns have proven to be unwarranted on two fronts. (a) Both actions in the videos showed both characters moving; thus, the children's conjecture to distinguish the two actions could not have been 'contrast one moving character vs. two moving characters'. (b) Further research with 28-month-olds has shown that children of this age do not treat single-NP subject transitive and intransitive sentences identically. For example, Naigles (1996, 1998) found that toddlers distinguished novel verbs heard in both transitive and intransitive sentences in the omitted object alternation (e.g. *The duck is blicking the frog*, *the duck is blicking*) from novel verbs heard in both sentence types in the causative alternation (e.g. *The duck is blicking the frog*, *the frog is blicking*) and from novel verbs heard in two intransitive sentences (e.g. *The duck is blicking*, *the duck is blicking*; see also Hirsh-Pasek et al., 1996). In sum, considerable evidence exists that 2-year-old children are treating transitive and intransitive sentences as different syntactic frames.

of the verb because the verb was a nonsense word. That these toddlers were able to demonstrate their understanding of the frame (in contrast to those studied by OT and AT) can be attributed to the ease of meaning discernment in the IPL studies: crucially, the two possible action referents were already segmented for the children rather than requiring the children to remember and enact the possible actions themselves. Moreover, the causative and non-causative action stimuli in the IPL studies were always wholly separable and distinct, whereas the complex actions used by OT and AT involved causative actions in which non-causal components played an integral part. And making this a recognition task rather than one involving recall – either of the verb or of the action – made the children's selection of the more plausible referent of the verb computationally easier, so that they could more clearly display the influence of the syntactic frame (see also Naigles, Bavin, & Smith, 2002).[6]

A final point: the existence of these latter findings about verb syntax raises the possibility of a fourth resolution to the paradox. Simply, it is that 'form is easy': there is no developmental paradox because both infants and toddlers can make abstract generalizations. Is it necessary to add that 'meaning is hard'? I suggest that this second part of the preferred resolution is, indeed, crucial for three reasons. First, it explains *why* children of the same age behave so differently in the OT and AT studies, on the one hand, and in the BT and above-mentioned syntactic bootstrapping studies, on the other. Second, it highlights a major – and yet little-discussed – contrast in the way linguistic abilities are studied in infants vs. toddlers. And third, it succinctly captures the contrastive findings reported by deVilliers, Werker, and Mintz. Across these three reasons, the same pattern holds: some aspects of linguistic form are first shown to be acquired when the meaning-based demands on the children are low or nonexistent, whereas the introduction of more complex meaning-based demands (i.e. not just performance-based demands, as discussed in Section 3.2) can mask or disrupt the children's abilities. Thus, while the 'form is easy' part of the resolution indeed captures the ability of both infants and toddlers to make abstract generalizations, the 'meaning is hard' part of the resolution points toward an explanation for the further progression of language development as infants become toddlers.

4. Summary and conclusions

In this paper, I have tried to do two things. First, by contrasting the findings of five studies of infant language and pseudo-language processing with five studies of toddler language production, I have highlighted a developmental paradox. Specifically, the infants appear to be better at processing and extracting abstract properties of linguistic stimuli than the toddlers are at producing speech that makes use of the abstract properties of language. Moreover, the infants appear to have learned some subtle aspects of English grammar (e.g. the dependency between the "be" form of the auxiliary and the "-ing" suffix on

[6] Mintz and Gleitman (2002) (see also Mintz, 2002) recently reported similar findings in the domain of adjective learning: 24-month-olds were better able to map a novel adjective onto the relevant property when the adjective was presented with a noun referring to a specific taxonomic category (e.g. *dog*, *toy*) than when it was presented with a content-less noun (e.g. *one*, *thing*). Thus, utilizing the adjective frame (e.g. *the stoof Noun*) was easier for the children when the head noun denoted a specific category which the adjective could delimit.

main verbs) whereas the toddlers have apparently not yet mastered basic English word order. Given that one endpoint of language acquisition is the creation of abstract linguistic categories that capture the grammatical configuration of the exposure language, these studies, if taken at face value, suggest a strange developmental progression, in which the infants – the younger children – are closer to the goal than the toddlers, the older children.

Second, I have discussed three possible resolutions to this paradox. Resolution 1, that the infancy findings did not reflect "real" language or language development, was rejected based on research showing how infants employ much the same language learning processes in a wide variety of contexts, both inside and outside of the laboratory. In contrast, Resolution 2, that the infancy and toddler findings are at odds because the infancy research uses comprehension/discrimination or recognition tasks whereas the toddler research primarily assessed spontaneous or elicited production, was found to explain some of the contradictory results. Specifically, the toddler studies yielded results that might have been affected by sampling limitations, they did not fully take into account some effects of communicative interaction and priming on language production, and they suffered when compared with studies revealing more sophisticated word and sentence comprehension in similar-aged children. Thus, some of the toddlers' seeming inability to extract abstract categories over lexical items and to demonstrate knowledge of rudimentary aspects of English grammar can be attributed to characteristics of language production which masked what they knew.

The fact that appealing to methodological differences did not resolve all of the contradictory findings led to the introduction of Resolution 3. Here, another difference between the infancy and toddler studies was highlighted, that the toddler studies assessed the abstract use of linguistic forms, and of language-specific grammar, when these were paired with meanings, whereas the infancy studies investigated the abstraction of auditory and linguistic forms that were dissociated from meaning. This resolution, too, proved explanatory. A discussion of the difficulties, both theoretical and empirical, involved in children's discernment of the meanings expressed in language led to the conclusion that children's early spontaneous language use could be limited in form because it must be – given the aforementioned difficulties – limited in meaning. A re-examination of the experimental toddler studies revealed that the actions and training conditions that were included had a high likelihood of confusing the toddler participants, by enabling multiple interpretations for the verb and/or by leading the children *away* from the verb-meaning pairings intended by the experimenters. A re-examination of the toddlers' so-called "errors" (see footnote 3) supported this latter claim, in that these utterances could be considered productive if other meanings for the verbs were accepted. Thus, difficulties with meaning discernment provided an explanation for the toddlers' conservatism in elicited production, chance performance in sentence comprehension and so-called errors.

The breadth of Resolution 3 was then explored by discussing studies from a range of areas of language acquisition, all of which showed a developmental dissociation wherein the forms of language (e.g. grammatical gender, third person singular verb marking, phonological minimal pairs) begin to be acquired before their accompanying meanings. This dissociation between form and meaning during development has been attributed to the limited availability of computational resources in such young children (i.e. Stager & Werker, 1997; Werker et al., 2002). That is, the analysis of linguistic forms and the

discernment of linguistic meanings for those forms both take computational resources; at early stages of development, when so many of the forms and the meanings are still unfamiliar, very young children cannot focus on both at once. This explanation also provided a partial account for the findings from my laboratory which were more directly at odds with those of the toddler studies. Specifically, we have shown that, when the task of meaning discernment is made easy, 2-year-olds can demonstrate that they have already abstracted at least two English sentence frames, the transitive and the intransitive, which are distinct and independent from the verbs with which they might appear (see also Naigles et al., 2002). In sum, in early language acquisition, acquiring the forms is easy, but learning how to integrate the forms with meanings is hard.

Further explorations of Resolutions 2 and 3 might go in several directions. One direction involves the use of comprehension/recognition tasks to further investigate infants' and toddlers' ability to make formal distinctions without having to map those distinctions onto meanings. For example, the Akhtar (1999) study might be recast as a Head-Turn-Procedure task wherein infants are asked to distinguish utterances with familiar nouns and novel verbs in SOV vs. SVO structures. Moreover, this and other such studies should be conducted cross-linguistically, comparing infants exposed to different languages (as has been done with phonological and phonotactic distinctions; see Jusczyk, 1997, for a recent summary; see also Bates & MacWhinney, 1989; Slobin & Bever, 1982, for examples of such cross-linguistic work with the grammatical systems of older children). Thus, Japanese infants (whose language is SOV) should behave differently from English learners on an SOV/SVO discrimination task. These investigations would address the question of which formal linguistic distinctions children can acquire relatively divorced from meaning vs. which ones require meaning to be acquired.

Another direction might make use of the elicited production task, but now investigate the status of children's abstraction of the grammatical category *verb* in a less meaning-dependent way. For example, although the use of a given verb in different syntactic manifestations varies by the meaning of the verb, its usage in different morphological manifestations may be less meaning-dependent (albeit not wholly meaning-independent). Berko (1958) demonstrated that children aged 3–4 years can produce a novel verb in the past tense without having heard it attested in that tense (see also Kim et al., 1994); Akhtar and Tomasello (1997) found limited productivity in older 2-year-olds. But English may not be the ideal language to study early morphological productivity; other languages, whose inflectional morphological paradigms are rich and highly regular, may yield more revealing findings. Thus, a child learning Polish, Turkish, or Greek (all with highly inflected verbal morphology) might be taught a novel verb in one tense or aspect (for example) and then asked to produce it in a situation facilitative of a contrasting tense or aspect. Existing evidence (Aksu-Koc & Slobin, 1985; Smoczynska, 1985; Stephany, 1997; Weist, 1983) suggests that young 2-year-old (at least) learners of these languages should be able to demonstrate this type of generalization, and so demonstrate their command of the grammatical category *verb*.

Yet another direction might directly compare children's ability to distinguish grammatical constructions with and without a meaning component as part of the task. For example, learners of a given language could be tested for their ability to distinguish passages containing verbs (or nouns) in different inflectional forms, i.e. verbs ending in "-ed" vs.

"-ing" in English. Mere distinction of form though does not mark complete acquisition; the further test would be to investigate (perhaps using IPL) when the children matched the "-ed" form with a past or completed action and the "-ing" form with a present or ongoing action. The hypothesis consistent with Resolution 3 is that the formal distinction would be evident before the children showed they had successfully mapped the forms onto their meanings. In contrast, accounts in which grammatical acquisition is driven by the search for forms to capture already-distinguished meanings would predict no developmental difference in children's ability to succeed in the two tasks.

I conclude by emphasizing what the two successful resolutions to the developmental paradox do *not* imply. First, the proposal that learning meanings is difficult for young children, such that it can emerge developmentally after learning forms, does not imply that pre-verbal infants are solely focusing on the analysis of forms. Quite the contrary, there is a burgeoning literature that demonstrates the extent of infant conceptual development that occurs during the first 12–18 months of life (see Haith & Benson, 1998; Mandler, 1998, for comprehensive summaries). Most of these researchers agree, though, that this early conceptual development proceeds independently of the influence of language. Thus, the concepts have not yet become linguistic meanings. It is this mapping, or integration, of linguistic meaning with linguistic form that I am proposing is a later-emerging phenomenon in the life of the child, at least partly because this mapping is subject to meaning discernment challenges.

Second, the proposal that infants' ability to process linguistic and pseudo-linguistic stimuli enables them to abstract some of the forms of language before they begin to talk does not imply that the children emerge, at 18 months or so, with English grammar fully configured (and yet devoid of meaning)! For one thing, there are many grammatical constructions that require meaning to be fully distinguished. However, the available evidence on what infants can do suggests that pre-verbal and barely verbal infants may be accruing a rough parse of their input sentences based on the distributional regularities of the lexical items contained therein. Both Marcus et al. (1999) and Gómez and Gerken (1999) have shown that infants are capable of this type of analysis. Distributional regularity has long been hypothesized to be a major source of sentence analysis (e.g. Maratsos, 1982, 1998; Maratsos & Chalkley, 1980; Pinker, 1984); more recent computational work has demonstrated that it has the potential to shoulder a large part of the burden in children's early formal categorizations of their input (e.g. Cartwright & Brent, 1997). Thus, children may have acquired a rough abstract parse of several types of sentences and morphological paradigms before they are 2 years of age. Have they also acquired a parse, or representation, of more complex sentences? No one has investigated this, so the extent of infants' ability to abstract configurations based just on form is unknown. Still, it is not necessary for my argument for the children to have learned everything about the forms of their language before they have learned much about their meanings. It is more likely that the forms that the children have acquired by 18 months or so, which lead to a rough abstract parse of a small number of sentence types, then facilitate (along with other sources of information) children's acquisition of a multitude of linguistic meanings. These meanings, then, could in turn facilitate the acquisition of more complex linguistic forms.

This sketch is in accord with the types of reciprocal "bootstrapping" discussed by Gleitman (Gleitman & Gleitman, 1997; Gleitman & Wanner, 1984), Pinker (Pinker,

1984, 1989), Shatz (1987) and Fisher (2002), among others (see also Morgan & Demuth, 1996), where linguistic forms and meanings "bootstrap" off each other to facilitate the acquisition of syntax and semantics. Most of these accounts postulate that the bootstrapping process gets started with some aspect of meaning (typically, word or lexical meaning) as its initial instigating force. Another possibility, though, is that the initial instigating force of the bootstrapping process is *form*, be it segmental, prosodic, or structural (see also Kuhl, 2000; Maratsos, 1998). Thus, these two resolutions to the developmental paradox highlight the enormous amount of auditory and linguistic analysis that infants must be carrying out, but not yet revealing in their speech, and the possible developmental primacy of form over meaning at the beginnings of child language acquisition.

Acknowledgements

This paper is dedicated to the memory of Peter W. Jusczyk, whose research inspired the line of argument pursued here. I am also grateful to Erika Hoff, Edith Bavin, Cynthia Fisher, Lila R. Gleitman, Jill deVilliers, Rebecca Gómez, Gary Marcus, Jenny Saffran, Whit Tabor, and three reviewers for their comments and suggestions on this research, which has been supported by a Large Faculty Grant from the University of Connecticut Research Foundation.

References

Akhtar, N. (1999). Acquiring basic word order: evidence for data-driven learning of syntactic structure. *Journal of Child Language*, *26*, 339–356.

Akhtar, N., Dunham, F., & Dunham, P. J. (1991). Directive interactions and early vocabulary development: the role of joint attentional focus. *Journal of Child Language*, *18*, 41–50.

Akhtar, N., Jipson, J., & Callanan, M. (2001). Learning words through overhearing. *Child Development*, *72*, 416–430.

Akhtar, N., & Tomasello, M. (1997). Young children's productivity with word order and verb morphology. *Developmental Psychology*, *33*, 952–965.

Akhtar, N., & Tomasello, M. (2000). The social nature of words and word learning. In R. Golinkoff & K. Hirsh-Pasek (Eds.), *Becoming a word learner: a debate on lexical acquisition.* Oxford: Oxford University Press.

Aksu-Koc, A., & Slobin, D. (1985). The acquisition of Turkish. In D. Slobin (Ed.), *The cross-linguistic study of language acquisition* (pp. 839–880). Vol. 1. Mahwah, NJ: Erlbaum.

Aslin, R., Saffran, J., & Newport, E. (1999). Statistical learning in linguistic and nonlinguistic domains. In B. MacWhinney (Ed.), *The emergence of language* (pp. 359–380). Hillsdale, NJ: Erlbaum.

Baldwin, D. A. (1993). Infant's ability to consult the speaker for clues to word reference. *Journal of Child Language*, *20*, 395–418.

Baldwin, D., & Bland, R. (2001). *Broadening the scope of "motherese" to include "motionese"*. Paper presented at the 2001 meeting of the Society for Research in Child Development, Minneapolis, MN.

Bates, E. & MacWhinney, B. (1989). *The cross-linguistic study of sentence processing.* Cambridge: Cambridge University Press.

Batman-Ratyosyan, N., & Stromswold, K. (2002). Morphosyntax is easy, discourse/pragmatics is hard. In B. Skarabela, S. Fish & A. H. J. Do (Eds.), *Proceedings of the 26th Boston University Conference on Language Development* (pp. 793–804). Somerville, MA: Cascadilla Press.

Bavin, E. (1992). The acquisition of Warlpiri. In D. Slobin (Ed.), *The cross-linguistic study of language acquisition* (pp. 309–372). Vol. 3. Hillsdale, NJ: Erlbaum.

Bavin, E., & Kidd, E. (2000). Learning new words: beyond the input. In C. Davis, T. van Gelder & R. Wales

(Eds.), *Cognitive science in Australia: proceedings of the 5th annual Australasian Cognitive Science Conference.* Adelaide: Causal.

Berko, J. (1958). The child's learning of English morphology. *Word*, *14*, 150–177.

Berman, R. & Slobin, D. (1994). *Relating events in narrative: a cross-linguistic developmental study.* Hillsdale, NJ: Erlbaum.

Best, C. T., & McRoberts, G. (1989). *Phonological influences on the perception of native and non-native speech contrasts*. Paper presented at the 1989 meeting of the Society for Research in Child Development, Kansas City, MO.

Bloom, L. (1998). Language acquisition in its developmental context. In D. Kuhn & R. S. Siegler (Eds.), *Cognition, perception, and language. Handbook of child psychology* (pp. 309–370). Vol. 2. New York: Wiley.

Bloom, L., Lifter, K., Haftiz, J. (1980). Semantics of verbs and the development of verb inflection in child language. *Language*, *56*, 386–412.

Bloom, P. (2000). *How children learn the meanings of words.* Cambridge, MA: MIT Press.

Bock, K. (1990). Structure in language: creating form in talk. *American Psychologist*, *45*, 1221–1236.

Bock, K., Loebell, H., & Morey, R. (1992). From conceptual roles to structural relations: bridging the syntactic cleft. *Psychological Review*, *99*, 150–171.

Bowerman, M. (1974). Learning the structure of causative verbs: a study in the relationship of cognitive, semantic and syntactic development. *Papers and Reports on Child Language Development*, *8*, 142–178.

Bowerman, M. (1982). Starting to talk worse: clues to language acquisition from children's late speech errors. In S. Strauss (Ed.). *U-Shaped behavioral growth.* New York: Academic Press.

Brooks, P., & Tomasello, M. (1999). How children constrain their argument structures. *Language*, *75*, 720–738.

Brown, R. (1973). *A first language*. Cambridge, MA: Harvard University Press.

Budwig, N. (1995). *A developmental-functionalist approach to child language*. Mahwah, NJ: Erlbaum.

Carpenter, M., Nagell, K., & Tomasello, M. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development, 63*(4, Serial No. 255).

Cartwright, T., & Brent, M. (1997). Syntactic categorization in early language acquisition: formalizing the role of distributional analysis. *Cognition*, *63*, 121–170.

Choi, S. (2000). Caregiver input in English and Korean: use of nouns and verbs in book-reading and toy-play contexts. *Journal of Child Language*, *27*, 69–96.

Clark, H. (1996). *Using language*. Cambridge: Cambridge University Press.

Dapretto, M., & Bjork, E. (2000). The development of word retrieval abilities in the second year and its relation to early vocabulary growth. *Child Development*, *71*, 635–648.

Demuth, K. (1996). Collecting spontaneous production data. In D. McDaniel, C. McKee & H. S. Cairns (Eds.), *Methods for assessing children's syntax* (pp. 3–22). Cambridge, MA: MIT Press.

deVilliers, J., & deVilliers, P. (1973). A cross-sectional study of the acquisition of grammatical morphemes in child speech. *Journal of Psycholinguistic Research*, *2*, 267–278.

deVilliers, J., & Johnson, V. (2001, November). *The case of the disappearing 3rd person /s/*. Paper presented at the 26th Annual Boston University Conference on Language Development, Boston, MA.

Dixon, R. M. W. (1991). *A new approach to English grammar, on semantic principles*. Oxford: Oxford University Press.

Eimas, P. (1999). Letter to the editor. *Science*, *284*, 435–436.

Eimas, P., Miller, J. & Jusczyk, P.W. (1987). On infant speech perception and the acquisition of language. In S. Harnad (Ed.), *Categorical perception*. New York: Cambridge University Press.

Eimas, P., Siqueland, E., Vigorito, J., & Jusczyk, P. (1971). Speech perception in infants. *Science*, *171*, 303–306.

Fisher, C. (2000). *Who's blicking whom? Word order in early verb learning*. Poster presented at the International Conference on Infancy Studies, Brighton, UK.

Fisher, C. (2002). The role of abstract syntactic knowledge in language acquisition: a reply to Tomasello (2000). *Cognition*, *82*, 259–278.

Fisher, C., Gleitman, H., & Gleitman, L. (1991). On the semantic content of subcategorization frames. *Cognitive Psychology*, *23*, 331–392.

Fisher, C., & Song, H. (2001). *What's in a sentence? Acquiring verb knowledge from ordinary discourse*. Paper presented at the 2001 meeting of the Society for Research in Child Development. Minneapolis, MN.

Fodor, J. A. (1970). Three reasons for not deriving "kill" from "cause to die". *Linguistic Inquiry*, *1*, 429–438.

Fromkin, V., & Rodman, R. (1988). *An introduction to language* (4th ed.). Fort Worth, TX: Holt, Rinehart & Winston.

Gerken, L., & MacIntosh, B. (1993). The interplay of function morphemes and prosody in early language. *Developmental Psychology*, *29*, 448–457.

Gerken, L., & Shady, M. (1996). The picture selection task. In D. McDaniel, C. McKee & H. S. Cairns (Eds.), *Methods for assessing children's syntax* (pp. 125–146). Cambridge, MA: MIT Press.

Gershkoff-Stowe, L., & Hahn, E. (2001). *Learning how to learn words: beyond individual practice*. Paper presented at the 2001 meeting of the Society for Research in Child Development, Minneapolis, MN.

Gillette, J., Gleitman, H., Gleitman, L., & Lederer, A. (1999). Human simulations of vocabulary learning. *Cognition*, *73*, 135–176.

Gleitman, L. (1990). The structural sources of verb meanings. *Language Acquisition*, *1*, 3–55.

Gleitman, L. & Gleitman, H. (1997). What is a language made of? *Lingua*, *100*, 29–67.

Gleitman, L., & Wanner, E. (1984). Current issues in language learning. In M. Bornstein & M. Lamb (Eds.), *Perceptual, cognitive, and linguistic development. Developmental psychology: an advanced textbook* (pp. 297–356). Vol. 2. Hillsdale, NJ: Erlbaum.

Goldberg, A. (1995). *Constructions: a construction grammar approach to argument structure*. Chicago, IL: University of Chicago Press.

Golinkoff, R. (1986). "I beg your pardon?" The preverbal negotiation of failed messages. *Journal of Child Language*, *13*, 455–476.

Golinkoff, R., Mervis, C. & Hirsh-Pasek, K. (1994). Early object labels: the case for a developmental lexical principles approach. *Journal of Child Language*, *21*, 125–156.

Gómez, R., & Gerken, L. (1999). Artificial grammar learning by one-year-olds leads to specific and abstract knowledge. *Cognition*, *70*, 109–135.

Gómez, R., & Gerken, L. (2000). Infant artificial language learning and language acquisition. *Current Trends in Cognitive Science*, *4*, 178–186.

Goodman, J. (2001). *The rate and shape of receptive and expressive vocabulary development in infants and toddlers*. Paper presented at the 2001 meeting of the Society for Research in Child Development, Minneapolis, MN.

Gropen, J., Pinker, S., Hollander, M., & Goldberg, R. (1991). Affectedness and direct objects: the role of lexical semantics in the acquisition of verb argument structure. *Cognition*, *41*, 153–196.

Haith, M., & Benson, J. (1998). Infant cognition. In D. Kuhn & R. S. Siegler (Eds.), *Cognition, perception, and language. Handbook of child psychology* (pp. 199–254). Vol. 2. New York: Wiley.

Hirsh-Pasek, K., & Golinkoff, R. (1996). *The origins of grammar*. Cambridge, MA: MIT Press.

Hirsh-Pasek, K., Golinkoff, R., & Naigles, L. (1996). Young children's use of syntactic frames to derive meaning. In K. Hirsh-Pasek & R. Golinkoff (Eds.), *The origins of grammar* (pp. 123–158). Cambridge, MA: MIT Press.

Hoff, E., & Naigles, L. (2002). How children use input to acquire a lexicon. *Child Development*, *73*, 418–433.

Hoff-Ginsberg, E. (1987). Topic relations in mother-child conversation. *First Language*, *7*, 145–156.

Hoff-Ginsberg, E. (1991). Mother-child conversation in different social classes and communicative settings. *Child Development*, *62*, 782–796.

Hohenstein, J., Naigles, L., & Eisenberg, A. (in press). Keeping verb acquisition in motion: a comparison of English and Spanish. In S. Waxman, & G. Hall (Eds.), *Weaving a lexicon*. Hillsdale, NJ: Erlbaum.

Hollich, G. J., Hirsh-Pasek, K., & Golinkoff, R. M. (2000). Breaking the language barrier: an emergentist coalition model for the origins of word learning. *Monographs of the Society for Research in Child Development, 65*(3, Serial No. 262).

Huttenlocher, J. (1974). The origins of language comprehension. In R. Solso (Ed.), *Theories in cognitive psychology: the Loyola symposium* (pp. 331–368). Hillsdale, NJ: Erlbaum.

Ingram, D. (1988). *First language acquisition*. Cambridge: Cambridge University Press.

Jackendoff, R. (1983). *Semantics and cognition*. Cambridge, MA: MIT Press.

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

Johnson, V. E., deVilliers, J. G., & Seymour, H. N. (1998, November). *Comprehension of third person singular /s/ in children*. Poster session presented at the Annual Convention of the American Speech-Language-Hearing Association, San Antonio, TX.

Jusczyk, P. (1997). *The discovery of spoken language*. Cambridge, MA: MIT Press.

Jusczyk, P., & Aslin, R. (1995). Infants' detection of sound patterns of words in fluent speech. *Cognitive Psychology*, *29*, 1–23.

Jusczyk, P., Cutler, A., & Redanz, N. (1993). Preference for predominant stress patterns of English words. *Child Development*, *64*, 675–687.

Jusczyk, P., Friederici, A., Wessels, J., Svenkerud, V., & Jusczyk, A. (1993). Infants' sensitivity to the sound patterns of native language words. *Journal of Memory and Language*, *32*, 402–420.

Kemler Nelson, D., Jusczyk, P., Mandel, D., Myers, J., Turk, A., & Gerken, L. A. (1995). The head-turn preference procedure for testing auditory perception. *Infant Behavior and Development*, *18*, 111–116.

Kim, J., Marcus, G., Pinker, S., Hollander, M., & Coppola, M. (1994). Sensitivity of children's inflection to grammatical structure. *Journal of Child Language*, *21*, 173–210.

Kuhl, P. (2000). A new view of language acquisition. *Proceedings of the National Academy of Sciences USA*, *97*, 11850–11857.

Kuhl, P., Williams, K., Lacerda, R., Stevens, K., & Lindblom, B. (1992). Linguistic experiences alter phonetic perception in infants by 6 months of age. *Science*, *255*, 606–608.

Landau, B., & Gleitman, L. R. (1985). *Language and experience*. Cambridge, MA: Harvard University Press.

Laskey, R., Syrdal-Lasky, A., & Klein, R. (1975). VOT discrimination by four to six and a half month old infants from Spanish environments. *Journal of Experimental Child Psychology*, *20*, 215–225.

Lasnik, H. (1989). On certain substitutes for negative data. In R. Matthews & W. Demopoulos (Eds.), *Learnability and linguistic theory* (pp. 89–105). Amsterdam: Kluwer.

Levelt, W. (1989). *Speaking: from intention to articulation*. Cambridge, MA: MIT Press.

Levin, B. (1993). *English verb classes and alternations: a preliminary investigation*. Chicago, IL: University of Chicago Press.

Levin, B., & Rappoport Hovav, M. (1994). A preliminary analysis of causative verbs in English. *Lingua*, *92*, 35–77.

Levy, Y. (1983). It's frogs all the way down. *Cognition*, *15*, 75–93.

Lieven, E., Behrens, H., & Tomasello, M. (2001, November). *Corpus-based studies of children's development of verb-argument structures*. Paper presented at the 26th Annual Boston University Conference on Language Development, Boston, MA.

Mandel, D., Jusczyk, P., & Pisoni, D. (1995). Infants' recognition of the sound patterns of their own names. *Psychological Science*, *6*, 315–318.

Mandler, J. (1998). Representation. In D. Kuhn & R. S. Siegler (Eds.), *Cognition, perception, and language. Handbook of child psychology* (pp. 255–308). Vol. 2. New York: Wiley.

Maratsos, M. (1982). The child's construction of grammatical categories. In E. Wanner & L. Gleitman (Eds.), *Language acquisition: the state of the art* (pp. 240–366). Cambridge: Cambridge University Press.

Maratsos, M. (1998). The acquisition of grammar. In D. Kuhn & R. S. Siegler (Eds.), *Cognition, perception, and language. Handbook of child psychology* (pp. 421–466). Vol. 2. New York: Wiley.

Maratsos, M., & Chalkley, M. (1980). The internal language of children's syntax. In K. Nelson (Ed.), *Children's language* (pp. 127–213). Vol. 2. New York: Gardner Press.

Marcus, G. (1999a). Reply to Seidenberg, Elman, Neigishi, Eimas. *Science*, *284*, 436–437.

Marcus, G. (1999b). Reply to Sidenberg & Elman. *Trends in Cognitive Sciences*, *3*, 289.

Marcus, G. (1999c). Reply to Christiansen & Curtin. *Trends in Cognitive Science*, *3*, 290–291.

Marcus, G., Vijayan, S., Bandi Rao, S., & Vishton, P. (1999). Rule learning by seven-month-old infants. *Science*, *283*, 77–80.

Markman, E. (1989). *Categorization and naming in children.* Cambridge, MA: MIT Press.

Martinez, I., & Shatz, M. (1996). Linguistic influences on categorization in preschool children: a crosslinguistic study. *Journal of Child Language*, *23*, 529–548.

McClelland, J., & Plaut, D. (1999). Does generalization in infant learning implicate abstract algebra-like rules? *Trends in Cognitive Science*, *3*, 166–168.

McDaniel, D., McKee, C. & Cairns, H. S. (1996). Methods for assessing children's syntax Cambridge, MA: MIT Press.

Mintz, T. (2002, July). *Constraints on adjective mapping in two and three-year-olds: the importance of taxonomic specificity*. Paper presented at the IXth International Congress for the Study of Child Language, Madison, WI.

Mintz, T., & Gleitman, L. R. (2002). Adjectives really do modify nouns: the incremental and restrictive nature of early adjective acquisition. *Cognition*, *84*, 267–293.

Morgan, J. & Demuth, K., (Eds.), (1996). *From signal to syntax.* Hillsdale, NJ: Erlbaum.

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

Naigles, L. (1996). The use of multiple frames in verb learning via syntactic bootstrapping. *Cognition*, *58*, 221–251.

Naigles, L. (1998). Developmental changes in the use of structure in verb learning. *Advances in Infancy Research*, *12*, 298–317.

Naigles, L. (2000). Call for information about children's names for mom and dad, and summary thereof. Available at: www.listserv.linguistlist.org/archives/info-childes.html 7 June 2000 (call) and 8 July 2000 (summary).

Naigles, L., Bavin, E., & Smith, M. (2002). Generalizing novel verbs to different structures: evidence for the importance of understanding meaning. In B. Skarabela, S. Fish & A. H. J. Do (Eds.), *Proceedings of the 26th Boston University Conference on Language Development*. Somerville, MA: Cascadilla Press.

Naigles, L., Eisenberg, A., Kako, E., Highter, M., & McGraw, N. (1998). Speaking of motion: verb use by English and Spanish speakers. *Language and Cognitive Processes*, *13*, 521–549.

Naigles, L., Fowler, A., & Helm, A. (1992). Developmental shifts in the construction of verb meanings. *Cognitive Development*, *7*, 403–428.

Naigles, L., Gleitman, L. R., & Gleitman, H. (1993). Children acquire word meaning components from syntactic evidence. In E. Dromi. *Language and cognition: a developmental perspective* (pp. 104–140). Norwood, NJ: Ablex.

Naigles, L., & Hoff-Ginsberg, E. (1995). Input to verb learning: evidence for the plausibility of syntactic bootstrapping. *Developmental Psychology*, *31*, 827–837.

Naigles, L., & Hoff-Ginsberg, E. (1998). Why are some verbs learned before other verbs? Effects of input frequency and structure on children's early verb use. *Journal of Child Language*, *25*, 95–120.

Naigles, L., & Kako, E. (1993). First contact: biases in verb learning with and without syntactic information. *Child Development*, *64*, 1665–1687.

Newport, E., & Aslin, R. (2000). Innately constrained learning: blending old and new approaches to language acquisition. *Proceedings of the Boston University Conference on Language Development* (pp. 1–21). Somerville, MA: Cascadilla Press.

Olguin, R., & Tomasello, M. (1993). Twenty-five month old children do not have a grammatical category of verb. *Cognitive Development*, *8*, 245–272.

Oshima-Takane, Y. (1988). Children learn from speech not addressed to them: the case of personal pronouns. *Journal of Child Language*, *15*, 95–108.

Oshima-Takane, Y., Goodz, E., & Derevensy, J. (1996). Birth order effects in early language development: do second-born children learn from overheard speech? *Child Development*, *67*, 621–634.

Pickering, M. J., & Branigan, H. P. (1998). The representation of verbs: evidence from syntactic priming in language production. *Journal of Memory and Language*, *39*, 633–651.

Pine, J., Lieven, E., & Rowland, C. (1998). Comparing different models of the development of the English verb category. *Linguistics*, *36*, 807–830.

Pinker, S. (1984). *Language learnability and language development*. Cambridge, MA: Harvard University Press.

Pinker, S. (1989). *Learnability and cognition: the acquisition of argument structure*. Cambridge, MA: MIT Press.

Pinker, S. (1994a). How could a child use verb syntax to learn verb semantics? *Lingua*, *92*, 377–410.

Pinker, S. (1994b). *The language instinct*. New York: William Morrow.

Polka, L., & Werker, J. (1994). Developmental changes in perception of nonnative vowel contrasts. *Journal of Experimental Psychology: Human Perception and Performance*, *202*, 321–435.

Quine, W. V. O. (1960). *Word and object*, Cambridge, MA: Harvard University Press.

Reznick, J. S., Corley, R., & Robinson, J. (1997). A longitudinal twin study of intelligence in the second year. *Monographs of the Society for Research in Child Development, 62*(1, Serial No. 249).

Saffran, J. (2001). Words in a sea of sounds: the output of infant statistical learning. *Cognition*, *81*, 149–169.

Saffran, J., Aslin, R., & Newport, E. (1996). Statistical learning by 8-month-old infants. *Science*, *274*, 1926–1928.

Santelmann, L., & Jusczyk, P. (1998). Sensitivity to discontinuous dependencies in language learners: evidence for limitations in processing space. *Cognition*, *69*, 105–134.

Schiefflin, B. (1985). The acquisition of Kaluli. In D. Slobin (Ed.), *Crosslinguistic study of language acquisition* (pp. 525–594). Vol. 1. Hillsdale, NJ: Erlbaum.

Sera, M., Berge, C., & Pintado, J. (1994). Grammatical and conceptual forces in the attribution of gender by English and Spanish speakers. *Cognitive Development*, *9*, 261–292.

Shady, M. (1996). *Infants' sensitivity to function morphemes*. Unpublished doctoral dissertation, State University of New York at Buffalo, Buffalo, NY.

Shady, M., & Gerken, L. (1999). Grammatical and caregiver cues in early sentence comprehension. *Journal of Child Language*, *26*, 163–175.

Shady, M., Gerken, L., & Jusczyk, P. (1995). Some evidence of sensitivity to prosody and word order in ten-month-olds. In D. MacLaughlin & S. McEwen (Eds.), *Proceedings of the Boston University Conference on Language Development* (pp. 553–562). Vol. 2. Somerville, MA: Cascadilla Press.

Shatz, M. (1987). Bootstrapping operations in child language. In K.E. Nelson & A. van Kleeck (Eds.), *Children's Language* (pp. 1–22). Vol. 6. Hillsdale, NJ: Erlbaum.

Shipley, E., Smith, C., & Gleitman, L. (1969). A study in the acquisition of language: free responses to commands. *Language*, *45*, 322–342.

Sirois, S., Buckingham, D., & Shultz, T. (2000). Artificial grammar learning by infants: an auto-associator perspective. *Developmental Science*, *3*, 442–456.

Slobin, D., & Bever, T. (1982). Children use canonical sentence schemas: a cross-linguistic study of word order and inflections. *Cognition*, *12*, 229–265.

Smoczynska, M. (1985). The acquisition of Polish. In D. Slobin (Ed.), *The cross-linguistic study of language acquisition* (pp. 595–686). Vol. 1. Hillsdale, NJ: Erlbaum.

Snow, C. E. (1999). Social perspectives on the emergence of language. In B. MacWhinney (Ed.), *The emergence of language* (pp. 257–276). Mahwah, NJ: Lawrence Erlbaum Associates.

Stager, C., & Werker, J. (1997). Infants listen for more phonetic detail in speech perception than in word learning tasks. *Nature*, *388*, 381–382.

Stephany, U. (1997). The acquisition of Greek. In D. Slobin (Ed.). *The cross-linguistic study of language acquisition* (pp. 183–334). Vol. 4. Mahwah, NJ: Erlbaum.

Stromswold, K. (1996). Analyzing children's spontaneous speech. In D. McDaniel, C. McKee & H. S. Cairns (Eds.), *Methods for assessing children's syntax* (pp. 23–54). Cambridge, MA: MIT Press.

Swingley, D. (2001, December). *Phonetic representation in the developing lexicon*. Paper presented at the Early Lexicon Acquisition Conference, Lyon, France.

Talmy, L. (1985). Lexicalization patterns: semantic structure in lexical forms. In T. Shopen (Ed.), *Language typology and syntactic description* (pp. 57–149). Vol. 3. New York: Cambridge University Press.

Theakston, A., Lieven, E., Pine, J., & Rowland, C. (2001). The role of performance limitations in the acquisition of verb argument structure: an alternative account. *Journal of Child Language*, *28*, 127–152.

Tomasello, M. (1992a). *First verbs: a case study of early grammatical development*. Cambridge: Cambridge University Press.

Tomasello, M. (1992b). The social bases of language development. *Social Development*, *1*, 67–87.

Tomasello, M. (2000). Do young children have adult syntactic competence? *Cognition*, *74*, 209–253.

Tomasello, M. (2001). Perceiving intentions and learning words in the second year of life. In M. Bowerman & S. Levinson (Eds.), *Language acquisition and conceptual development* (pp. 132–158). Cambridge: Cambridge University Press.

Tomasello, M., & Akhtar, N. (1995). Two-year-olds use pragmatic cues to differentiate reference to objects and actions. *Cognitive Development*, *10*, 201–224.

Tomasello, M., & Barton, M. (1994). Learning words in nonostensive contexts. *Developmental Psychology*, *30*, 639–650.

Tomasello, M., & Brooks, P. (1998). Young children's earliest transitive and intransitive constructions. *Cognitive Linguistics*, *9*, 379–395.

Tomasello, M., Akhtar, N., Dodson, K., & Rekau, L. (1997). Differential productivity in young children's use of nouns and verbs. *Journal of Child Language*, *24*, 373–387.

Tomasello, M., Conti-Ramsden, G., & Ewert, B. (1990). Young children's conversations with their mothers and fathers: differences in breakdown and repair. *Journal of Child Language*, *17*, 115–130.

Tomasello, M., & Farrar, J. (1986). Joint attention and early language. *Child Development*, *57*, 1454–1463.

Tomasello, M., & Olguin, R. (1993). Twenty-three-month-old children have a grammatical category of noun. *Cognitive Development*, *8*, 451–464.

Tomasello, M., & Todd, J. (1983). Joint attention and lexical acquisition style. *First Language*, *4*, 197–212.

Trehub, S. (1976). The discrimination of foreign speech contrasts by infants and adults. *Child Development*, *47*, 466–472.

Valian, V. (1986). Syntactic categories in the speech of young children. *Developmental Psychology*, *22*, 562–579.

Weist, R. (1983). Prefix vs. suffix information processing in the comprehension of tense and aspect. *Journal of Child Language*, *10*, 85–96.

Werker, J., Corcoran, K., Fennell, C., & Stager, C. (2002). Age and vocabulary size influences on the phonological representation of newly learned words in infants aged 14 to 20 months. *Infancy*, *3*, 1–30.

Werker, J., & Tees, R. (1984). Cross-language speech perception: evidence for perceptual reorganization during the first year of life. *Infant Behavior and Development*, *7*, 49–63.

Wittgenstein, L. (1953). *Philosophical investigations*. New York: Macmillan.

Woodward, A., & Markman, E. (1998). Early word learning. In D. Kuhn & R. S. Siegler (Eds.), *Cognition, perception, and language*. *Handbook of child psychology* (pp. 371–420). Vol. 2. New York: Wiley.