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The effects of child-directed speech vs adult-directed speech on attention and categorization in prelinguistic infants

Jean M. Schumacher
University of Nebraska at Omaha

THE EFFECTS OF CHILD-DIRECTED SPEECH VS ADULT-DIRECTED SPEECH ON ATTENTION AND CATEGORIZATION IN PRELINGUISTIC INFANTS

A Thesis

Presented to the

Department of Psychology

and the

Faculty of the Graduate College

University of Nebraska

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

University of Nebraska at Omaha

by

Jean M. Schumacher

January 1993

THESIS ACCEPTANCE

Acceptance for the faculty of the Graduate College, University of Nebraska, in partial fulfillment of the requirements for the degree Master of Arts, University of Nebraska at Omaha.

Committee

Name	Department
[signature]	Psychology
[signature]	Counseling
[signature]	Psychology

[signature]
Chairman

5 February 1993
Date

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Abstract

The facilitative role of linguistic input on nonlinguistic categorization is frequently explained in terms of children's attention to uniquely linguistic forms such as words. In the three experiments reported here, 15-month-old infants were familiarized to visual stimuli in the context of hearing either adult-directed speech (ADS) or child-directed speech (CDS) during visual fixations. Categorization was successful with CDS and ADS input when accumulated attention was not constrained (Experiment 1). Moreover, there were no differences in accumulated attention as a function of input type. When attention was constrained to 90 seconds (Experiments 2 and 3), ADS input disrupted categorization more for female than male subjects. This disruption is not predicted by current constraints/biases accounts and suggests that a psychologically real noun-category bias may not be present prior to the vocabulary explosion.

Chapter 1

Introduction

Statement of the problem

The interrelationship of cognition and language has been a topic of interest to philosophers, linguists, and psychologists for centuries (Cromer, 1976). It is an issue of particular importance in the study of children's language acquisition (e.g., Bowerman, 1973, 1988, 1989; Clark, 1973, 1983; Nelson, 1974, 1985; Schlesinger, 1982; Slobin, 1973, 1985). This relationship is a complicated one, because neither cognition nor language is a unitary phenomenon, and will probably vary depending on what aspect of cognition is of interest (e.g., Piagetian sensori-motor abilities, memory) relative to what aspect of language (e.g., phonology, sentence or discourse level syntax, semantics) is emphasized (Karmiloff-Smith, 1989).

One basic aspect of cognition that has been widely recognized as playing a fundamental role in human functioning is that of categorization (Bruner, Goodnow, & Austin, 1956; Rosch, 1977, 1978). It has been noted that "virtually all cognitive activity involves and is dependent upon the process of categorization" (Bruner, Goodnow, & Austin, 1956, p. 246). Consistent with this

assertion, categorization has been suggested to be basic to the nature of language and language learning (Bowerman, 1976; Nelson, 1985; Schlesinger, 1977, 1982). For example, Bowerman has observed that language learning can be characterized as a process of solving complex problems in category formation: "No acquisitional task places greater demand on children's skill at categorizing than learning to talk. The forms of language are themselves categories, and these forms are linked to a vast network of categorical distinctions in meaning and discourse function" (Bowerman, 1988, p. 28-29). Thus, a basic understanding of categorization and its relationship to language will provide fundamental insights into the process of language acquisition.

The general issue of interest in this thesis is the developmental dynamics between nonlinguistic categories and the semantic category information available in the linguistic input. A nonlinguistic category is a grouping of discriminably different stimuli that are treated as essentially the same, while out-of category stimuli are treated differently, as measured by responses not dependent upon linguistic knowledge. Semantic categories are groupings of

stimuli (e.g., objects) that have come to make a difference in the structure of the language under study. For example, a semantic category could reflect a range of objects (e.g., robin, sparrow, bluejay) to which a word (e.g., "bird") appropriately applies. Early language learning then becomes a problem of coordinating corresponding linguistic (semantic) and nonlinguistic categories (Brown, 1958); i.e. the problem for the child is to determine what subset of members (e.g., robins, sparrows, bluejays, but not bats) of a potential nonlinguistic category are to be appropriately called by a particular name ("bird"). In solving such a problem, the child must also come to realize that words do not stand for specific objects, but rather for groups or categories of similar items. The question remains, then, do children map words onto previously established nonlinguistic categories, or do words serve to stimulate and/or shape nonlinguistic categorization, or both? (Bowerman, 1976). While much attention has been devoted to this issue, the details of the relationship remain sketchy.

Review of the literature

The mapping problem

Current explanations regarding this relationship have evolved from the observation that children's language acquisition occurs very rapidly and with apparently little effort. One prominent explanation of word learning offered by many researchers is that prior categories formed on a nonlinguistic basis (e.g., similarities in form and function) serve as a major facilitator in learning the corresponding word (Clark, 1973, 1983; Macnamara, 1972; Nelson, 1974; Slobin, 1973). The application of words to new objects, then, is mediated by category knowledge already present.

Many of these same researchers, however, although acknowledging the facilitative effect of prior categories on language acquisition, also maintain that language can influence categorization (Bowerman, 1980, 1989; Harris, 1982; Kuczaj, 1982; Nelson, 1985; Schlesinger, 1977, 1982; Slobin, 1982). It is possible that language may shape or modify the boundaries of an existing category, thus bringing it in line with the adult's extension of the word (Bowerman, 1989; Schlesinger, 1977). For example, the child learns what counts as "doggie" by observing adults' application of

the word. Language may also serve to introduce the possibility of grouping in a way not previously noticed (Bowerman, 1980; Markman & Hutchinson, 1984), thus, functioning as a "lure to cognition" (Brown, 1958, p. 206) and stimulating the categorical treatment of stimuli. An example of this strong form of the influence of language on categorization is provided by Bowerman's (1980) explanation of her daughter's unique use of the word "hi". "Hi" was initially used correctly as a greeting. However, subsequent exposure to the co-occurrence of the "hi" with something on a hand or finger (e.g., finger puppet) apparently resulted in the construction of a new category reflecting the covering of a hand or foot. The unique category guiding the use of "hi" apparently originated from the desire to reconcile the use of "hi" in the context of having a hand or foot covered. A weaker form of this influence is apparent in situations where a category is known (in the absence of labeling) in some contexts but not others. For example, children often hear the word "hot" in reference to entities found in a kitchen (e.g., flame on a gas stove, coffee pot, cup of hot chocolate). Subsequently hearing "hot" applied to these items in other contexts can stimulate

categorical treatment, whereas without such labeling categorical responding would not occur (Markman & Hutchinson, 1984; Waxman & Gelman, 1986).

These current explanations, however, rely primarily on inferences drawn from linguistic responses. Children's word production or comprehension is used to infer knowledge of their nonlinguistic categories at the current or some previous point in time. Several investigators have commented on the indirect nature of this approach (Rice, 1980; Roberts & Horowitz, 1986; Schlesinger, 1982) and its circularity (Brown, 1976).

Reflecting this reliance, why linguistic input, per se, influences categorization is frequently explained in terms of children's use of uniquely linguistic information, particularly words (Adams & Bullock, 1986; Bowerman, 1980; Markman & Hutchinson, 1984). Although this may be true at some point, it is not clear that uniquely linguistic influences are seen prior to the vocabulary explosion. Language, although providing important linguistic information, also embodies other factors that may be operating in the context of linguistic input; for example, amount of attention, acoustic factors (frequency, time,

intensity), and the manner of presentation of the linguistic input. However, the effects of nonlinguistic inputs (e.g., music) on categorization have seldom been examined. Thus, it is not clear whether it is the words per se in the linguistic input that are facilitating categorization, or if it is other, more general information. Contrasting linguistic and nonlinguistic input is necessary to determine just what factors are involved in explaining the facilitative effect of linguistic input on categorization.

The facilitative role of input on categorization

Recently, Roberts (Roberts, 1990; 1992a; Roberts & Jacob, 1991) examined the effects on categorization of two nonlinguistic factors (attention and the manner of input presentation) in the context of two types of input (linguistic input and instrumental music). This series of 9 experiments on 15-month-olds utilized an habituation-discrimination paradigm. This paradigm involved presenting several visual stimuli (line drawings of a dog, cat, and horse) repeatedly, one at a time, until looking time decremented to a predetermined proportion of initial looking levels (habituation). Testing for categorization involved presenting, one at

a time, some number of novel, within-category exemplars (e.g., deer, pig, bird) and an out-of-category stimulus (e.g., car). Categorization was defined as comparable looking times to the novel within-category exemplars (generalization) and significantly increased looking to the out-of-category stimulus (discrimination).

Using the above paradigm and visual stimuli, Roberts and Jacob (1991) reported successful categorization by infants hearing either language or instrumental music input. They suggested two possible explanations for these results: (a) the increased attention accumulated during habituation relative to a previous experiment which provided no input (Roberts & Cuff, 1989, Experiment 3) and, (b) the perfect covariation between an infant's fixation of a visual stimulus and the presentation of auditory input. Roberts (1990) examined the effect of both of these explanations on categorization utilizing the same paradigm and visual stimuli. In the context of linguistic input (Exp. 1) or music (Exp. 2), one group was presented input only when, and for as long as, they fixated the visual stimuli (perfect covariation); any look away from the pictures terminated the input. Another group heard input continuously throughout the

experiment (degraded covariation), including all looks away and the intertrial intervals during which no pictures were present. As in the Roberts and Jacob (1991) study, attention increased in both experiments relative to Roberts and Cuff (1989). Successful categorization was reported only in the perfect correlation groups of Experiments 1 and 2 (replicating Roberts & Jacob, 1991). However, although categorization was not successful, when the fixation-input covariation was degraded, the disruptive effects appeared to be small. A third experiment constrained attention to either 90 s or 156 s of looking accumulated over 12 equated trials (7.5 s or 13 s per trial, respectively) in the absence of auditory input. Results indicated that neither group successfully categorized, suggesting that increased attention alone may not be responsible for the categorization success observed in the Roberts and Jacob (1991) study and Experiments 1 and 2.

Roberts (1992b) further manipulated covariation and attention information, allowing a more direct examination of attention vs fixation-input covariation and type of input (language vs instrumental music) on categorization. Accumulated attention was limited to

90 s in the context of either a perfect or degraded fixation-input covariation, with the presentation of linguistic input (experiment 1) or instrumental music (experiment 2). Results indicated that the perfect covariation groups in both experiments responded categorically, while the degraded groups did not. Since amount of accumulated attention was controlled, these results suggest that the degree of fixation-input covariation directly influences categorical responding; thus helping to clarify the role of attentional factors under various conditions.

The previous experiments examining the facilitative role of auditory input on prelinguistic infants' ability to categorize have used child-directed input (both the linguistic input and the instrumental music). There are, however, a number of differences between speech addressed to children and speech addressed to adults that may be interacting with attention and the visual fixation-auditory input correlation. The necessary studies looking at these differences and their effects on categorization have not been done.

Characteristics of child-directed speech

Child-directed speech (CDS) can be characterized by a number of phonological, lexical, and semantic simplifications. These simplifications include the substitution of phonetically simpler sounds (Ferguson, 1977); a decrease in the rate of speech (Blount & Padgug, 1977; Garnica, 1977; Stern, Spieker, Barnett, & MacKain, 1983); the use of a smaller set of words (Ferguson, 1977); repetition of words and phrases, expansions, and semantic extensions (Blount & Padgug, 1977; Fernald & Simon, 1984; Stern et al., 1983); and a restricted semantic content (Snow, 1986).

In addition, CDS is distinguished by a number of prosodic features. These prosodic features are the most prominent perceptual characteristics differentiating CDS from adult-directed speech (ADS). They consist of a higher pitch (Blount & Padgug, 1977; Ferguson, 1977; Fernald, 1984, 1985; Fernald & Kuhl, 1987; Garnica, 1977; Grieser & Kuhl, 1988; Jacobson, Boersma, Fields, & Olson, 1983; Stern et al., 1983; Stern, Spieker, & MacKain, 1982); longer duration of sounds and exaggerated contours (Fernald & Simon, 1984); and an especially rhythmic quality (Blount & Padgug, 1977; Stern et al., 1983).

Many of these same features, particularly an increase in pitch, have been documented in cross-linguistic studies (Blount & Padgug, 1977; Fernald & Simon, 1984; Fernald, Taeschner, Dunn, Papousek, Boysson-Bardies, & Fului, 1989; Grieser & Kuhl, 1988). Fernald, et al. (1989) compared prosodic modifications of CDS in French, Italian, German, Japanese, British English, and American English, and found cross-language consistency in both mothers' and fathers' prosodic modifications when addressing infants. Similar findings were reported for the tonal language of Mandarin Chinese (Grieser & Kuhl, 1988). Taken together, the results of these studies may suggest a biological emphasis or "universality" in CDS across languages that may serve a common function (Ferguson, 1977; Fernald et al., 1989; Garnica, 1977; Grieser & Kuhl, 1988; Sachs, 1977; Stern et al., 1983).

There are, however, some cultures that do not make these prosodic modifications; yet their children still learn the language. For example, speakers of Quiche (a Mayan language) and Kaluli (New Guinea) make no pitch distinctions when addressing young children (Bernstein Ratner & Pye, 1984; Pye, 1986; Schieffelin, 1979). However, whispering, initial-syllable deletion, a

relatively fixed word order, and the use of special sounds in Quiche, or mothers holding their infants up and speaking "for" them in a special high-pitched voice (Kaluli) may be functionally equivalent to the prosodic changes noted in other languages, providing varied auditory input that may be particularly salient to the infant.

Contribution of CDS to language acquisition

The modifications in CDS may contribute to language acquisition in a variety of ways. CDS may facilitate phonetic perception and aid in the discriminability of sounds (Grieser & Kuhl, 1988); assist in marking clausal boundaries (Kemler Nelson, Hirsch-Pasek, Jusczyk, & Cassidy, 1986); distinguish between new and given information, making the new perceptually salient (Fernald & Mazzie, 1991; Grieser & Kuhl, 1988); express different communicative intentions (Fernald, 1989); and increase the saliency of speech over background noise (Cooper & Aslin, 1989). In addition, CDS may be important in the expression of affect (Abe, 1980; Fernald, 1984; Pakosz, 1983; Papousek & Papousek, 1981; Sachs, 1977; Stern, 1985; Werker & McLeod, 1989). Exaggerated prosodic contours evident in CDS convey the communicative intent of the

speaker, providing important affective information to the prelinguistic infant (Fernald, 1989). It may be through these affective qualities that speech first becomes meaningful to the infant (Fernald, 1989). As the child becomes more linguistically competent, and able to rely on speech content and structure, the prosodic contours assume increasing linguistic importance: they serve to parse the speech stream, thereby facilitating the processing of linguistic information (Lewis, 1951).

Child-directed speech has also been found to be an important modulator of attention (Fernald, 1984, 1985; Fernald & Kuhl, 1987; Jacobson et al., 1983; Stern et al., 1983; Stern et al., 1982; Sachs, 1977; Sullivan & Horowitz, 1983). Fernald (1985), using an operant head-turn procedure, found that 4-month-old infants showed a preference for CDS, significantly increasing their attention to it. Four women, unfamiliar to the infants, were used to generate speech samples characteristic of CDS and ADS. Following a training period, infants were able to control the presentation of speech by a 30-degree turn of their head, with side of presentation counterbalanced across infants. The infants made a significantly greater amount of head-

turns toward the motherese, or CDS, demonstrating a preference for it; however, inferences regarding which variables of CDS were most attention-getting could not be drawn from these data.

In a follow-up study, Fernald and Kuhl (1987) attempted to isolate the critical acoustic features of CDS which influence infant preferences. They eliminated the lexical content of the utterances, and isolated the major prosodic features of CDS: (1) fundamental frequency, or pitch; (2) amplitude, a loudness correlate; and (3) duration, which is related to speech rhythm. Using the same operant head-turn procedure as Fernald (1985), they found that 4-month-old infants showed a preference only for fundamental frequency. They did not, however, compare each of those features with the natural intact CDS from which each feature was derived, so it cannot be concluded that fundamental frequency is sufficient to explain the increase in attention, or if evidence for an interaction would be indicated.

Other researchers (Cooper & Aslin, 1989; Sullivan & Horowitz, 1983; Werker & McLeod, 1989), corroborating and extending the findings of Fernald (1985), also found increased attentional responsiveness to CDS in

auditory preference tasks. A preference for CDS in infants as young as four weeks was reported by Cooper and Aslin (1989) when the prosodic features remained intact. Sullivan and Horowitz (1983) segmented speech into syllables, and found that a rising intonation contour was more effective in eliciting and maintaining attention in 2-month-old infants. Similar findings were reported by Stern, Spieker, and MacKain (1982). They found that mothers of 2-6-month-old infants use two types of pitch contours in gaining and maintaining their infant's attention. A high, rising pitch contour was used to initially gain attention when the infant was looking away. Once the mother had the infant's attention, however, a "bell-shaped" or "sinusoidal" pitch contour was used to maintain and hold the infant's attention during periods of interaction.

Baldwin and Markman (1989), studying older infants, speculate that attention may play an important role in establishing word-object correspondences. Exactly what this role may be, however, was again left open. Bauer and Mandler (1989), consistent with an attentional explanation, suggest that frequent nonverbal reminders were responsible for focusing children's attention on the categorical nature of the

task employed in their study, resulting in successful categorization.

Although researchers generally conclude that CDS is important to language acquisition, there remain critical gaps regarding the influence of increased attention on language acquisition, or its influence on abilities having prominent roles in language acquisition, such as categorization. Also, because the majority of research reporting increased attention to the prosodic features of CDS has focused on infants younger than six months, it is not known what role increased attention to CDS may have at ages when children have some degree of linguistic knowledge.

Aim of the present study

The present research attempted to address these gaps. The habituation-discrimination paradigm of Roberts and his colleagues (Roberts, 1990; Roberts, 1992a; 1992b; Roberts & Jacob, 1991) was used. Visual stimuli were identical to that used by Roberts (1992a; 1992b), consisting of line drawings of a dog, cat, and horse (habituation stimuli), and a pig and car (discrimination). Fifteen-month-old infants were randomly assigned to a CDS or ADS group. Intonationally different carrier phrases (e.g., "See the dak," "Look

at the dak") representing CDS and ADS were presented contingent upon fixation of the visual stimulus.

The questions addressed in this study include what, if any, effects CDS and ADS may have on (a) accumulated attention during habituation and, (b) infants' success or failure at categorization.

Chapter 2

Experiment 1

Method.

Subjects.

Forty-eight normal 15-month-olds (+/-7 days) served as subjects. An additional 13 subjects were excluded from the final sample due to fussing (2), distractions by siblings (5), current ear infections (3), possible developmental delays (1), falling asleep (1), and failure to habituate (1). Subjects were recruited from the Omaha area, drawn from a computerized list provided by the Nebraska State Health Department of all legitimate births in Douglas county. The information provided included infant birthdate, sex, birthweight, and codes for any unusual prenatal or delivery conditions. The list was screened for any birth anomalies and birthweights under five pounds. These were then excluded. Letters were sent to the parents of the remaining infants meeting the age requirement, briefly describing the study and asking for their participation. The letters were followed up by a phone call to schedule any interested parents. At that time, parents were questioned regarding their infant's current health and hearing. Infants with any

developmental delays, hearing problems, or current ear infections were not included in the data, although, if parents wished, their infant was still allowed to participate.

Stimuli.

Visual stimuli. The visual stimuli were identical to that of Roberts and Cuff (1989) and Roberts and Jacob (1991) who have demonstrated discriminability between the stimuli. Visual stimuli consisted of black and white line drawings equated for size. A dog, cat, and horse were used for habituation, and the test stimuli included a pig (within-category exemplar) and a car (out-of-category exemplar). These stimuli were chosen based on Uyeda and Mandler's (1980) rankings of four-footed animals. The dog, cat, and horse were determined to be good prototypical animals, and the pig was rated as a moderately good exemplar. The car was chosen because it has the capacity for movement, unlike some inanimate objects. Infants have the ability to discover form-function correlations (Mervis, 1988), so in this respect the car would be similar to the animals in that they are both capable of movement, and thus may prove to be a stronger test of categorization. Also, Roberts and Cuff (1989) and Roberts (1990) reported

conditions in which categorization was unsuccessful in that infants did not differentiate between the car and the within-category stimuli after habituation. Therefore, any increased looking to the car would not be attributed to salient properties or a preference for the car.

Auditory stimuli. The auditory stimuli consisted of intonationally different presentations of the same carrier phrases representing child-directed speech and adult-directed speech. The carrier phrases, containing the word "dak" at the end of each phrase, were recorded by a female speaker. The carrier phrases were identical to those used in Roberts and Jacob (1991), with the exception that the pseudo-word "dak" was used to replace "animal" (see Table 1). In choosing the carrier phrases, Roberts & Jacob (1991) gave mothers of four infants objects and pictures, and asked them to interact with their infants using these materials. Carrier phrases were then chosen that were produced at least three times by three of the four mothers.

Table 1: Utterances

"Look at the dak."
"See the dak?"
"There's the dak."
"Where's the dak."
"That's the dak."
"Dak."

To generate the child-directed speech a 12-month-old infant was brought into the lab with his mother, and the female speaker interacted with the infant in a play situation. The female speaker produced each of the carrier phrases a number of times, using intonation contours matching as closely as possible those used by mothers in interacting with their infants. The play situation was recorded in a pediatric audiological suite, and one noise-free production of each of the phrases was selected for digitizing using the software package CSpeech. Digitizing was at 10 KHz using a 5 KHz low-pass filter, and peak loudness levels across stimuli were equated at 65 dB HL via a programmable attenuator. Stimuli were presented via a LABMASTER DMA laboratory control board, with a one sec interval between each utterance.

Generation of the adult-directed speech stimuli was similar. The same female speaker produced the same carrier phrases in the context of directing an adult's attention to the target referent. The speech samples were recorded and selected for digitizing as described for the child-directed speech stimuli.

Setting and apparatus.

The setting and apparatus were identical to that of Roberts (1990), Roberts (1992a; 1992b), and Roberts and Jacob (1991). Infants were seated on their mother's lap in a semi-dark testing enclosure, surrounded by dark curtains on three sides and a free-standing wall. Auditory stimuli were presented at approximately 65 dB via a LABMASTER DMA laboratory control board and a Concept Enterprises Coustic-ci speaker, centered 2 in. above the projection screen. Mother and infant faced the rear-projection screen from approximately 27 inches. A trained and reliable observer, wearing headphones through which masking music was played, recorded infant visual fixations. The corneal reflection technique was used, in which points of light are observable on the infant's pupil during fixation of the screen. Corneal reflections were observed through 1/2 in. holes located at the bottom and 4 1/2 in. to the side of the screen. Two Kodak Ectographic III slide projectors, one for habituation stimuli and one for test stimuli, were used for presentation of the visual stimuli. The observer depressed a hand-held button during infant visual fixations, which activated presentation of the auditory stimuli. The presentation

of stimuli, timing of fixations and intertrial intervals, and calculation of habituation criterion were computer controlled by an AT clone microcomputer equipped with a LABMASTER laboratory control board (Scientific Solutions, Inc.).

This type of procedure has consistently reported observer reliability in the range of 90-95% (Roberts 1992a, 1992b). The trained observer participating in these past experiments (Roberts, 1992a, 1992b) is also the observer in the current experiments.

Procedure.

Infants were randomly assigned to one of two test groups: child-directed speech (N=24) or adult-directed speech (N=24). Using the habituation-discrimination procedure with trials under infant control, infants were habituated to blocks of three different line drawings of prototypical animals (dog, cat, horse), presented randomly within blocks of three trials. Mean looking times for each block were computed as the session progressed. A trial was defined as one unlimited look beginning with an initial fixation of at least 1 sec and termination with a look away of 1 sec. The intertrial interval was 2.4 sec. The auditory stimuli were presented continually during infant

fixation of the screen, and terminated immediately by any looks away and for the duration of the look away and the intertrial interval. Habituation criterion was defined as mean looking within a block that equalled or exceeded a 50% decrement from the largest of the first two block means in the habituation phase.

The test phase for each condition consisted of counterbalanced, single trial presentations of a familiar stimulus (either dog, cat, or horse), a pig, and a car. The test phase remained under infant control, with auditory input continuing to be presented as in habituation (see Table 2).

Table 2: Experimental Design

Group	Habituation	Test	
		In-category	Out-of-category
CDS	Dog	Familiar	Car
	Cat	(dog, cat, or horse)	
	Horse	Novel (pig)	
ADS	Dog	Familiar	Car
	Cat	(dog, cat, or horse)	
	Horse	Novel (pig)	

The minimal requirement for categorization was that mean looking to the out-of-category stimulus (car)

be significantly greater than looking to the familiar (dog, cat, or horse), with no significant differences between the pig and the familiar stimuli. Thus, a nonmember should be treated as different while the within-category stimuli are treated as essentially the same.

Categorization was examined as a within groups analysis using pre-planned Bonferroni-corrected comparisons (familiar-pig, familiar-car, pig-car) within each group (corrected p=.02) because between group comparisons may not have detected these relationships. Between group comparisons were made to determine any differences in accumulated looking times during habituation and test phases.

Results and Discussion

Within each group, graphical inspection of looking times revealed a pronounced right skew in the distributions. To equalize the variances and normalize the distributions, a natural log transformation was applied to the looking times at habituation and to those in the test phase of each group. All analyses of test data were performed on these transformed scores. To examine categorization, three preplanned comparisons

(familiar-car, familiar-pig, car-pig) were performed using Bonferroni correction (critical p=.02).

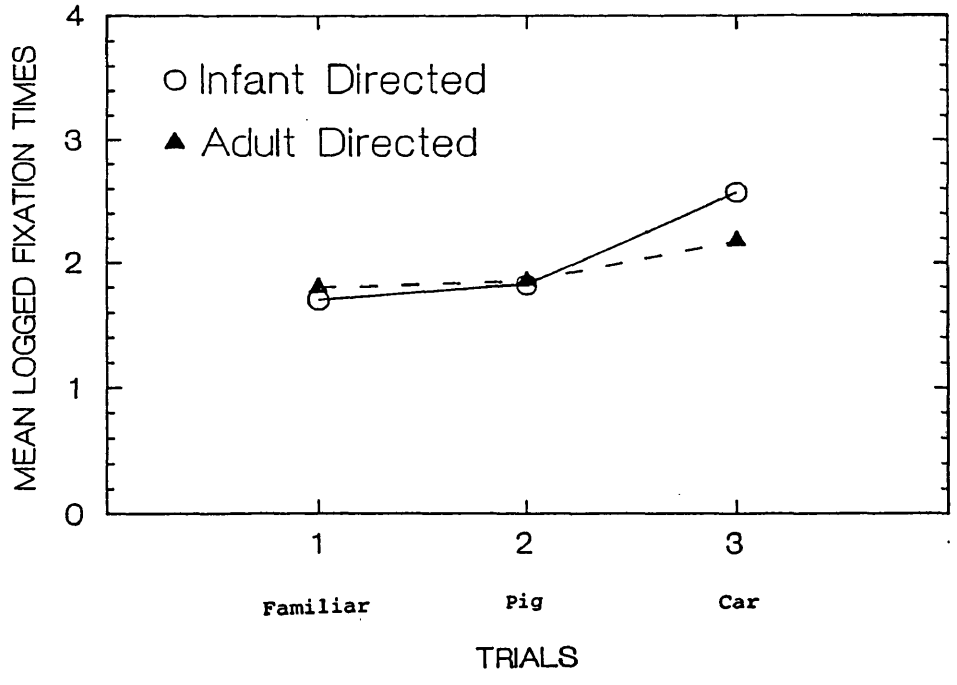
An independent t-test revealed no significant differences in mean total fixation time, p=.31, 133 s (adult) vs. 157 s (child). Results of a median test also indicated that the median total fixation time in the adult group (Mdn=117.01 s) did not differ from that of the child-directed speech group (Mdn=121.18 s). This suggests that CDS may not have the same attention getting properties at 15 months as it does at younger ages. This is inconsistent with results of past studies (Fernald, 1985, 1989; Fernald & Kuhl, 1987; Cooper & Aslin, 1989) reporting increased attention to CDS. These studies, however, were all conducted with infants much younger than 15 months. It may be that by 15 months of age, when infants are in the early stages of word learning, that the acoustical factors have less of an attentional effect because other factors (i.e., words) are gaining in importance.

Test results are presented in Figure 1. Infants in Group 1 (child-directed speech) significantly (p<.001) increased looking to the out-of-category car relative to the familiar picture (dog, cat, or horse). Significance was also reached for comparisons between

the novel in-category pig and the car ($p<.001$). There were no differences between the familiar animal and the pig. This finding is consistent with categorization, and replicates findings reported by Roberts and Jacob (1991, Experiment 1) in which child-directed linguistic input was presented perfectly correlated with infant fixation.

Infants in Group 2 (adult-directed speech) also ($p=.025$) increased looking to the out-of-category car, although technically failed to meet the critical level of $p=.02$. The proximity of $p=.025$ to the Bonferroni critical p of .02 cannot be ignored, however, and is close enough to suggest that infants in this group were recovering to the car (See Figure 1). Other

Figure 1



comparisons were nonsignificant, although there appeared to be a tendency for infants in the ADS group to look longer at the car than the pig.

To supplement the above analyses, infants in each group were classified as to the direction of change in looking (increase or decrease) from the familiar to the car. If CDS had any facilitative effects on this within-group looking pattern, then proportionally more infants who increase looking from the familiar to the car should be found in this group. The proportion of infants who increased looking in the CDS group (.88) vs the ADS group (.67) was significantly different, $z=1.75$, $p<.05$ (1 tailed).

To examine for any sex differences a Groups (male vs female) X Trials Analysis of Variance (ANOVA) was performed with trials as a repeated factor. No significant sex differences were found.

Graphical inspection of test data revealed longer looking times to the novel out-of-category car by infants in the CDS group. To examine this, a Groups (CDS vs ADS) X Trials Analysis of Variance (ANOVA) was performed with trials as a repeated factor. Analyses revealed a significant Groups X Trials interaction ($F(2,45)=3.19$, $p=.05$). Following Bruning & Kintz

(1977), an analysis of group differences by trial revealed significant differences (p=.05) only on the out-of-category trial, with infants in the CDS group looking longer to the out-of-category car. The meaning of this difference is not clear from only the present data, however, it may suggest that the task of categorizing was made easier for infants hearing CDS.

While both groups appear to have successfully categorized, it is possible that the relatively high amounts of attention accumulated during habituation may have been a contributing factor. Relatively high levels of attention could compensate for any differences that may exist between the two types of input. Roberts and Jacob (1991) speculated that attentional factors may be interacting with input factors in facilitating nonlinguistic categorization. Baldwin and Markman (1989) also suggest that amount of attention may be contributing to the formation of word-object correspondences. Thus, increased amounts of attention may be compensating for type of input. However, by constraining the amount of attention, it may be possible to disrupt categorical responding in infants hearing ADS. A second experiment was conducted to examine this possibility by limiting the amount of

attention to 90 s in the context of hearing only adult-directed speech. Roberts (1991, 1992a) had previously found successful categorization by 15-month-olds with 90 s of accumulated attention using child-directed input. This did not deserve further replication.

Experiment 2

Method

Subjects

Twenty-four 15-month-old infants served as subjects. Infants were screened in the same manner as in Experiment 1. An additional 9 infants were excluded from the final sample due to fussing (8) and distractions by siblings (1).

Stimuli, setting, and apparatus

The visual stimuli, setting, and apparatus were the same as in Experiment 1. However, infants in Experiment 2 heard only the adult-directed auditory stimuli contingent upon their fixating the screen.

Procedures

During familiarization to the dog, cat, and horse, infants accumulated 90 s of looking distributed equally across 12 trials (7.5 s per trial). Ninety seconds was the mean total fixation time accumulated during habituation by 15-month-olds who failed to categorize

in a previous study using these stimuli (Roberts & Cuff, 1989, Experiment 3). Roberts (1990, 1992a) also found that a total fixation time of only 90 s without auditory input was insufficient to facilitate categorization. Familiarization stimuli were presented in four blocks of three trials with each stimulus randomly presented once within each block. Thus, accumulated looking times to each stimulus were equal. Intertrial intervals were 2 s.

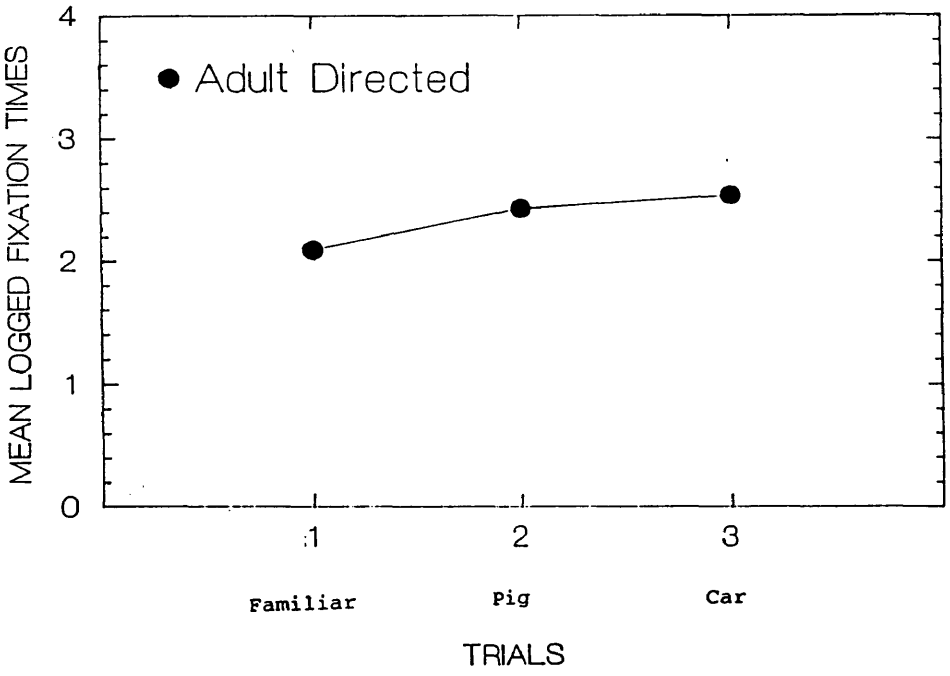
Results and Discussion

As in Experiment 1, graphical inspection of the data revealed a pronounced right skew. A natural log transformation was applied to all looking times in test. All analyses were performed on these transformed scores.

Planned Bonferroni-corrected comparisons (familiar-car, familiar-pig, car-pig; corrected p=.02) revealed a significant increase in looking to the out-of-category car (p=.02), consistent with categorization. No other comparisons reached significance. However, while the group met the statistical requirements for categorization, they showed a weak tendency to increase looking to the in-category pig. A pattern of recovery to both the

novel in-category pig and the novel out-of-category car would be more consistent with a failure to categorize, and most probably indicative of discrimination. Given this possibility, the data do not provide a strong case for generalization, and the interpretations remain tentative (see Figure 2).

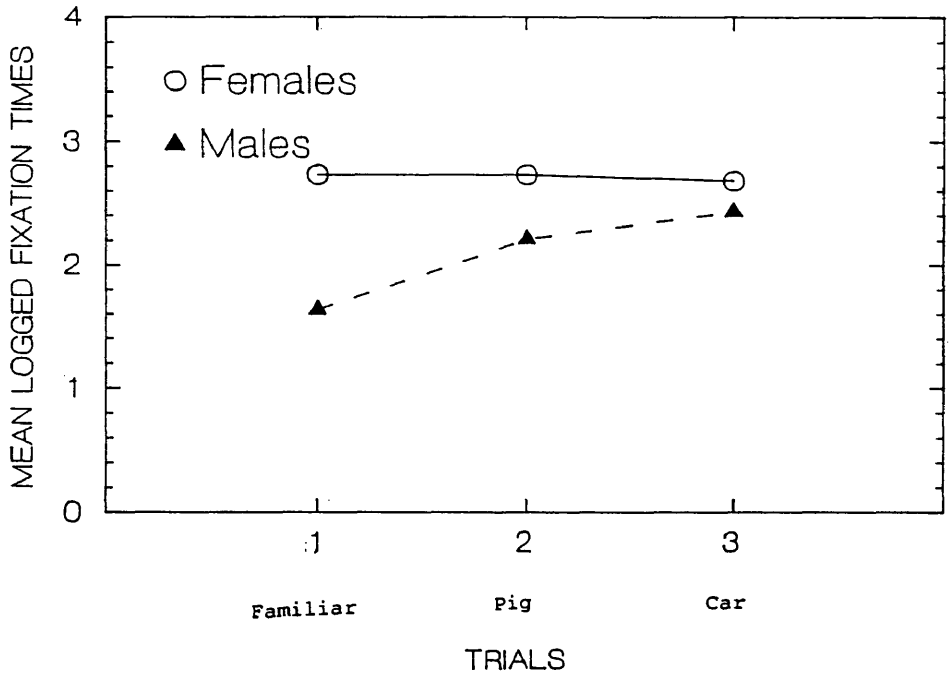
Figure 2



In addition, analyses of sex effects suggest caution in concluding that categorization was successful. Independent t-tests show that the girls (n=10) were clearly not categorizing, with no significant differences between test stimuli. The boys (n=14) however, showed a significant increase in

looking (p=.004) to the out-of-category car. They also showed a tendency to increase looking to the in-category pig, indicating possible discrimination of both test stimuli (see Figure 3).

Figure 3



Therefore, neither sex independently showed a pattern consistent with categorization, although the combined group statistics would suggest otherwise. The group pattern may reflect looking times of the boys, and thus concluding that categorization was successful for the group would be inaccurate.

The interpretations therefore remain tentative, and at this point it is not clear what effect

constraining attention may have on categorization. The results of Experiment 2 may not generalize to other groups, and clearly deserve replication.

Experiment 3

Methods

Subjects

Twenty-four normal 15-month-olds (+\- 7 days) served as subjects. An additional 4 subjects were excluded from the final sample due to fussing (1), distractions by siblings (1), experimenter error (1), and equipment failure (1).

Stimuli, apparatus, and procedures

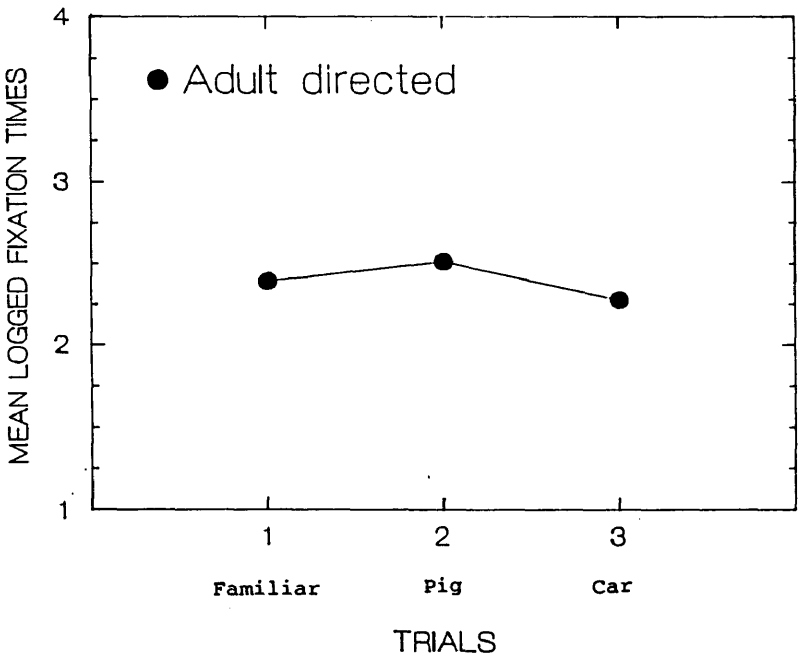
The methods and procedures of Experiment 3 were identical to those of Experiment 2. For seven of the 24 infants, two independent observers recorded fixations. Mean reliability in familiarization was 95% and mean reliability in test was 97%.

Results and Discussion

As in both previous experiments, graphical inspection of the data revealed a pronounced right skew. A natural log transformation was applied to all looking times in test. All analyses were performed on these scores.

Planned Bonferroni-corrected comparisons (familiar-car, familiar-pig, car-pig; corrected p=.02) revealed no significant differences between stimuli. Infants in this experiment clearly were not meeting the minimal response requirements consistent with categorization (see Figure 4).

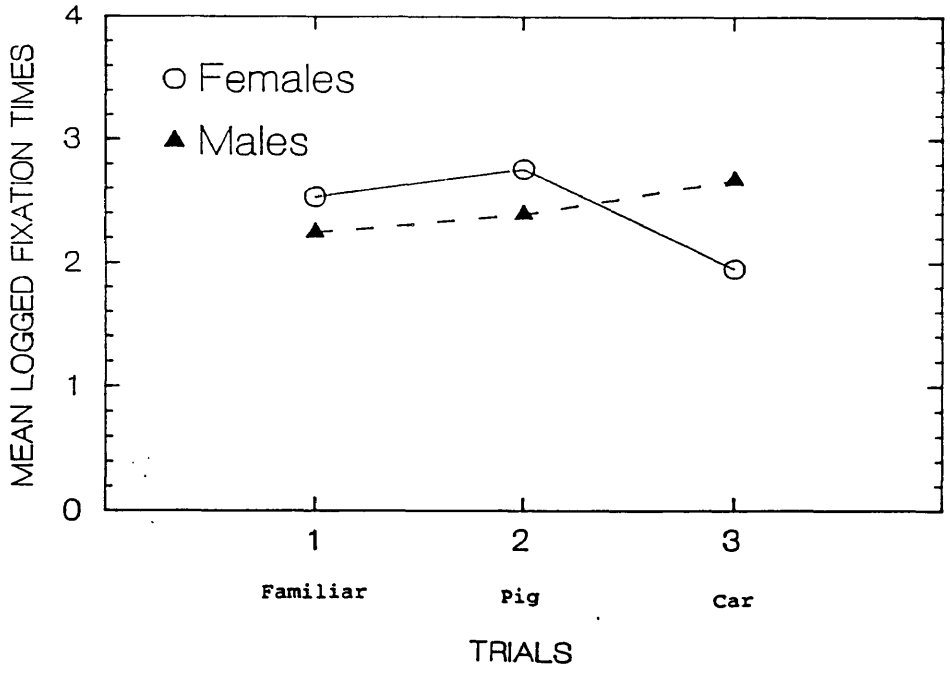
Figure 4



However, sex effects were again present. To examine these, a Groups (male vs female) X Trials Analysis of Variance (ANOVA) was performed with trials as a repeated factor. This analysis revealed a significant Groups X Trials interaction ($F(2,21)=10.30, p=.001$) with significant differences

between groups (p=.001) only on the out-of-category (car) trial. This difference was analyzed using Bonferroni corrected comparisons (p=.02) within groups, and revealed a significant (p=.02) decrease in looking to the car for the females, while the males showed a nonsignificant tendency to increase looking (see Figure 5).

Figure 5



It appears that adult-directed speech interferes with girls' recognition of this task as a categorization problem. However, no clear explanation for these results is available from the present data. Although no data are available suggesting that 15-

month-old boys and girls are talked to differently by adults, one speculation is that cultural factors are playing a role. In particular, there may be subtle differences between speech addressed to boys and speech addressed to girls, with girls continuing to receive more child-directed input at later ages than boys. This deserves further investigation.

Chapter 3

General Discussion

Categorical responding appeared to be affected by type of register in the context of these experiments. Specifically, categorization appeared to be most adversely affected by ADS under conditions of constrained attention and for female subjects.

While type of register did not directly influence amount of accumulated attention (Expt. 1) as would be expected from work with younger infants (Fernald, 1985, 1989; Fernald & Kuhl, 1987; Cooper & Aslin, 1989), it may be interacting with attention to aid or disrupt categorization success. Under conditions of constrained attention categorization was adversely affected only for infants hearing ADS. Both groups in Experiment 1 appear to have categorized. Part of this success may be due to the large amounts of accumulated attention. When attention was constrained to 90 s in Experiments 2 and 3, categorization was adversely affected in the ADS groups. This contrasts with Experiment 1 and experiments reported by Roberts (1991; 1992a) in which infants in a 90 s accumulation group successfully categorized when input was child-directed. Thus, by constraining attention to 90 s, differences

between registers may begin to appear that are not as clearly evident at higher levels of accumulated attention. This may help clarify the role of attention in influencing categorical responding by placing attention's influence in the context of ADS.

The multiple source hypothesis of Smith, Jones, and Landau (1992) and others (Roberts, 1992b; Roberts & Jacob, 1991; Nelson, 1988) would suggest that infants' categorical responding may be influenced by a complex of factors (i.e., attention, covariation information, CDS) interacting in as yet undetermined ways. Data from the present experiments suggest that attention may be among the many possible factors that push children to treat objects categorically, although no one factor may operate under all conditions. While several researchers (Markman & Hutchinson, 1984; Roberts & Jacob, 1991; Waxman & Kosowski, 1990) have suggested that attention does play a role in categorical responding and forming word-object correspondences, exactly what this role is has not been detailed. These results may help in specifying the conditions under which attention affects categorical responding, consistent with a multiple source explanation.

Type of register also interacted with sex. Adult-directed speech clearly disrupted categorization success in girls when attention was constrained to 90 s. This is seen most clearly in Experiment 3 where girls significantly (p=.02) decreased their looking to the car. The boys' performance, on the other hand, appeared to be less influenced by type of register. Thus, ADS appears to be less disruptive for 15-month-old boys than 15-month-old girls.

While sex effects were present, one cannot overlook the importance of the overall finding that type of register appears to affect categorization success under specific conditions. These data suggest that CDS does contribute to more general cognitive processes, specifically categorization. Most researchers studying differences between registers have focused on the syntactic influence of CDS, its role in speech parsing, highlighting of object names, comprehension growth, and its role in affective communicative abilities. The present research provides evidence that cues present in CDS may be part of a complex of factors that help lay a foundation for the acquisition of words by stimulating infants to treat objects in a categorical fashion. These prior

nonlinguistic categories may provide infants with a knowledge base to work from, leading them to search for object labels in order to fill a lexical gap, thereby stimulating growth of comprehension vocabulary.

Recently, several researchers (Markman, 1989; Markman & Hutchinson, 1984; Waxman & Kosowski, 1990) have suggested that children possess linguistic biases that aid in word acquisition by limiting the number of hypotheses that a word might refer to. These biases have been proposed to help explain children's rapid and remarkably error-free acquisition of language. One of the proposed biases possessed by the child is to organize objects on the basis of similarity-in-kind when nouns are present: a uniquely linguistic taxonomic/noun-category bias (Markman & Hutchinson, 1984; Waxman & Kosowski, 1991). That is, when nouns are present in the input, the noun-category bias predicts that children will treat objects categorically because of the sheer presence of nouns; whereas when nouns are absent, there should be a tendency for children to group objects thematically.

The results of the present experiments would not be predicted if infants possessed a strong taxonomic/noun-category bias prior to the vocabulary

explosion. That is, if a noun/category bias was in place by 15 months, a change in register should not have disrupted categorization success, given that nouns were present in both the CDS and ADS groups. In other words, if the bias is operative prior to the vocabulary explosion, it should override any changes in register. However, the disruptions of categorical responding as a function of attention and register type suggest that, prior to the vocabulary explosion, a uniquely linguistic, noun-category bias may not be present.

This is consistent with previous findings reported by Roberts & Jacob (1991) in which infants successfully categorized in the context of instrumental music input containing no nouns. Although generalization of the bias to music may be possible, an explanation in terms of factors common to both input types seems more parsimonious. Furthermore, Roberts (1992a) has found that by degrading the fixation-input covariation categorical responding is disrupted, even in the presence of nouns. This suggests that covariation information, rather than generalization of the noun-category bias (Markman & Hutchinson, 1984; Waxman & Kosowski, 1990) may account, in part, for successful categorization in the context of music input.

These disruptions by nonlinguistic variables (attention, type of register, fixation-input covariation), while weakening claims for a psychologically real taxonomic/noun category bias prior to the vocabulary explosion (Smith et al., 1991), also suggest that infants' grouping strategies may be influenced by more general cognitive variables not necessarily unique to language.

Although possibly not present prior to the vocabulary explosion, the noun-category bias does appear to be in place by age 2 (Markman & Hutchinson, 1984; Waxman & Kosowski, 1990). How does such a strong and apparently linguistically rooted preference arise? One consideration is that there are constraints on the range of input environments. In natural joint attentional episodes, the auditory input is primarily language. This amounts to a formal constraint on the range of input environments in which categorical responding is found. Fischer & Bullock (1981) point out that constrained environments can make the data pattern appear to be the result of constraints on the cognitive system. That is, although preferences for responding categorically may eventually reflect an understanding about what nouns do, the onset of this

pattern may reflect nonlinguistic factors that only appear to be linguistic because of the constrained environment. Thus, the presence of nouns may be an important influence on categorical responding at some point, without necessarily being rooted in a linguistic bias possessed by the child. The roots of an apparent noun bias by 2 years of age may lie in the manifold sources of information present in social-communicative contexts, including cues present in CDS.

References

Abe, I. (1980). How vocal pitch works. In L.R. Waugh & C.H. van Schounveld (Eds.), The melody of language. Baltimore: University Park Press.

Adams, A.K. & Bullock, D. (1986). Apprenticeship in word use: Social convergence processes in learning categorically related nouns. In S. Kuczaj & M. Barrett (Eds.), The development of word meaning: Progress in cognitive development research. New York: Springer-Verlag.

Baldwin, D.A. & Markman, E.M. (1989). Establishing word-object relations: A first step. Child Development, 60, 381-398.

Bauer, P. & Mandler, J. (1989). Taxonomies and triads: Conceptual organization in one- to two-year-olds. Cognitive Psychology, 21, 156-184.

Bernstein Ratner, N. & Pye, C. (1984). Higher pitch in BT is not universal: Acoustic evidence from Quiche Mayan. Journal of Child Language, 11, 515-522.

Blount, B.G. & Padgug, E.J. (1977). Prosodic, paralinguistic, and interactional features in parent-child speech: English and Spanish. Journal of Child Language, 4, 67-86.

Bowerman, M. (1973). Early syntactic development: A cross-linguistic study with special reference to Finnish. Cambridge, England: Cambridge University Press.

Bowerman, M. (1976). Semantic factors in the acquisition of rules for word use and sentence construction. In D.M. Morehead & A.E. Morehead (Eds.), Normal and deficient child language. (pp. 99-178). Baltimore: University Park Press.

Bowerman, M. (1980). The structure and origin of semantic categories in the language learning child. In M.L. Foster & S.H. Brandes (Eds.), Symbol as sense: New approaches to analysis of meaning (pp. 277-299). New York: Academic Press.

Bowerman, M. (1988). Inducing the latent structure of language. In F.S. Kessel (Ed.), The development of language and language researchers: Essays in honor of Roger Brown (pp. 23-49). Hillsdale, N.J.: Lawrence Erlbaum.

Bowerman, M. (1989). Learning a semantic system: What role do cognitive predispositions play? In M. Rice & R.L. Schiefelbusch (Eds.), The teachability of language (pp. 133-169). Baltimore: Paul Brookes.

Brown, R. (1958). Words and things. New York: The Free Press.

Brown, R. (1976). Reference: In memorial tribute to Eric Lenneberg. Cognition, 4, 125-153.

Bruner, J., Goodnow, J., & Austin, G. (1956). A study of thinking. New York: Wiley.

Bruning, J.L. & Kintz, B.L. (1977). Computational handbook of statistics. Glenview, IL: Scott, Foresman, & Company.

Clark, E.V. (1973). What's in a word? On the child's acquisition of semantics in his first language. In T.E. Moore (Ed.), Cognitive development and the acquisition of language (pp. 65-110). New York: Academic Press.

Clark, E.V. (1983). Meanings and concepts. In P.H. Mussen (Ed.), Handbook of child psychology: Cognitive development (pp. 787-840). New York: Wiley & Sons.

Cooper, R.P. & Aslin, R.N. (1989). The language environment of the young infant: Implications for early perceptual development. Canadian Journal of Psychology, 43, 247-265.

Cromer, R.F. (1976). The cognitive hypothesis of language acquisition and its implications for

child language deficiency. In D.M. Morehead & A.E. Morehead (Eds.), Normal and deficient child language (pp. 283-333). Baltimore: University Park Press.

Ferguson, C.A. (1977). Baby talk as a simplified register. In C.E. Snow & C.A. Ferguson (Eds.), Talking to children: Language input and acquisition (pp. 219-235). Cambridge: Cambridge University Press.

Fernald, A. (1984). The perceptual and affective salience of mothers' speech to infants. In L. Feagans, C. Garvey, R. Golinkoff, M.T. Greenberg, C. Harding, & J.N. Bohannon (Eds.), The origins and growth of communication (pp. 5-29). Norwood, N.J.: Ablex Publishing.

Fernald, A. (1985). Four-month-olds prefer to listen to motherese. Infant behavior and development, 8, 181-195.

Fernald, A. (1989). Intonation and communication intent in mothers' speech to infants: Is the melody the message? Child Development, 60, 1497-1510.

Fernald, A. & Kuhl, P. (1987). Acoustic determinants of infant preference for motherese speech. Infant Behavior and Development, 10, 279-293.

Fernald, A. & Mazzie, C. (1991). Prosody and focus in speech to infants and adults. Developmental Psychology, 27, 209-221.

Fernald, A. & Simon, T. (1984). Expanded intonation contours in mothers' speech to newborns. Developmental Psychology, 20, 104-113.

Fernald, A., Taeschner, T., Dunn, J., Papousek, M., De Boysson-Bardies, B., & Fukui, I. (1989). A cross-language study of prosodic modifications in mothers' and fathers' speech to preverbal infants. Journal of Child Language, 16, 477-501.

Fischer, K. & Bullock, D. (1981). Patterns of data: Sequence, synchrony, and constraint in cognitive development. In K.W. Fischer (Ed.), Cognitive Development (pp. 1-19). San Francisco: Jossey-Bass.

Garnica, O.K. (1977). Some prosodic and paralinguistic features of speech to young children. In C.E. Snow & C.A. Ferguson (Eds.), Talking to children: Language input and

acquisition (pp. 63-88). Cambridge: Cambridge University Press.

Grieser, D.L. & Kuhl, P.K. (1988). Maternal speech to infants in a tonal language: Support for universal prosodic features in motherese. Developmental Psychology, 24, 14-20.

Harris, P.L. (1982). Cognitive prerequisites to language? British Journal of Psychology, 73, 187-195.

Jacobson, J.L., Boersma, D.C., Fields, R.B., & Olson, K.L. (1983). Paralinguistic features of adult speech to infants and small children. Child Development, 54, 436-442.

Karmiloff-Smith, A. (1989). Commentary. Human Development, 32, 272-275.

Kemler Nelson, D.G., Hirsh-Pasek, K., Jusczyk, P., Wright Cassidy, K. (1989). How the prosodic cues in motherese might assist language learning. Journal of Child Language, 16, 55-68.

Kuczaj, S.A. (1982). Acquisition of word meaning in the context of the development of the semantic system. In C.J. Brainerd & M. Pressley (Eds.), Verbal processes in children (pp. 95-123). New York: Springer-Verlag.

Lewis, M.M. (1951). Infant speech: A study of the beginnings of language. London: Routledge & Kegan Paul.

Macnamara, J. (1972). Cognitive basis of language learning in infants. Psychological Review, 79, 1-13.

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

Markman, E. & Hutchinson, J. (1984). Children's sensitivity to constraints on word meaning; Taxonomic vs. thematic relations. Cognitive Psychology, 16, 1-27.

Mervis, C. (1988). Early lexical development: Theory and application. In L. Nadel (Ed.), The psychology of down syndrome (pp. 101-143). Cambridge: Bradford/MIT Press.

Nelson, K. (1974). Concept, word, and sentence: Interrelations in acquisition and development. Psychological Review, 81, 267-285.

Nelson, K. (1985). Making sense: The acquisition of shared meaning. Orlando: Academic Press.

Pakosz, M. (1983). Attitudinal judgments in intonation: Some evidence for a theory. Journal of Psycholinguistic Research, 12, 311-326.

Pye, C. (1986). Quiche Mayan speech to children. Journal of Child Language, 13, 85-100.

Rice, M. (1980). Cognition to language: Categories, word meaning and training. Baltimore: University Park Press.

Roberts, K. (1990). Attention and the covariation between visual fixation and auditory input: Influences on nonlinguistic categorization in 15-month-olds. Paper presented at the International Conference on Infant Studies, Montreal.

Roberts, K. (1992a). Degree of covarition between visual fixation and auditory input: Influence on categorical responding in 15-month olds. Poster presented at the International Conference on Infant Studies, Miami.

Roberts, K. (1992b). Categorical responding in 15-month-olds: Influence of attention, noun-category bias, and the covariation between visual fixation and auditory input. Unpublished manuscript, Boystown National Research Hospital, Omaha, Nebraska.

Roberts, K. & Cuff, M.D. (1989). Categorization studies of 9-to 15-month-old infants: Evidence

for superordinate categorization? Infant Behavior and Development, 12, 265-288.

Roberts, K. & Horowitz, F.D. (1986). Basic level categorization in seven- and nine-month-old-infants. Journal of Child Language, 13, 191-208.

Roberts, K. & Jacob, M. (1991). Linguistic vs attentional influences on nonlinguistic categorization in 15-month-old infants. Cognitive Development, 6.

Rosch, E. (1977). Human categorization. In N. Warren (Ed.), Advances in cross-cultural psychology (Vol. 1) (pp. 1-72). London: Academic Press.

Rosch, E. (1978). Principles of categorization. In E. Rosch & B. Lloyd (Eds.), Cognition and categorization (pp. 27-48). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Sachs, J. (1977). The adaptive significance of linguistic input to prelinguistic infants. In C.E. Snow & C.A. Ferguson (Eds.), Talking to children: Language input and acquisition (pp. 51-61). Cambridge: Cambridge University Press.

Schieffelin, B.B. (1985). The acquisition of Kaluli. In D.I. Slobin (Ed.), The cross-linguistic study of language acquisition: Vol. 1: The data

(pp.525-593). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Schlesinger, I.M. (1977). The role of cognitive development and linguistic input in language acquistion. Journal of Child Language, 4, 153-169.

Schlesinger, I.M. (1982). Steps to language. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Slobin, D.I. (1973). Cognitive prerequisites for the development of grammar. In C.A. Snow & D.I. Slobin (Eds.), Studies of child language development (pp. 175-208). New York: Holt, Rinehart, & Winston.

Slobin, D.I. (1982). Universal and particular in the acquisition of language. In E. Wanner & L.R. Gleitman (Eds.), Language acquisition: The state of the art (pp. 128-170). Cambridge: Cambridge University Press.

Slobin, D.I. (1985). Crosslinguistic evidence for the language-making capacity. In D.I. Slobin (Ed.), The cross-linguistic study of language acquisition: Vol. 2. Theoretical issues (pp. 1157-1249). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Smith, L., Jones, S., & Landau, B. (1992). Count nouns, adjectives, and perceptual properties in children's novel word interpretations. Developmental Psychology, 28, 273-286.

Snow, C.E. (1986). Conversations with children. In P. Fletcher & M. Garman (Eds.), Language acquisition: Studies in first language development (pp. 69-89). Cambridge: Cambridge University Press.

Stern, D.N. (1985). The interpersonal world of the infant. New York: Basic.

Stern, D.N., Spieker, S., Barnett, R.K., & MacKain, K. (1983). The prosody of maternal speech: Infant age and context related changes. Journal of Child Language, 10, 1-15.

Stern, D.N., Spieker, S., & MacKain, K. (1982). Intonation contours as signals in maternal speech to prelinguistic infants. Developmental Psychology, 18, 727-735.

Sullivan, J.W. & Horowitz, F.D. (1983). The effects of intonation on infant attention: The role of the rising intonation contour. Journal of Child Language, 10, 521-534.

Uyeda, K. & Mandler, G. (1980). Prototypicality norms for 28 semantic categories. Behavior Research Methods and Instrumentation, 12, 587-595.

Waxman, S.R. & Gelman, R. (1986). Preschoolers' use of superordinate relations in classification and language. Cognitive Development, 1, 139-156.

Waxman, S.R. & Kosowski, T.D. (1990). Nouns mark category relations: Toddlers' and preschoolers' word-learning biases. Child Development, 61, 1461-1473.

Werker, J.F. & McLeod, P.J. (1989). Infant preference for both male and female infant-directed talk: A developmental study of attentional and affective responsiveness. Canadian Journal of Psychology, 43, 230-246.