

NOTE

**Characterizing changes in parent labelling and gesturing and their relation to early communicative development\***

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ABSTRACT

In a longitudinal study, 17 parent–child dyads were observed during free-play when the children were 1;0, 1;6, and 2;0. Parents' labelling input in the verbal and gestural modalities was coded at each session, and parents completed a vocabulary checklist for their children at each visit. We analysed how the frequency of labelling in the verbal and gestural modalities changed across observation points and how changes in parental input related to children's vocabulary development. As a group, parents' verbal labelling remained constant across sessions, but gestural labelling declined at 2;0. However, there are notable individual differences in parental trajectories in both modalities. Parents whose verbal labelling frequency increased over time had children whose vocabulary grew more slowly than those whose labelling frequency decreased, remained constant, or peaked at 1;6. There were few systematic relations between patterns of parental gesturing and children's vocabulary development. Parents' verbal and gestural labelling patterns also appeared dissociable. However, parents' words and gestures were correlated when their children were 1;6, suggesting that

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gestures serve an important bootstrapping function at a critical point in children's vocabulary development.

#### INTRODUCTION

Gestural communication plays an integral role in human communication and serves a number of critical communicative functions for both the user and the recipient of the gesture. For example, gestures often supplement information conveyed verbally in a manner that clarifies or enriches the verbal content (McNeill, 1992). Gestures also appear to influence the user in that they improve the fluency of speech and ease lexical retrieval (see e.g. Krauss, Morrel-Samuels & Colasante, 1991; Rauscher, Krauss & Chen, 1996; Frick-Horbury & Guttentag, 1998; Beattie & Coughlan, 1999). Gestures are pervasive, appearing even in congenitally blind children (Iverson & Goldin-Meadow, 1997). Given the importance of gesture in human interaction, input in this communication channel may serve an important function in bootstrapping children's communicative development.

Parents of young hearing children often augment their verbal labelling of objects with gestures. These gestures include not only pointing and gestures of emphasis, but also gestures that convey semantic or representational information about the identity, function, or characteristics of the object being labelled. For example, Acredolo & Goodwyn (1985, 1988; Goodwyn & Acredolo, 1993; Namy, Acredolo & Goodwyn, 2000) have demonstrated that parents frequently produce symbolic gestures; that is, they engage in gestural or motor routines that refer to and depict aspects of objects while interacting with their infants. These gestures are modelled for infants either deliberately (e.g. *Itsy-Bitsy Spider* gesture accompanying the song) or unwittingly (e.g. sniffing a flower). Although these gestures are very likely produced by parents with the intention of augmenting or clarifying information provided in the verbal modality, Acredolo & Goodwyn's work reveals that infants adopt these gestures and begin to employ them as labels themselves. For example, children may flap their hands to indicate a bird, or perform a drinking gesture to request juice. In fact, infants appear to use words and gestures interchangeably to serve the same communicative functions, to request or label objects, actions, and outcomes. That children appear to interpret both words and gestures as object names makes sense, given that parental gestural routines and verbal labelling often occur simultaneously, within the same rich, interactive joint-attention contexts.

Iverson, Capirci, Longobardi & Caselli (1999) provided further evidence that parental gesturing influences children's communicative development. They analysed a wide array of gestures produced by parents while interacting with their children at ages 1;4 and 1;10, including deictic (e.g. pointing), conventional (e.g. shaking the head to mean 'no'), representational

(e.g. extending and retracting the index finger to indicate a snail) and emphatic gestures (e.g. extending the arms outward). They, like Acredolo & Goodwyn, found that gestures tended to co-occur with speech. They also found that, in general, the frequency of parental gesturing was predictive of the frequency of their children's gesturing at both ages, further suggesting that parental input may be influencing children's communicative attempts at these early stages in language development. These studies provide compelling evidence that parental gestures appear to bootstrap early communicative development by broadening the repertoire of labels from which infants can draw in their initial communicative attempts (Acredolo & Goodwyn, 1988; Goodwyn & Acredolo, 1993; Iverson, Capirci & Caselli, 1994; Namy & Waxman, 1998, 2002).

However, recent work by Goodwyn & Acredolo (1998) suggests an even stronger role for gestural input in infants' communicative development. They report that parental gestures appear to increase not only children's use of gestural communication, but also their VERBAL comprehension and production. They compared word comprehension and production rates in children whose parents were assigned randomly to a Gesture Training, Verbal Training or No Training control condition. They found that infants whose parents were instructed and encouraged to employ and reinforce symbolic gestures during their interactions learned not only more symbolic gestures, but also more words than infants whose parents were encouraged only to engage in frequent verbal labelling with their children, or those in the No Training control condition. By 1;3, children in the gesture training group had acquired more words in both their lexical comprehension and production than either of the other groups. Furthermore, this word learning advantage persisted through 3;0. Goodwyn & Acredolo argue that this advantage in the Gesture Training condition is a function of the broader range of symbolic forms intensively modelled during interactions. They propose that redundant exposure to symbols in both modalities strengthened children's mastery of symbol learning more generally, which fed back into the learning system, leading to more facile word acquisition.

This evidence clearly implicates gestural input as an important factor in children's communicative development. However, relatively little is known about how parental input, and in particular labelling input in the verbal and gestural modalities, is modulated as a function of changes in children's communicative competence. There are several possible models of how parental labelling behaviour in the verbal and gestural modalities might change in response to or in anticipation of advances in their children's communication. One possibility is that parents frequently produce object labels (in the verbal modality) and object functions or actions (in the gestural modality) early in development to provide an initial toehold into communication, but decrease the frequency of labelling input in one or both

modalities as children begin to produce more object labels themselves. Another possibility is that words and gestures, while frequent and coordinated early in development, follow dissociable trajectories over time. For example, verbal labels may remain constant in the input while gestures fall to the wayside after facilitating infants' initial entry into symbolic communication. This possibility makes intuitive sense, given that gestural labels are not destined to become a prominent part of older hearing children's labelling repertoire. Indeed, this trajectory might well account for the findings by Namy and colleagues (Namy & Waxman, 1998, 2002; Namy, Campbell & Tomasello, 2004) indicating that developing language skills appear to give rise to a reluctance to accept gestures as object names. A third intriguing possibility is that labelling might increase in response to communicative attempts on the part of the child, providing enrichment or scaffolding (Vygotsky, 1962) as infants enter a period of heightened receptivity to labelling. If so, we also might predict that frequency of parental labelling (especially in the gestural modality) would decline later in development, as children become more readily able to carry their share of the conversation, creating an inverted-U or peaked trajectory in parental input.

The goals of this paper are (1) to characterize how the use of verbal and gestural labels in parental input changes over their children's development, and (2) to assess how changes in parental input influence or relate to children's vocabulary development. In this study, we observed parent-child dyads interacting in free-play sessions and recorded the frequency of verbal and gestural labels produced by parents during their interactions with their children. To assess developmental change in parental input, we observed the frequency of verbal and gestural labels at three critical time points in children's communicative development, spaced at six-month intervals: 1;0 (the age at which children typically begin to produce their very first verbal and gestural labels), 1;6 (the age at which many children undergo an increased rate of word acquisition), and 2;0 (the age at which many children begin to combine words into two- and three-word utterances). At each observation point, we also collected measures of child vocabulary size as an index of how individual differences in parents' input might relate to variability in children's vocabulary acquisition.

## METHOD

### *Participants*

A total of 21 parent-child dyads were recruited via direct mailings to participate in this longitudinal study involving three laboratory visits. Of these 21 dyads, 2 completed only the first visit, and 2 completed only the first and second visits. The 17 remaining dyads visited the laboratory when the children were approximately 1;0 ( $M = 1;0.7$ , range = 0;11.6–1;1.1), 1;6

( $M=1;6.3$ , range =  $1;5.8-1;7.1$ ), and 2;0 ( $M=2;0.9$ , range =  $2;0.3-2;3.3$ ). These dyads were predominantly White and all participating parents were mothers.

### *Stimuli*

The stimuli for this study consisted of a wide range of toys that were selected to be interesting, engaging, and familiar to young children. The same stimuli were used for all three visits. Parents and children were free to direct their attention to any of the stimuli during the study. As a result, although all dyads had access to the same set of objects, the particular objects with which each dyad interacted varied somewhat from family to family and visit to visit. Some examples of stimuli available for play include an array of toy animals, a plastic airplane and plastic boat with people figures that fit inside, a toy train, a play camera, pretend food and child-sized plates, cups, and utensils, and toy tools.

### *Procedure*

The parent and child were invited to be seated on the floor in a small play room with the toys in a large toy bin beside them. The experimenter explained to the parents that she would be sitting in the corner, videotaping the parent-child interactions and that the parents should play normally with their children as they would at home. The experimenter instructed the parents that they were free to interact with anything in the room, and that the play session would last 10 minutes. During the session, the experimenter unobtrusively adjusted the camera's orientation and zoom levels to follow the movements of the parent and infant, and to ensure that both members of the dyad were captured on video at all times. At each visit, parents also completed the MacArthur CDI checklist, short version (Fenson, Pethick, Renda, Cox, Dale & Reznick, 2000). At Time 1, parents completed the Infant inventory and at Times 2 and 3, they completed the Toddler inventory. For the purposes of this study, number of words on the list in the child's productive vocabulary was used as an index of children's total productive vocabulary.

### *Coding*

Coders noted each incident of parents' production of verbal labels and distinctive gestures representing or depicting specific objects (i.e. excluding pointing, holding up or referring to objects in a generic or deictic fashion) within joint-attention episodes. Verbal labels were defined as any count noun that was used uniquely to identify the object depicted. For example,

a parent might label a tiger as 'tiger' or 'kitty'; either would have been coded as a verbal label.

Gestural labelling included any distinctive gesture that appeared to be semantically related to or representative of the object depicted, including both empty handed (sign-like) gestures and gestures produced with an object in hand. For example, if the parent produced a spooning-to-mouth action without the spoon in hand or held the toy camera up to her eye and clicked the button, these were both coded as gestural labels. We included 'in-hand' gestures in our analysis because research by Acredolo & Goodwyn (1988) indicated that many of the (empty-handed) symbolic gestures that infants acquire are abstracted from routines originally performed with objects in hand. These 'in-hand' gestures also conveyed unique reference to the object category. We consider it likely that many of parents' 'in-hand' gestures were produced with the intention of demonstrating or playing with the objects, as opposed to labelling the object *per se*. However, because children tend to recruit gestural labels from such play routines, we consider parental play (i.e. 'in-hand' gestures) as a potential basis for insight into object naming in children.

For both words and gestures, labelling instances were coded only when joint-attention was established; that is, when the child and parent directed their gaze to the same object or activity.

Three different primary coders analysed the labelling behaviours (both verbal and gestural) of all 17 parents, one at each time point. All three coders transcribed a randomly selected four children's sessions from Time 1 to establish reliability. Reliability was calculated using the kappa statistic based on the number of coders identifying each instance of labelling behaviour recorded. Inter-coder agreement was highly reliable,  $k=0.52$ ,  $p<0.005$ .

## RESULTS

The average rates of parental verbal and gestural labelling at each time point are depicted in Figure 1. We conducted planned comparisons of change in the frequency of labels in each modality across time points, and also compared the relative frequency of verbal vs. gestural labelling at each time point (adjusted  $p$ -level = 0.006). Averaged across dyads, parental rate of verbal labelling did not differ across the three time points. In contrast, frequency of gestural labelling did not differ between Time 1 and Time 2, but was significantly lower at Time 3 than at both Times 1 and 2 ( $t$ 's (16) = 3.34 and 4.74 respectively, both  $p$ 's < 0.006). Overall, parents produced significantly more verbal than gestural labels at each time point ( $t$ 's (16) = 3.16, 3.76, and 7.20 at Times 1, 2, and 3, respectively,  $p$ 's = 0.006, 0.002, and 0.001). Thus, parental rate of verbal labelling does not appear to change

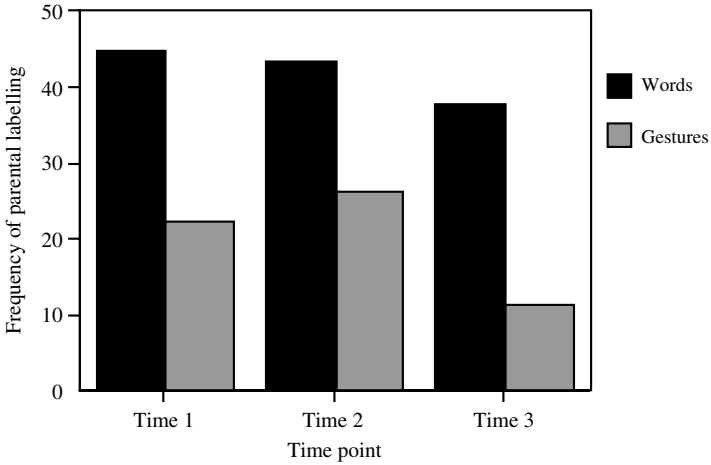


Fig. 1. Mean parental labelling in the verbal and gestural modality at each time point.

over their children’s second year. However, there is developmental change in parental use of gestures. The data suggest that although gestures play an important function in bootstrapping verbal labelling early in development, they play a less central role in parental communication as children become more verbally proficient themselves. This pattern also provides a potential explanation for why children initially expect both words and gestures to act as labels, but over time develop a priority for verbal labels (Namy & Waxman, 1998).

The divergent patterns for words and gestures in parental input implies that there is little shared variance associated with these two communicative modalities. However, it is possible that parents are coordinating their verbal and gestural input early in development. To assess this, we analysed the frequency with which gestural labels were produced simultaneous with a verbal label. We found that such instances of simultaneous labelling in the two modalities were relatively infrequent with a mean of only 7% of gestures accompanied by verbal labels averaged across the three time points (range = 0%–33%, median = 6%, mode = 0%). The mean frequency of gestures accompanied by and independent of verbal labels at each time point is depicted in Figure 2. Verbal and gestural labels were often generated for the same referent within the same play episode, but rarely during the same referential act. To assess whether this lack of coordination varied across time points, we compared the proportion of gestures produced with verbal labels across the three time points using a single-factor ANOVA ( $M = 0.08, 0.07, \text{ and } 0.06$  for times 1, 2, and 3, respectively). This analysis revealed no significant effect of time.

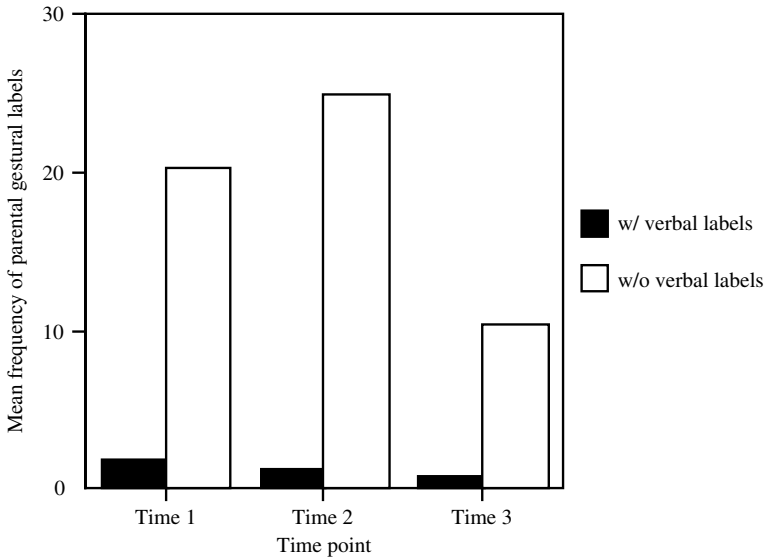


Fig. 2. Mean frequency of gestures produced with vs. without a simultaneous verbal label at each time point.

This trend for parents to employ verbal labels at a consistent rate across the second year but to decline in the use of gestural labels appeared quite informative and interpretable. However, analyses of individual patterns yield a surprising result: no single parent adheres to this group pattern. We attempted to classify the trajectories of individual parents' change in communication over time categorically to assess how the group trends related to individuals' behaviours. We operationalized change from one time point to the next as an increase or decrease of 10 labels. Using this criterion, we discovered that the parents fall into one of four patterns of VERBAL labelling including (1) the static pattern of no change in labelling over time, (2) a monotonic increase in the frequency of labelling over the three time points, (3) a monotonic decline in the frequency of labels produced over the three time points and (4) an inverted U-shaped trajectory in which the frequency of the parent's labelling peaks when her child is 1;6. Change in parents' GESTURAL labels fell into one of three patterns, none of which corresponded to the group pattern observed. Instead, parents' gestures either (1) did not change over time, (2) monotonically decreased, or (3) demonstrated a peak at 1;6. No parent showed a linear increase in frequency of gestures. Interestingly, there is no clear relation between individual parents' pattern of verbal labelling and pattern of gestural labelling as depicted in Table 1. There was also no significant correlation between frequency of verbal labels

TABLE 1. *Number of parents falling into each pattern for verbal and gestural labelling*

	Word pattern				Total
	No change	Linear increase	Linear decrease	Peak @ Time 2	
Gesture pattern:					
No change	3	1	1	0	5
Linear decrease	1	0	2	1	4
Peak @ Time 2	0	2	3	2	7
Total	4	3	6	3	16*

\* One outlier parent's word pattern differed from the others' by decreasing at Time 2 and then resuming original labelling rate at Time 3. This parent was in the 'Peak @ Time 2' category for gestures.

and frequency of gestural labels at either Time 1 or Time 3 ( $r$ 's = 0.244 and 0.128 respectively, both  $p$ 's ns). However, there was a near significant correlation between frequency of words and frequency of gestures at Time 2 ( $r$  = 0.473,  $p$  = 0.055).

The timing of this correlation is particularly interesting because 1;6 tends to be a critical transitional time in children's productive language development. For example, around this age, many children undergo a vocabulary spurt, there appear to be changes in lexical retrieval processes, word processing becomes more left-hemisphere lateralized in the brain, and children's receptivity to nonverbal labels such as gestures begins to decline (Gershkoff-Stowe & Smith, 1997; Mills, Coffey-Corina & Neville, 1997; Namy & Waxman, 1998; Woodward & Hoyne, 1999). This finding raises the possibility that although parental trajectories are variable and unrelated in the two modalities in general, parents' communicative styles in both modalities are changing in response to changes in children's communicative development at this important transitional stage. This suggests that regardless of communicative style prior to and after 1;6, there is a concerted effort to coordinate input in the two modalities at this point in development.

Next, we examined how these different communication patterns related to children's vocabulary development. As a group, children's vocabulary increased at a roughly linear rate, see Figure 3. However, there were, not surprisingly, large individual differences in children's trajectories. For example, the amount of change in the vocabulary checklist between Time 1 and Time 3 varied from 37 to 93. Because this is a small sample, we have limited power to conduct parametric analyses (such as analysis of variance or growth curve modelling) of the relation between changes in parental input patterns and changes in children's communicative development. However, we employed effect size analyses to evaluate the relation between

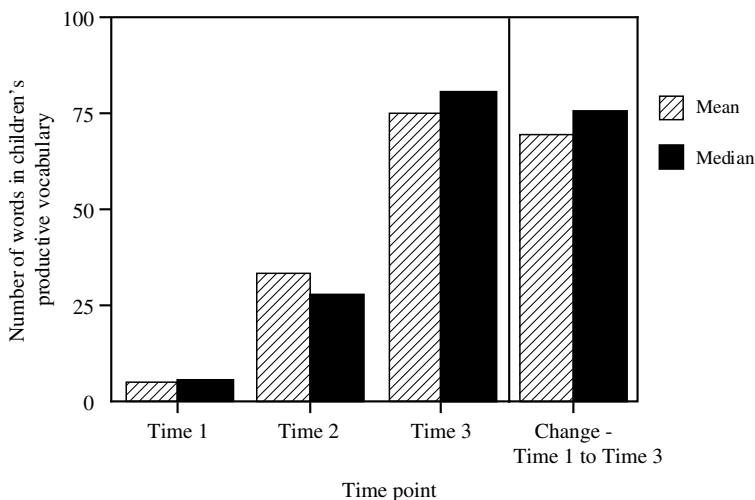


Fig. 3. Mean and median of children's vocabulary checklist measures at each time point, and change from Time 1 to Time 3.

the type of trajectory of parents' labelling behaviours and indices of children's vocabulary development.

We assessed whether parental trajectories related to child vocabulary at Time 2, to child vocabulary at Time 3, and also to the vocabulary growth that occurred between Time 1 and Time 3. These analyses indicate that parental verbal pattern relates to all three measures of child vocabulary, with large effect sizes for all three indices of vocabulary development (See e.g. Keppel, 1991 for a discussion of magnitude of effect sizes). In particular, children of parents whose verbal labelling INCREASED over their child's development had smaller vocabularies at Time 2 ( $R^2=0.184$ ), smaller vocabularies at Time 3 ( $R^2=0.285$ ), and slower vocabulary growth between Time 1 and Time 3 ( $R^2=0.21$ ) than did children from all other parental word patterns. See Figure 4. In contrast, parents' gesture patterns tended to have smaller effects on children's verbal vocabulary development, and tended to shift between Time 2 and Time 3. For example, there was a medium effect size for the impact of parental gesture pattern on Time 2 Vocabulary ( $R^2=0.092$ ), suggesting a disadvantage for children whose parents' gesturing remained constant, particularly relative to those whose gestural input decreased over time. However, there was a small effect size for Time 3 vocabulary ( $R^2=0.013$ ) suggesting a slight ADVANTAGE for children whose parents' gesturing did not change in frequency. There was also a small to medium effect size for change in vocabulary between Time 1 and 3 ( $R^2=0.034$ ), also suggesting an advantage for children whose parents' gesturing remained constant. See Figure 5. One possible interpretation of

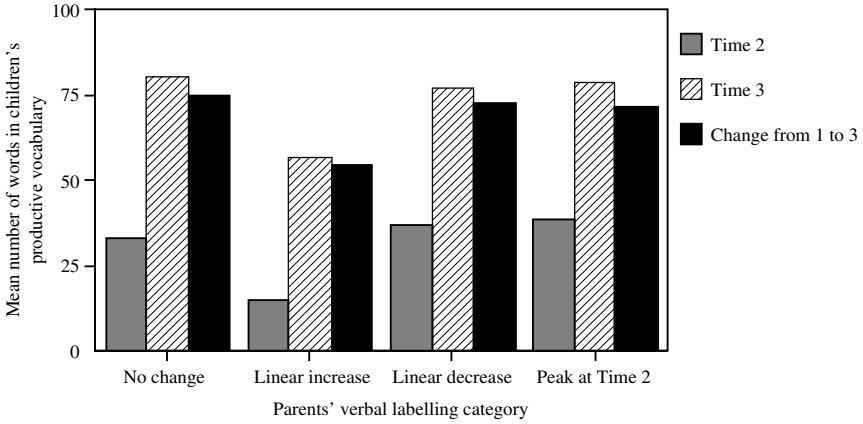


Fig. 4. Mean productive vocabulary measure for children of parents in each verbal labelling category at each time point.

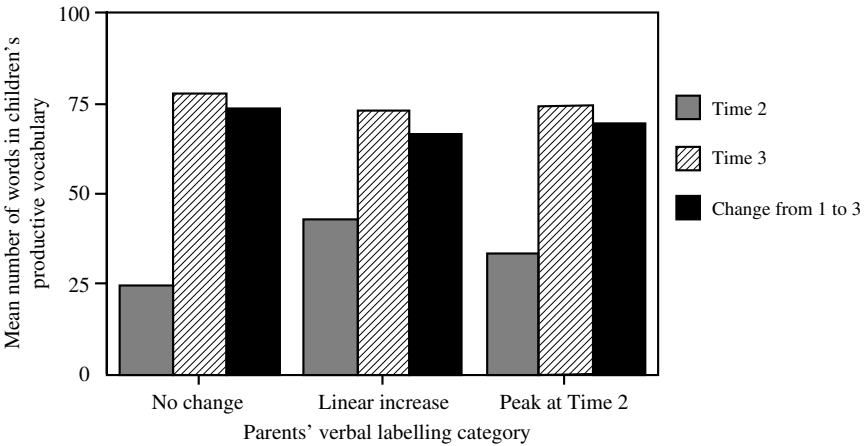


Fig. 5. Mean productive vocabulary measure for children of parents in each gestural labelling category at each time point.

these findings is that providing frequent gestural modelling beyond 1;0 slowed verbal vocabulary development in the short run, but, as suggested by Goodwyn & Acredolo (1998) facilitated verbal lexical development in the long run.

Overall these data suggest that increases in parental labelling inhibit vocabulary growth, and that frequent gestural input past Time 1 may enhance slightly long term vocabulary acquisition. We followed up this analysis with

TABLE 2. *Correlations among frequency of parental production of words and gestures at each time point and size of children's productive vocabulary (as indexed by the Macarthur CDI, short form) at each time point*

Parent production	Macarthur CDI (short form) vocabulary size			
	Time 1	Time 2	Time 3	Change (Time 1 to 3)
Time 1 Gestures	-0.05	0.03	0.15	0.16
Time 1 Words	0.07	0.00	0.00	-0.01
Time 2 Gestures	-0.13	0.04	0.10	0.15
Time 2 Words	-0.03	-0.12	-0.18	-0.17
Time 3 Gestures	-0.31	-0.14	0.18	0.26
Time 3 Words	0.22	-0.16	-0.34	-0.40*

\*  $p = 0.108$ .

a series of simple correlations between frequency of verbal and gestural input at each time point and children's vocabulary index at each time point. As depicted in Table 2, the only correlation approaching significance is a negative correlation between frequency of parental verbal input at Time 3 and children's change in vocabulary from T1 to T3. This negative correlation captures what appears to be an inhibitory effect of parents' frequent labelling on children's productive vocabulary by 2;0. This finding raises the possibility that although frequent early labelling by parents serves to bootstrap children's vocabulary, frequent later labelling may overshadow children's attempts to develop a productive vocabulary themselves. Alternatively, this trend may reflect a compensatory strategy on the part of parents whose children are slow talkers. Either interpretation implies an important link between parental labelling behaviours and children's early development.

#### DISCUSSION

This examination of changes in parental input in the verbal and gestural modalities revealed several interesting findings. First, we discovered that there is a great deal of individual variability in how parents' communication styles change in response to advances in children's communicative competence. Indeed, group analyses largely misrepresented the types of change parents' communication underwent, and how they might relate to children's development. Second, we found surprisingly little relation between changes in verbal and gestural modalities, revealing that despite the prevalence of gestural input early in children's development, these two modalities are not particularly coordinated. The one exception to this dissociability was the coordination of words and gestures at 1;6. This finding is interesting,

raising the possibility that parents are responding to the significant changes occurring at this time point in both the production and comprehension of their children. Of course, there was variability in whether individual parents' coordination at this time point was characterized by heightened labelling in the two modalities or dampening of labelling in both modalities, and at no time point did the two modalities appear coordinated within the same referential act. However, as a group, this correlation at Time 2 in the absence of such correlations at Times 1 or 3 reveals that parents' use of gestural input is, in fact, sensitive to changes in their children's communicative development and to the role that gesture might play in encouraging such strides.

In addition to these discoveries regarding the relation between verbal and gestural input, we also found some interesting patterns of association between parental input and child vocabulary development. We found that there is no clear relation between changes in parents' verbal labelling and children's lexical development with the exception of one style, an increase in labelling rate over time, which appeared to have an inhibitory effect on children's lexical development. It is important to note, however, that we did not assess directly receptive vocabulary in this sample. If we are correct in proposing that this detrimental effect is due to lack of opportunity to exercise verbal production skills, we would not expect an inhibitory effect of parents' increased labelling on children's RECEPTIVE vocabulary, only on production. In contrast, if this relation is a strategic response on the part of parents to slow talkers, the correlation between parental input and child vocabulary may hold for receptive as well as productive vocabulary. In future work, it will be important to explore how this parental style influences comprehension as well as production.

Overall, we found somewhat weaker relations between parental input in the gestural modality and children's vocabulary development. Consistent with past work (Goodwyn & Acredolo, 1998) we found that children whose parents' gestural labelling remained constant throughout the second year had slightly larger increases in verbal vocabulary than those whose parents' gestures decreased by Time 3. Interestingly, this slight advantage at Time 3 for children whose parents' gesturing remained constant was accompanied by a slight disadvantage in verbal vocabulary size at Time 2. Because these effects of parental gesture are small, these conclusions are tentative. It also is important to consider that frequency of gestural 'labels' at any given time may not be the best index of how parental gestural input is influencing children's communicative development. For example, Bates, Benigni, Bretherton, Camaioni & Volterra (1979) note the possibility of a threshold effect for gestural input. That is, perhaps a minimal degree of exposure to gestural input is sufficient to facilitate lexical development, with no apparent advantage for more frequent gesturing beyond this threshold. Further,

the dynamics of how parents respond to and reinforce children's fledgling attempts at gesture, and the integration of gesture with words in parental communication are likely to be critical factors in how gestural input influences children's communicative development.

The individual differences discovered in parental patterns and the dissociation of parental labelling and gestural patterns are an intriguing basis for further study. In future work, we hope to explore what factors in children's development appear to influence or elicit changes in parental input in the two modalities, and how the bi-directional interplay of parent-child interactions in the two modalities can facilitate or inhibit children's communicative insights over time.

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