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# Manual Babbling in Deaf and Hearing Infants: A Longitudinal Study

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## 1. Introduction

Babbling is an important step in the acquisition of language, whether that language is spoken or signed. However, the linguistic status of manual babbling is unclear. Inquiries into this issue have only appeared in the last decade. As is the convention for any new research area, studies have been descriptive in their aims. Predictions about when babbling should occur or explanations of how the manual babble relates to the onset of language await an accurate description of manual babbling. In the present study, we extend previous attempts to describe the manual babble by exploring prelinguistic gesture in a larger sample of deaf and hearing infants than has been heretofore studied.

In one view, Petitto and Marentette (1991) suggest that all infants are equipped to detect rhythmic properties of linguistic input--signed or spoken. Vocal babbling is "triggered" by the patterned input of a spoken linguistic environment; manual babbling is triggered by the patterned input of a signed linguistic environment. Empirically, one should expect a difference between hearing and deaf babies in the frequencies of these two modes of

babbling. And, in fact, Petitto and Marentette have found such a difference. In their studies (1991; Marentette, 1989), deaf babies produced significantly more tokens of manual babbles than did hearing babies. However, no differences occurred in the frequency of communicative gestures produced by hearing and deaf infants.

Petitto and Marentette define the manual babble as consisting of non-referential sign syllables. They require a signed syllable to have a handshape, a location, and a movement. Further, movement must be realized as a change in location, handshape or palm orientation. This description of the manual babble is language-driven.

On the other hand, Meier and Willerman (1995) point out that the ASL syllable has not been clearly defined. They view early infant behavior such as the babble as largely motor driven. They draw on Thelen's (1979) observations of rhythmical stereotyped behaviors ("motor stereotypies) to argue that infant propensities to cyclic motor behaviors may underlie both manual and vocal babbling.

Thelen (1979) characterizes the rhythmical stereotypies that arise between the fourth and fiftieth weeks as repetitive behaviors involving rotation around an axis or simple flexion and extension. She has observed that the onsets of these motor patterns seem to regularly precede more complex behaviors. She suggests that infants perform these behaviors or stereotypies as a function of maturing neuromuscular pathways. A stereotypy such as arm waving may be transitional between uncoordinated, nonrhythmical activity and coordinated, voluntary behavior such as reaching.

Meier and Willerman note that the frequency of arm and hand stereotypies observed by Thelen peaks at the same developmental point that vocal babbling does (e.g., between 5.5 and 9.5 months). The authors contend that a common rhythmical basis exists for vocal babbling and upper limb stereotypies. In fact, manual babbling may be rooted in such stereotypies. In adopting this account for their description of manual babbling, Meier and Willerman predict similarities between hearing and deaf babies in the frequency of manual babbling. And, in contrast to Petitto and Marentette, Meier and Willerman find similarities in the frequencies of manual babbling in their deaf and hearing subjects.

In spite of the differences in their findings, these two research programs overlap in the behaviors that are coded. In their observations of three deaf and two hearing babies, Meier and Willerman identify 3 types of manual activity: signs, communicative gestures (points, reaches, waves) and meaningless, nonreferential gestures that they called babbles. They propose that their definition of babbles may compose a superset of the manual activity that Petitto and Marentette identify as canonical manual babbling.

These contrasting viewpoints on how and why manual babbling emerges indicate a need for further descriptive studies. In the present study we have conducted a natural observation of the behaviors of hearing and deaf infants. In our coding, we adopted the more global approach to manual babbling suggested by Meier and Willerman. Our goals were twofold: (1) Specify the time course of manual babbling in deaf and hearing infants; and (2) Examine the relationship between manual babbling and the onset of communicative gestures.

## 2. Subjects, Data Collection, and Equipment

### 2.1 Subjects

We observed five deaf children of deaf parents (3 girls and 2 boys) and five hearing children of hearing parents (4 girls and 1 boy). All deaf children were brought up in households where the primary language was American Sign Language (ASL). The hearing children were brought up with English as their primary language and had no exposure to any sign language. All children were recruited locally through friends and acquaintances of the researchers.

### 2.2 Data Collection

The children were videotaped at home during free play, while interacting with a parent and/or experimenter. The videotaping sessions lasted 30 to 45 minutes every two weeks, beginning at 5 months and continuing until the child was 15 months of age.

### 2.3 Equipment

We videotaped the children using Sony Hi-8 Video Camera Recorders, models CCD-TR700 and CCD-TR101. For viewing, we used the Sony CVD-1000 Computer Video Deck, a Hi-8 tape player with a control stack to allow various speeds of playback. We coded gestures using a custom database designed within FileMaker Pro 3.0.

## 3. Coding Scheme

We coded a fifteen minute sample (from 10:00 to 25:00) from each of the videotaped sessions. Our coding scheme has evolved out of that of Meier and Willerman (1995). Instead of defining a distinct set of gestures to code, we first defined what gestures not to code.

### 3.1 What not to code

We did not code gestures which were functional (e.g., reaches where the child seems to actually attempt to grasp something). Likewise, instrumental gestures were not coded (e.g., play with an object). Object exploration and postural adjustments were also not coded. We did not code sympathetic

movements, since children sometimes move both hands when only one is "intended" due to imperfect motor control.

### 3.2 Coding fields

All gestures not excluded by the above restrictions were coded with respect to the following categories: FUNCTION, CYCLICITY, GESTURE DESCRIPTION, HAND DOMINANCE, and IMITATIVE CONTEXT. Our analysis focused primarily on function. Further description and examples are given below.

#### 3.2.1 Function

Each gesture was coded as having one of the following functions: *babble*, *bang*, *communicative*, or *sign*. We coded gestures with no referential or manipulative purpose as *babbles*. Some common babbles include:

- Arm waves: Gestures in which the child does not contact her body
- Body pats: Gestures in which the child contacts her body
- Claps: Inward movements with palm-to-palm contact

All gestures that contacted a surface other than the child's own body were coded as *bangs*. Some common banging surfaces include toys, another person's body or the floor.

Any non-linguistic gesture (i.e., not an ASL sign) that was used referentially or to maintain a social interaction was coded as *communicative*. The most common types of communicative gestures that we found were:

- Reaches
- Points
- Shows
- Conventional waves
- Rituals (e.g., pattycake)

Reaches, points and shows were further categorized as referentially communicative, while waves and rituals were considered social communicative gestures.

Any gesture resembling an ASL sign in form that was used in an appropriate context for that sign was coded as a *sign*. The signs we coded were COLOR, FINISH, MORE, TV, MILK, HAIR, BALL, and PACIFIER.

#### 3.2.2 Other fields

In addition to function, we coded the cyclicity of each gesture. By cyclicity, we mean the number of movement cycles in a given gesture token.

We also coded gestures for other criteria. We recorded a general description, including relevant information about the context in which the gesture occurred, as well as hand dominance (the hand more actively involved in the gesture) for each gesture. Finally, we coded gestures for their imitative context (i.e., whether the child was imitating an adult who was on-camera).

### 3.3 Reliability

We did reliability tests on one-third of our data (i.e., 8 out of 24 tapes). Four random samples from each hearing status (i.e., four from deaf and four from hearing) were selected. Each tape was coded by two people independently. Reliability scores represent percentage agreement between these pairs of coders. Differences between the original coding and the reliability coding were reconciled in the database. In all, we coded 543 gestures.

Coders agreed 68.7% on gesture tokens (i.e., which gestures should be coded). Excluding bangs (which we did not analyze for this particular study), our reliability increased slightly, up to 70%. Reliability on individual fields was generally quite high (84%-97% in most cases). Function, as our primary field, was agreed upon 87% of the time.

## 4. Results

When interpreting our data, we looked first at the distribution of babbles across three ages: 7, 10 and 13 months. We also looked at the relation between the time course of babbling and the onset of communicative gestures. Results showed interesting differences and similarities between the deaf and hearing children in all respects.

### 4.1 Babble results

In order to specify the time course of manual babbling, we compared the proportion of babbles across the three ages.

Table 1
Proportion of Babbles out of Total Gestures (Excluding Bangs and Signs)

| | 7 months | 10 months | 13 months |
|---|---|---|---|
| Deaf | 1.00 | 0.63 | 0.40 |
| Hearing | 1.00 | 0.70 | 0.60 |

As predicted, we found no significant difference between the hearing and deaf children with respect to these proportions. But we did find an overall decrease in the proportion of babbles across ages for both groups of children, as shown in Table 1 ($F(2,14) = 16.04$, $p<0.0001$). The high proportion of babbles at age 7 months is a consequence of the fact that none of our subjects was then producing communicative gestures.

The frequency of babbling was also very similar between deaf and hearing at the three ages. Table 2 shows the rate of babbling per minute.

Table 2
Mean Rate of Babbles per Minute

| | 7 months | 10 months | 13 months |
|---|---|---|---|
| Deaf | 1.08 | .43 | .64 |
| Hearing | 1.05 | .64 | .39 |

We found that there was a general decline from age 7 months to age 13 months in the rate of babbling. Further, the rate was similar in both sets of infants. Taken together, the information from Tables 1 and 2 shows that both the proportion and the actual number of babbles decreased.

**4.2 Communicative results**

We did find interesting differences between the deaf and hearing children when we looked at the communicative gestures. In our initial analysis of the proportion of referential gestures (*reaches*, *shows*, and *points*) across hearing status, we found a tendency for deaf infants to produce more of these gestures than hearing infants, as shown in Table 2 ($F(1,8) = 3.71$, $p<0.09$).

Table 2
Proportion of Referential Gestures out of All Communicative Gestures

| | 10 months | 13 months |
|---|---|---|
| Deaf | 0.95 | 0.80 |
| Hearing | 0.59 | 0.60 |

However, when we conducted further analyses to locate the source of this difference, we found that, in fact, it was pointing that distinguished deaf infants from hearing infants, as shown in Table 3 ($F(1,8) = 7.38$, $p<0.026$).

Table 3
Proportion of Points out of All Communicative Gestures

| | 10 months | 13 months |
|---|---|---|
| Deaf | 0.44 | 0.48 |
| Hearing | 0.11 | 0.11 |

When comparing the time course of babbles with the onset of communicative gestures, we found that the initial decrease in babbles co-occurred with the onset of communicative gestures, between 7 and 10 months for both groups.

## 5. Discussion

Based on the motor-driven theory of manual babbling from Meier and Willerman (1995), we predicted that deaf and hearing would show similar proportions of manual babbles. In addition, we predicted that the babbles would decrease over time, and that this decrease would co-occur with the onset of communicative gestures, regardless of whether the child was deaf or hearing. The results given above support these predictions and the claim made by Meier and Willerman that much of early gestural behavior is a function of motor development rather than purely linguistic influences.

Further, we found that deaf children tended to produce more referential gestures than the hearing children did. In fact, it was referential pointing that distinguished deaf infants from hearing infants. The greater proportion of communicative points in deaf children may be due to the different linguistic environments of the two groups. For deaf children acquiring sign, points become integral to their language. For hearing children, points will always be gestures that add to but are not part of the spoken language.

## 6. Conclusions

Together, these findings suggest that while the child's early communicative gestures are determined in part by the linguistic environment, manual babbling is highly influenced by motor development common to both deaf and hearing children.

In many respects, our results represent a significant departure from the work of Petitto and Marentette (1991). Their identification of manual babbling references the parameters of ASL sign phonology: handshape, place of articulation, movement, and palm orientation; and they showed significant differences between the frequencies of manual babbling in hearing and deaf infants. The identification rubric we used did not make reference to specific values for these formational parameters, and we found significant commonalties between hearing and deaf. The apparent disparity between Petitto and Marentette (1991) and our study possibly arises from the differences between our two coding systems.

Our future research will focus on narrowing the gap between the methods of Petitto and Marentette (1991) and those of our study. For our sample of deaf and hearing infants, we will describe the distributions of handshape, location and movement parameters. We believe that these future analyses may show some of the effects of the language environment on manual babbling found by Petitto and Marentette. In particular, we would anticipate that future studies will yield evidence of environmental effects on the manual babbling of children aged 10 months and older.

## 7. Acknowledgments

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