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ABSTRACT

The degree to which vocal accommodation occurred in the interaction of mothers with 27 infants 3- to 5-months old equally divided among three diagnostic groups (heart disease, Down Syndrome, and no known abnormalities) was investigated. Videotapes were made of the infants during 3 minutes of face-to-face play with their mothers. Tapes were coded in terms of sequence of vocalizations, pauses, switching pauses, and turns. Time-series regression analyses indicated that a great deal of accommodation occurred, especially for the vocalization and pause parameters. The accommodation was primarily compensatory in nature and was exhibited equally by mothers and infants in all three diagnostic groups. There were also substantial individual differences in vocal behavior across dyads within each group. Findings appeared to support the notion of the importance of interpersonal vocal accommodation in normal individuals and to extend it to some at-risk grous. A 9.5 page reference list is included. (Author/CL)

INTERPERSONAL ACCOMMODATION OF VOCAL BEHAVIOR IN THE INTERACTIONS OF INFANTS WITH DOWN SYNDROME WITH THEIR MOTHERS: A PRELIMINARY STUDY

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ABSTRACT

The purpose of the study was to compare the degree to which vocal accommodation occurs in the interactions of infants with Down syndrome, heart disease, and no known abnormalities with their mothers. It has been suggested that the ability of mothers and infants to mutually accommodate is critical to social development, but only recently have investigators begun to examine the interactions of at-risk infants and their mothers for the occurrence of accommodation. It was hypothesized that infants with Down syndrome may exhibit impaired accommodation. The subjects were 27 3- to 5-month-old infants equally divided among the three diagnostic groups. Split-screen videotapes were made of the infants during 3 minutes of face-to-face play with their mothers. The tapes were coded to produce sequences of vocalizations, pauses, switching pauses, and turns. Twenty-four time-series regression analyses were performed, which indicated that a great deal of accommodation occurred, especially for the vocalization and pause parameters. This accommodation was primarily compensatory in nature and was exhibited equally by mothers and infants in all three diagnostic groups. There were also substantial individual differences in vocal behavior across dyads within each group. The findings seem to support the notion of the importance of interpersonal vocal accommodation in normal individuals and extend it to some at-risk groups. That the three diagnostic groups shared similar profiles of accommodation is evidence of the generality of this phenomenon.

Interpersonal Accommodation of Vocal Behavior in the Interactions of Infants with Down Syndrome with their Mothers: A Preliminary Study

The study of infant capabilities and activities over the past several decades has invalidated the longstanding assumption that the infant lives in a "blooming, buzzing world of confusion" (James, 1890). The infant has in fact been shown to possess various perceptual and processing skills at birth or shortly thereafter (see Gibson & Spelke, 1983 for a review) and several books have been written which present research demonstrating that the infant is an active participant in complex interactions with the caregiver (e.g. Lamb & Sherrod, 1981; Lewis & Rosenblum, 1974; Schaffer, 1977). In addition, results of investigations of gaze (e.g. Brazelton, Koslowski, & Main, 1974; Fogel, 1977; Stern, 1974), kinesics (e.g. Beebe, Stern, & Jaffe, 1979; Beebe & Gerstman, 1980; Beebe, Feldstein, Jaffe, Mays, & Alson, 1985), and vocalizations (e.g. Anderson, Vietze, & Dokecki, 1977; Stern, Jaffe, Beebe, & Bennett, 1975) during interactions between the caregiver and healthy infant suggest that such behaviors are characterized by order and mutual influence.

The present paper focuses upon the nature of temporal patterns of vocalizations during face-to-face interaction. The study of temporal patterns in adult dialogue indicates that the durations of silences (pauses and switching pauses) in vocal exchange are subject to interpersonal influence although not in the presence of certain types of pathology. Such findings have led researchers (Jasnow & Feldstein, 1986) to speculate that the ability to be influenced by the timing of a speaker's partner might be necessary for the development of the facility for appropriate social exchange. In addition, studies of normal children's and infants' patterns of verbal and preverbal vocalizations show partial congruence with adult findings and suggest a developmental trend in the ability of an interactant to be influenced by the timing of another interactant (e.g. Jasnow & Feldstein; Welkowitz, Cariffe, & Feldstein, 1976).

The next logical step in this sequence of research is to determine whether the inability to engage in adequate social interaction at a later age can be predicted by a disturbance in an infant's ability to accommodate to the timing of the vocalizations of a caregiver. Because infants with Down syndrome are genetically identifiable at birth and are considered at risk for interpersonal difficulties based on evidence of delays in social development (e.g. Cicchetti & Sroufe, 1976; Cullen, Cronk, Pueschel, Schnell, & Reed, 1981), they are the focal subjects of this study. It may be that these social difficulties diminish over the years as the child catches up developmentally, but during the period of early infancy these difficulties are expected to be present. The purpose of the present study, therefore, is to determine whether Down syndrome involves a social deficit that is reflected during infancy in a decreased ability to vocally accommodate to the temporal patterns of caregiver vocalizations. The relevant findings about adult, child, and infant vocal patterns in dyadic exchanges are discussed below, followed by a consideration of the temporal-perceptual abilities of individuals with Down syndrome and their early communication skills, both of which are important for making predictions about the ability of infants with Down syndrome to modify their vocal patterns based upon those of the caregiver and vice versa.

Adult Temporal Patterns

Over the past two decades, a body of research has developed that is concerned with the study of the temporal patterns of adult dialogue. It has been found that the sequences of sounds and silences of individuals involved in dialogues are capable of providing information about the individuals and the nature of their relationship, regardless of verbal content. Indeed, the interpersonal timing of vocal interactions has been found to be characteristic of the speakers involved, stable within a given discourse, and consistent from one conversation to the next for the same two persons (see Feldstein & Welkowitz, 1978 for a review).

The method typically used for assessing the temporal properties of sounds and silences in dialogue is known as automated interaction chronography and is carried out by a computer system called the Automatic Vocal Transaction Analyzer (AVTA) (Cassotta, Feldstein, & Jaffe, 1964; Feldstein, BenDebba, & Alberti, 1974; Jaffe & Feldstein, 1970). It measures five behaviors of ongoing speech, namely, speaking turns, vocalizations, pauses, switching pauses, and simultaneous speech (interruptive and non-interruptive). (See the Method section for a detailed description of these behaviors.) The two silence behaviors, pauses and switching pauses, have been shown to be capable of being influenced in interpersonal speech such that the silences of one speaker are influenced by those of the other speaker and vice versa. When the patterns of one partner are modified by those of the other partner in conversation, the former individual is said to have accommodated to, or been influenced by, his or her partner. Interpersonal accommodation can occur both in the form of compensatory behavior (expressed as an inverse relationship between the behavior of one individual and that of another) and in the form of reciprocal behavior (expressed as a direct relationship between the behavior of one individual and that of another) (Cappella & Greene, 1981). Vocal accommodation has been found to be related to psychological differentiation or field independence (Marcus, Welkowitz, Feldstein, & Jaffe, 1970), empathy (Welkowitz & Kuc, 1973) and perceived similarity between interactants (Welkowitz & Feldstein, 1969, 1970), psychotherapeutic interventions (Alberti, Feldstein, Gross, McDaniel, & Welkowitz, 1975), and positive evaluations of interviewers (Natale, 1978).

The absence of accommodation in interpersonal timing seems to index the pathological communications of adult schizophrenics (Matarazzo & Wiens, 1967; Rutter, in press), and the pathological communications of autistic adolescents (Feldstein, Konstantareas, Oxman, & Webster, 1982). Results such as these have led Jasnow and Feldstein (1986) to conclude that the interpersonal accommodation of temporal patterns of dialogue represents a form of social sensitivity that is of crucial importance for a functional exchange between adults.

Similarly, Cappella (1981) had reached this conclusion regarding the presence of mutual influence in a summary of studies on gaze, vocalizations, kinesics, and engagement.

Children's Vocal Patterns

Studies about children's speech patterns seem to mirror, in part, results of interpersonal accommodation in the adult literature. Specifically, there is evidence that children are capable of taking turns in vocal exchange, as well as matching the frequency and types of their vocalizations to that of their partners.

Regarding turn-taking, Schaffer, Collis, and Parsons (1977) found that the pattern of speech for 2-year-olds interacting with their mothers was primarily an alternating one. Similarly, Kaye and Charney (1981) found evidence of turn-taking among 2.2- to 2.6-year-olds involved in conversation with their mothers. In addition, a longitudinal study of children ages 1.75- to 3 years showed that very few interruptions or simultaneous starts occurred when these children interacted with adults (Bloom, Rocissano, & Hood, 1976). Children in conversation with peers also seem to take turns (Garvey & Berninger, 1981).

In addition to turn-taking, young children appear to engage in vocal matching during dyadic exchange. For example, in a study of social versus egocentric speech, Garvey and Hogan (1973) found that 3.5- to 5-year-old children adapt the content of their speech to the speech and non-verbal behavior of their partners and that the percentage of utterances contributed by each member of each dyad are equivalent, indicating vocal matching. Vocal matching was also found by Garvey and BenDebba (1974) in 3.5- to 5.5-year-olds in that pairs of these children involved in verbal exchange tended to use similar numbers of utterances. The possibility that this matching was merely a reflection of children of the same age having equivalent productivity was ruled out because each child participated in two dyads and analyses showed that the number of utterances varied with change of partner. In addition, there was no significant correlation between the number of utterances of a given speaker with one partner versus another partner.

A third set of findings, reported by Shatz and Gelman (1973), shows that 4-year-olds could adapt the length and number of their utterances to the age of their addressees. Specifically, they used shorter and fewer utterances when addressing 2-year-olds and longer and more utterances when speaking with peers and adults. The work of Masur (1978) suggests that such adaptation is based not on age of the addressee, but instead on his or her verbal productivity. In this study, 4-year-olds used shorter utterances when speaking to low-verbal 2-year-olds and longer utterances when speaking to high-verbal 2-year-olds.

The first and only reported study of speech patterns of verbal children using the AVTA system was conducted by Welkowitz et al. (1976). This method is considered superior to methods used in the prior studies of conversation chronography because AVTA is automated and perhaps more objective. In this study, speech samples of pairs of same-gender peers were analyzed and those of 5- to 6-year-olds were compared to those of 6.5- to 7-year-olds. In the older group, significant interspeaker influence was apparent on both occasions of conversation analyzed; both pauses and switching pauses between dyad members were positively correlated. In the younger group, congruence was obtained on both occasions, but only for switching pauses. The authors concluded that the results may point to a developmental trend in the temporal parameters which characterize normal adult vocal patterns and that vocal temporal patterns may reflect the socialization process.

Infants' Temporal Patterns

Because the series of sounds and silences in conversation have proven fruitful in the study of adult exchange and have begun to show promise in the study of children's conversations, a small number of researchers have also explored this phenomenon in preverbal infants. As with the older children, vocal matching and turn-taking have been investigated.

Analyses of whether infants take turns vocalizing with their caregivers generally show that it does occur at this early age. For example, Bateson (1975) found that in mother-infant dyads with 1.5- to 3.5-month-old infants the partners took turns vocalizing more often than expected by chance. Evidence of such turn-taking in 1-year-olds has also been reported (Schaffer et al., 1977). However, studies which examined the degree of alternating speech compared to simultaneous speech show that preverbal infants take turns considerably less than older children and adults. Stern et al. (1975), for instance, examined sets of 3- to 4-month-old twins interacting with their mothers and found that a coactional pattern of vocalizations occurred about twice as frequently as an alternating pattern. Later reanalysis of this data indicated that coactive vocalizations occurred only 1/3 of the time (Beebe, Zelner, Feldstein, & Jaffe, in press), but this is still much greater than that found among adults (Jaffe & Feldstein, 1970). Other supporting evidence was reported by Anderson et al. (1977), who found that mothers and their 3-month-old infants were more likely to begin vocalizing when their partners were vocalizing than when their partners were silent.

As with turn-taking, vocal accommodation in the form of matching among infants interacting with their mothers does occur, but to a lesser degree than that found among older children and adults. Beebe et al. (1985) used AVTA to examine videotapes of 3.5- to 4-month-old infants and their mothers engaged in face-to-face play and found that the dyads matched the durations of switching pauses, but not pauses. This is analogous to the results of Welkowitz et al. (1976) in which the younger children's speech with peers was affected in terms of switching pauses, but not pauses. In addition, these results partially replicate the adult data which indicate that accommodation occurs for both pauses and switching pauses. Welkowitz et al. speculate that perhaps switching pauses are the first to fall under the influence of the speaking partner because they are interpersonal in nature, whereas accommodation for pauses occurs later in development because they are intrapersonal in nature. That is, switching pauses function to regulate turn-taking, making them crucial for successful communication. Pauses, however, have no such interpersonal function.

Of the research cited on the patterns of child and infant vocalizations thus far, none was able to clearly detect moment-to-moment influences of the mother on the child's vocalizations and conversely, of the child on the mother's vocalizations. Until very recently, researchers examining mother-infant vocal interaction did not utilize the sophisticated statistical techniques required for such an analysis, although they have been used to study other phenomena (Beebe et al., 1985) and populations (Cappella & Planalp, 1981; Crown, 1984; and Gottman, 1981). However, one study (Jasnow & Feldstein, 1986) of vocal accommodation in the mother-infant dyad has been able to show the direction of influences on vocal patterns. In this case, AVTA was used to record and describe the data, but unlike in other studies, the statistical technique applied was time-series regression analysis (Cappella & Planalp, 1981; Ostrum, 1978) rather than simple zero-order correlations, probabilities, or intraclass correlations. Time-series regression analysis (which is described in detail in the Method section) makes it possible to determine the influence of a subject's prior and concurrent vocal behavior on his or her partner's vocal behavior.

Jasnow and Feldstein (1986) audiotaped the interactions of 9-month-old infants and their mothers, analyzed the vocal patterns using AVTA, and used time-series regression analysis to analyze the data for accommodation. Turn-taking was also analyzed. They found that accommodation was bidirectional, meaning that the mother's vocal patterns influenced the infant's and the infant's vocal patterns influenced the mother's. Specifically, the infant's current moment switching pauses were influenced by the mother's current moment switching pauses such that as the mother's increased, the infant's also increased (indicating a reciprocal pattern). On the other hand, the mother's switching pauses were influenced by the infant's prior switching-pause durations such that as the infant's switching pauses increased in length, the mother's decreased (indicating a compensatory pattern). That only switching pauses were subject to accommodation is in line with the findings of Welkowitz et al. (1976) and Beebe et al. (1985). The evidence for turn-taking, however, did not reflect past findings. That is, unlike the findings discussed earlier which showed a large degree of coactive vocalizations (Anderson et al., 1977; Beebe et al., in press; Stern et al., 1975) these vocalizations were found to be primarily alternating rather than simultaneous. This is more reflective of adult speech patterns (Jaffe & Feldstein, 1970), and suggests another possible developmental phenomenon because the infants in the former studies were 3 to 5 months old, while those in the Jasnow and Feldstein study were 9 months old.

Findings Regarding Down Syndrome

The purpose of the proposed study was to determine whether there is a subtle prelinguistic social deficit in infants with Down syndrome reflected by patterns of vocal accommodation. Knowledge of the temporal-perceptual abilities of the infant with Down syndrome and the child's vocal environment and vocal behavior is presented below as a background for making predictions about the liklihood that infants with Down syndrome will display such a social deficit.

Infant temporal perception. The finding that the vocal patterns of the normal infant can be influenced by the mother's vocal patterns (Jasnow & Feldstein, 1986) leads to the question of what perceptual skills an infant needs in order to successfully accommodate. It is assumed that a sensitivity to temporal information is a necessary condition for the ability to match vocal timing with the mother because the child must first perceive the mother's vocal patterns before he or she is able to react to them. In normal infants, the existence of temporal-perceptual skills within the first few months of life is well-established, indicating that the infant is capable of discriminating the duration of events based upon studies of temporal conditioning (Allen, Walker, Symonds, & Marcell, 1977), rhythm perception (Demany, McKenzie, & Vurpillot, 1977), temporal synchrony between visual and auditory stimuli (Lawson, 1980; Spelke, 1976; Spelke & Cortelyou, 1981), soothing techniques (Brackbill, 1971; Korner & Thoman, 1972), and temporal contingency (DeCasper & Fifer, 1980; Millar & Watson, 1979).

In studies of infants with Down syndrome, on the other hand, temporal perceptual abilities are not so well established. Habituation studies measuring evoked potentials (EPs) of infants (Barnet, Ohlrich, & Shanks, 1971) and children with Down syndrome (Lichy, Vesely, Alder, & Zizka, 1975) found that the amplitudes of EP responses do not decrease after repeated presentations of auditory stimulation, indicating a lack of habituation to repetitive stimulation. This absence of habituation also characterizes the evoked potentials of adults with Down syndrome (Gliddon, Busk, & Galbraith, 1975; Schafer & Peeke, 1982; Straumanis, Shagass, & Overton, 1973), even when the timing of stimulation is controlled by the individual or occurs at a predictable periodic rate (Schafer & Marcus, 1973). Schafer and Peeke suggest that the ability to suppress a cortical response to predictable or insignificant stimuli is a reflection of the perception of order in time or the environment. They further suggest that the inability of individuals with Down syndrome to do so represents a deficit in the memory process responsible for temporal expectancy.

Early communication. By about 18 months of age, the average child is able to produce and comprehend words and has begun to apply rules to the use of grammar, syntax, and phonology. There is much variability in the development of language in children with Down syndrome, but a review of the research on language acquisition in mentally retarded children (de Villiers & de Villiers, 1983) indicates that development is delayed by several years and that there may also be some qualitative differences between children with Down syndrome and normal children in acquisition patterns and rule use.

Of more direct relevance to the present analysis are studies of vocal exchanges between mother and child. Several such studies have described the nature of maternal vocalizations to children with Down syndrome as qualitatively different from vocalizations to normal children. For example, Kogan, Wimberger, and Bobbitt (1969) observed mother-child dyads and found that the mothers of 3- to 7-year-old children with Down syndrome used significantly more directive speech than those of normal controls. These mothers also asked many leading questions or questions for which they supplied answers, while the speech of control mothers most commonly consisted of statements of agreement or acknowledgement of the child's activity. In studies of 2-year-olds, mothers of children with Down syndrome were found to use more and shorter utterances, more incomplete sentences, and more imperatives than control mothers (Buium, Rynders, & Turnure, 1974), as well as more and faster utterances (Buckhalt, Rutherford, & Goldberg, 1978). In addition, the vocalizations of the children with Down syndrome were less synchronous with the mothers' activity than the vocalizations of normal toddlers (Buckhalt et al.).

Rondal (1977), however, has pointed out that these studies, which matched subjects by chronological age (CA), suffered from a confound between the child's group membership (normal or Down syndrome) and linguistic competence. Therefore, Rondal matched children on three levels of mean length of utterance (MLU) rather than CA and found maternal speech generally not to differ between the groups. This suggests that the expressive language level of the children was the important factor influencing maternal speech in the above studies, not the presence or absence of Down syndrome. One subsequent study which matched subjects in terms of MLU, however, did show that the mothers of children with Down syndrome used more vocalizations that were semantically irrelevant to the ongoing interaction compared to mothers of normal children (Petersen & Sherrod, 1982).

Although it is not clear to what degree mothers provide differential linguistic environments for children with Down syndrome compared to normal children matched on MLU, there is evidence that when matched for developmental age the former group of children behave differently when vocalizing to their mothers. Specifically, Jones (1977, 1980) found that children with Down syndrome do not appear to be sensitive to their mothers' role in communication. Unlike the normal control group, the former children tended to repeat vocalizations in quick successions or to vocalize in long strings which did not allow for their mothers to make elaborated responses. In many cases, the children with Down syndrome seemed to begin vocalizing while their mothers were already in the midst of speaking, suggesting a lack of knowledge of the turn-taking mechanism important for successful communication. In addition, as with the Kogan et al. (1969) study, mothers of children with Down syndrome tended to direct conversation rather than allow the child to do so.

Hypothesis

The present study represents an exploratory analysis of 3- to 5-month-old infants with Down syndrome. The findings of the deficient ability of individuals with Down syndrome to habituate to repetitious and predictable stimulation and the findings of their linguistic deficits in interpersonal settings suggest that infants with Down syndrome accommodate less to the vocal behavior of their mothers in face-to-face interactions than do normal infants.

Method

Participants

The vocal exchanges of 27 mother-infant dyads that had been video-taped originally for a study of mutual gaze (Taylor, 1984) were analyzed in the present study. The infants were all born in a hospital, discharged at the same time as their mothers, living with both parents, and between 3 and 5 months of age at the time of videotaping. The dyads represented lower to upper-middle socioeconomic status. Nine of the babies had Down syndrome, nine had known heart disease (cyanosis, growth failure, and/or congestive heart failure), and nine had no known abnormalities. There were seven males and two females in the Down group, five males and four females in the heart group, and four males and five females in the normal group. The normal babies were recruited through pediatricians and ads placed in parent-group newsletters, while the handicapped babies were recruited through Children's Hospital National Medical Center in Washington, D.C.

The primary aim of the study was to determine whether infants with Down syndrome would display less vocal accommodation than normal infants, but the group of babies with heart disease was also added to explore the question of specificity, i.e., whether decreased accommodation is a consequence of Down syndrome specifically, or is present in general at-risk groups such as those with heart disease. It is acknowledged that comparing heart-diseased and Down-syndrome babies represents a possible confounding of diagnostic group membership (heart-diseased and Down syndrome) with coronary problems because approximately 30 - 40% of all babies with Down syndrome have heart defects (Pueschel, 1978). However, only two of the nine infants with Down syndrome in this sample had heart defects, which were not considered serious by their physicians. Furthermore, at the time of taping, these two babies were not experiencing any signs of distress that were a function of the heart defects, and the holes in their hearts seemed to be closing spontaneously. Thus, none of the infants with Down syndrome were considered ill, while all of the heart-diseased infants were considered seriously ill by their physicians.

Procedure

The mothers and their infants were videotaped interacting with one another at the Educational Technology Center of the University of Maryland College Park. The face-to-face laboratory interaction paradigm developed by Als, Tronick, and Brazelton (1980) was used in videotaping the dyads. Specifically, when each infant was alert and calm, the child was secured in an infant seat on a table by the mother and the mother sat in a chair facing the child. One camera was focused on the infant and another was focused on the mother. A special-effects generator yielded a split-screen image that showed frontal views of the mother and infant on one monitor at the same time.

One 3-minute segment of interaction was taped for each dyad. The mothers had been told that the purpose of the study was to understand how mothers and their infants play together. They were then instructed to play with their infants as they normally did.

Transformation of the interactions. As stated earlier, the videotapes were made for the purpose of examining gaze behavior in a prior study (Taylor, 1984). In order to make the tapes appropriate for the study of vocal exchange, two modifications were necessary. First, those dyads whose videotaped interactions had major sound problems (e.g. in some cases the microphone was not turned on) were excluded from the analysis. Second, the vocalizations on the videotapes were transformed into tones on cassette tapes with a voice-to-tone converter built for the purpose. The transformation was necessary because AVTA requires that each voice in the dyad be recorded on a separate channel, and the original interaction recordings were made on only one channel. Conversion of voices to tones was accomplished with a telegraph device with two keys connected by electrical wires to a tone generator on one end and the input of a Marantz cassette recorder on the other. The wiring was arranged so that pressing one key caused the tone generator to feed a tone of 1000 Hz into one channel of the Marantz, while pressing the other key caused the tone generator to feed a tone of 1200 Hz into the other channel. Each key, then, and the tones that were produced by pressing it represented the vocalizations of one member of the dyad. To record the sequence of sounds and silences of each member of the dyad, each videotape was viewed and the appropriate key for each member was pressed at the onset of a vocalization and was held down until there was a pause in the vocalization. For the purpose of making the conversions, a pause was defined as any silence discernable to the human ear.

In order to make the tone replications of the vocalizations as accurate as possible, one trained coder pressed the key for infant vocalizations, while another simultaneously recorded maternal sounds and silences.

For the purpose of converting voices to tones, only those sounds which were communicative were registered, excluding maternal singing (which has a confounding pre-established rhythm) and infant screaming which seemed out of the infant's control. Thus, in some cases it was not possible to have data for the entire 3 minutes of interaction per dyad because of uncontrollable crying, audio problems, and maternal singing.

Intercoder reliability. Intercoder reliabilities were assessed by having the two coders switch telegraph keys and repeat the toning procedure with a sample of 10 dyads chosen randomly, with the constraint that at least 3 dyads from each diagnostic category be included.

Reliability (product-moment) coefficients were calculated for both the average durations of the interaction behaviors and the proportions of time in each segment that the infants and mothers engaged in each behavior. The average reliability coefficient for the average durations of all the behaviors was .598, with coefficients ranging from .091 to .888. The reliability coefficients for the proportions of the bahaviors were substantially higher, with the rs ranging from .325 to .901 and averaging .702.

The most reliably coded behavior expressed in the form of proportions was vocalizations, with an *r* of .820 averaged across diagnostic groups; the most reliably coded behavior expressed in the form of average durations was pauses, with an *r* of .740 averaged across diagnostic groups. The least reliable parameter was switching pauses for both proportions (*r* = .411) and average durations (*r* = .402).

Not surprisingly, the normal dyads proved easier to code; their overall reliability (*r* = .775) was substantially higher than that of the Down (*r* = .581) and heart (*r* = .556) groups.

Data Generation and Variables

After the sequences of sounds and silences were transformed to tones in two channels and tested for adequate reliability, they were analyzed by the Automatic Vocal Transaction Analyzer (AVTA) (Cassotta et al., 1964; Feldstein et al., 1974; Jaffe & Feldstein, 1970), which is a computer system capable of detecting and recording automatically the presence and absence of vocalizations in an interaction. AVTA is designed to interpret vocal interaction as two sequences of sounds and silences, with the sequence recorded on one channel representing one participant in the interaction and the sequence recorded on the other channel representing the other participant. AVTA records, every 250 msec, whether each member of the dyad is vocalizing or silent.

From this analysis of sounds and silences, AVTA generates descriptive statistics for the five behaviors, or parameters, that have been found to characterize the temporal structure of vocal behavior completely, unambiguously, and reliably (Jaffe & Feldstein, 1970). These parameters are listed and defined in Table 1.

Table 1

Definitions of the Parameters of Conversation Chronography

1. A speaking turn begins the instant one of the speakers in an interaction begins talking alone and ends immediately prior to the instant the other speaker starts talking alone. Thus, a turn is the interval between two successive speaker switches.
2. A vocalization is a segment of sound (speech) uninterrupted by any discernible silence and uttered by the speaker who has the turn (or floor), and it is credited to him/her.
3. A pause is an interval of joint silence bounded by the vocalizations of the speaker who has the turn, and is therefore credited to him/her.
4. A switching pause is an interval of joint silence that is initiated by the speaker who has the turn, or floor, and terminated by the other speaker, who thereby obtains the floor. Thus, it marks a change of speakers and, inasmuch as it occurs within the turn of the speaker by whom it is initiated, it is credited to him/her.
5. Simultaneous speech is speech uttered by a speaker who does not have the floor during a vocalization by the speaker who does have the floor.
   a. Interruptive simultaneous speech is part of a speech segment that begins while the speaker who has the floor is talking and ends after he has stopped. Only that portion uttered while the other speaker is talking is considered simultaneous speech.
   b. Noninterruptive simultaneous speech begins and ends while the speaker who has the floor is talking.

Note. Table is reproduced from Crown and Feldstein (1985).

The three parameters which describe speech sounds (turns, vocalizations, and simultaneous speech) have been found to be stable within individuals and are not generally subject to interpersonal influence. The silence parameters, however, have been found to be subject to such influence (see Feldstein & Welkowitz, 1978 for a review). Since pauses and switching pauses are the two parameters that show the effects of interpersonal influence, they are the focal variables of the analysis, although turns and vocalizations were also analyzed. Simultaneous speech, however, could not be analyzed because of a technical problem with the new AVTA software programs that had not yet been corrected.

Data Analysis

Thirty seconds seems to be a stable unit of analysis, creating more reliable data as a result of minimal fluctuations from one unit to the next (Jasnow & Feldstein, 1986). Therefore, the unit of analysis in the present study was 30 seconds. This means that for every 3-minute interaction segment, AVTA averaged the descriptive statistics it accumulated every 250 msec for each parameter and provided six data points per dyad member. Because there was not enough data to statistally examine each dyad separately, these data were concatenated across all the dyads within each diagnostic group (normal, heart-diseased, and Down-syndrome), resulting in three data sets: normal infants and their mothers, infants with Down syndrome and their mothers, and hear~ ' :ased infants and their mothers. Within each set, interdyad variance was then removed by regressing its values onto a set of dummy-coded variables that represented the different dyads that comprised the group (Cohen & Cohen, 1975). With nine dyads per group and 3 minutes of interaction per dyad, there should ideally be 54 30-sec segments of data per group. However, because of the technical problems discussed earlier, the total number of useable segments in the Down and heart groups were 52 and 53, respectively, while only 43 segments in the normal group were useable.

After the unit of analysis was chosen and the data for each group were concatenated, time-series regression analyses were conducted on the parameters generated by AVTA. This type of analysis is capable of assessing whether interpersonal influences are bidirectional or unidirectional, and of removing the effects of autocorrelation or the influence of one individual's past behavior on his or her present behavior (Cappella & Planalp, 1981; Ostrum, 1978). Thus, time-series regression analysis allows for the determination of whether the infant vocal behavior is influenced by maternal vocal behavior and vice-versa. In addition, these analyses can detect both prior and current moment influences and can be made free of the confounding effects of autocorrelation.

Time-series regression analyses were conducted for concurrent and prior moment influences separately. Concurrent or present moment interpersonal influences were assessed in three steps. First, the infant's vocalizations at time $\underline{t} - 1$ were partialled from his or her vocal behavior at time $\underline{t}$ to remove autocorrelation effects. Second, the mother's behavior at $\underline{t} - 1$ was partialled from the infant's autocorrelation-corrected behavior at $\underline{t}$ (the residuals from step 1) in order to assess the effects of the mother's prior behavior on the infant's current behavior. Finally, the mother's behavior at _t_ was regressed onto the infant's behavior at _t_ with both infant autocorrelation and maternal prior influences removed (the residuals from step 2). This procedure evaluated the mother's current influence on the child's current vocal behavior, and was reversed to evaluate the infant's current influence on the mother's current vocal behavior.

Prior influence was also assessed in three steps. The first was the same as with assessing concurrent influence; the infant's autocorrelation effects were removed. In the second step, maternal _t_ - 2 vocal behavior was partialled from her _t_ - 1 behavior, resulting in a vector of t - 1 corrected for t - 2, or autocorrelation-corrected maternal vocalizations at t - 1. Finally, the residuals from step 2 were regressed onto the residuals from step 1. This procedure evaluated the influence of the mother's vocal behavior at the prior moment on the infant's behavior at the subsequent or current moment. Reversing the procedure allowed for the assessment of the influence of the infant's vocal behavior at the prior moment on the mother's behavior at the subsequent or current moment.

Each analysis resulted in standardized partial regression coefficients (i.e. beta weights), each of which represented a separate estimate of the degree of accommodation within each of four conditions: the effect of the mother's prior and current vocal behavior on the child's current behavior and the effect of the infant's prior and current vocal behavior on the mother's current behavior. These beta weights provide three types of information. First, beta weights which hrave significant probabilities associated with them indicate that a reliable degree of accommodation has occurred. Secondly, like a zero-order correlation, the larger the value of the beta weight, the larger the degree of accommodation. Finally, a negative beta weight indicates that the accommodation is compensatory in nature, while a positive one indicates that the accommodation is reciprocal in nature.

Results

Twenty-four (3 groups x 4 parameters x 2 interactants) time series regression (TSR) analyses were conducted (using SPSS New Regression). Each analysis yielded the following information: the magnitude and significance of interdyad variance; the magnitude and significance of self-influence or autocorrelation effects; and the magnitude, significance, and type of accommodation (reciprocal or compensatory) in both the prior and current moments. Each of these sets of results is discussed separately below. Before describing these results, however, a few points of clarification about the data are needed.

First, data generated by AVTA can be expressed in any of four forms: frequencies, summed durations, average durations, or proportions of time in which each individual is interacting during a given time segment. Historically, average durations have been the form used most frequently in analyses of the sequences of sounds and silences in dialogue (although proportions appear to be equally useful according to Crown, 1984). However, since the coding of average durations was substantially less reliable than proportions, the latter form of raw data was used as the input for TSR analyses. Unfortunately, turns could not be analyzed in this form because of the perfectly inverse relationship between the interactants' proportions of turns. Therefore, in the case of turns, the less reliable form of average durations was used for conducting the analyses. Fortunately, the reliability with which turns were coded in the form of average durations was within the acceptable range (r = .686).

Interdyad Variance

Interdyad variance was assessed within each diagnostic group and within each parameter, resulting in 12 separate tests (3 groups X 4 parameters) of interdyad variance for the infants and 12 for the mothers. All three diagnostic groups of infants exhibited significant interdyad variance within the vocalization and switching-pause parameters. In addition, the infants in the heart-diseased group also displayed significant interdyad variance for the other two parameters (turns and pauses). Overall, 8 of the 12 indices of infant interdyad variance were significant.

Mothers in all three diagnostic groups also exhibited a good deal of interdyad variance. Regardless of group membership, significant interdyad variance was apparent in both the vocalization and pause parameters. In addition, mothers of heart-diseased infants exhibited significant interdyad variance within the switching-pause parameter, while mothers of infants with Down syndrome exhibited interdyad variance with a significance level just above .05. In all, 7 of 12 indices of maternal interdyad variance were clearly significant.

Not only were the proportions of cases in which significant interdyad variance occurred large (about 2/3 for both infants and mothers), but the sizes of these effects were also substantial. Of the significant semi-partial *r*-squares, the proportions of variance accounted for by individual differences ranged from 34% to 72%. These proportions were about equal for infants and mothers, with individual differences accounting for about 44% of the variance in infant behavior and 48% of the variance in maternal behavior. Table 2 provides a breakdown of these results by group, parameter, and interactant.

Autocorrelation Effects

The effects of self-influence from the prior moment to the current moment were negligible, with only one of the 24 analyses showing significant autocorrelation. Given that when a large number of analyses are run, 5% would be expected to yield significant results by chance alone, this one significant result may be spurious.

Interpersonal Accommodation

Infant accommodation to maternal vocal behavior in the prior moment was generally non-existent in all three groups of infants and all four parameters. The only exception was a finding of significant matching of switching pauses in the group of heart-diseased babies. Because this effect is the only significant one, and because at least one of the 24 analyses would be expected to show significant results by chance, this effect is probably spurious. As one can see from Table 3, the assessment of maternal accommodation to infant vocal behavior in the prior moment yielded similar results. In no case was there a

Table 2

Interdyad Variance within Groups for the Time Series Regression Analyses

	Group	Infant r^2	Infant F	Infant p	Mother r^2	Mother F	Mother p
	D	.2368	1.5514	.1706	.1548	0.9155	.5139
Turns	H	.5395	6.1496	.0000	.0972	0.5654	.7999
	N	.1505	0.7086	.6819	.2127	1.0806	.4011
	D	.4144	3.5375	.0035	.4176	3.5848	.0032
Vocalizations	H	.4891	5.0259	.0002	.7184	13.3924	.0000
	N	.5524	4.9374	.0005	.4796	3.6866	.0038
	D	.1815	1.1091	.3778	.4775	4.5696	.0005
Pauses	H	.4359	4.0560	.0012	.4329	4.0072	.0013
	N	.1563	0.7410	.6552	.4504	3.2778	.0077
	D	.3672	2.9010	.0120	.2913	2.0547	.0641
Switching	H	.3368	2.6664	.0183	.3423	2.7327	.0160
Pauses	N	.3834	2.4867	.0319	.1788	0.8710	.5506

Note. Group abbreviations stand for the following: D = Down syndrome, H = heart-diseased, and N = normal. These statistics are based on analyses of average durations of turns and proportions of the other three parameters.

Table 3

Coefficients of Prior Accommodation, Magnitudes of Effects, and Associated F-ratios and Probabilities for the Time Series Regression Analyses

		Infant Accommodation				Mother Accommodation			
	Group	β	r^2	F	p	β	r^2	F	p
	D	.0951	.0059	0.3225	.5736	.3118	.0597	3.0664	.0882
Turns	H	-.1242	.0132	1.1635	.2874	.2563	.0382	1.8014	.1873
	N	-.2222	.0397	1.4364	.2404	-.1005	.0066	0.2550	.6174
	D	.0769	.0036	0.2317	.6331	.1257	.0066	0.4378	.5123
Vocalizations	H	-.2213	.0165	1.3980	.2442	.0710	.0020	0.2900	.5933
	N	.0765	.0025	0.1773	.6768	-.0692	.0028	0.1585	.6935
	D	.1909	.0143	0.7859	.3811	.0420	.0012	0.0922	.7632
Pauses	H	.0410	.0008	0.0593	.8089	-.2576	.0255	1.8551	.1810
	N	-.1251	.0098	0.3627	.5517	.0649	.0025	0.1405	.7105
	D	.0374	.0007	0.0410	.8407	.3123	.0390	2.4218	.1282
Switching	H	.3180	.0737	5.415	.0252	.0475	.0015	0.0882	.7681
Pauses	N	-.1194	.0096	0.5505	.4641	.3116	.0594	2.400	.1321

Note. Group abbreviations stand for the following: D = Down syndrome, H = heart-diseased, and N = normal. These statistics are based on analyses of average durations of turns and proportions of the other three parameters. The coefficients of accommodation are the standardized partial regression coefficients (β).

significant effect of prior infant behavior on current maternal behavior.

Unlike the null results for prior accommodation, several instances of accommodation in the current moment were apparent. This accommodation appears rather uniform in that both mother and infant displayed accommodation in all three diagnostic groups for both pauses and vocalizations. Specifically, as can be clearly seen in Table 4, 8 of the 12 coefficients of accommodation for vocalizations and pauses are significant, with three others having a probability level just above the .05 criterion level. The only coefficient representing vocalizations and pauses not showing some degree of significance was that which indexed the pauses of mothers of normal infants.

The magnitude of effects for mother and infant vocalizations accommodation ranged from $\underline{r}^2 = .049$ to $\underline{r}^2 = .124$, with an average of about 8% of the variance in current vocalizations accounted for by the partners' current vocalizations. Higher effect sizes were found for pauses, which ranged from $\underline{r}^2 = .045$ to $\underline{r}^2 = .231$. The average proportion of variance accounted for by the partners' current pauses was about 14%. The degree of accommodation expressed by the infants for these two parameters was very similar to that expressed by their mothers. In addition, there were not significant differences in the degree of accommodation exhibited by the normal versus Down, versus heart-diseased infants.

The type of accommodation evident in both the infants and mothers for these two parameters was of a compensatory rather than reciprocal

Table 4

Coefficients of Current Accommodation, Magnitudes of Effects, and Associated F-ratios and Probabilities for the Time Series Regression Analyses

		Infant Accommodation				Mother Accommodation			
	Group	β	r^2	F	p	β	r^2	F	p
	D	.2146	.0326	1.8187	.1859	.2300	.0357	1.8748	.1794
Turns	H	-.0493	.0017	0.1451	.7053	-.1303	.0076	0.3513	.5569
	N	.1834	.0229	0.8208	.3727	.1844	.0275	1.0744	.3086
	D	-.2955	.0502	3.4138	.0729	-.2913	.0493	3.4829	.0702
Vocalizations	H	-.5641	.0857	8.7125	.0054	-.3413	.0520	9.0477	.0046
	N	-.4900	.1230	11.8712	.0018	-.5332	.1244	9.0638	.0055
	D	-.5772	.1611	11.3412	.0018	-.4149	.1147	11.2110	.0019
Pauses	H	-.6366	.2095	26.9386	.0000	-.6726	.2311	28.8204	.0000
	N	-.4219	.0919	3.7387	.0633	-.2608	.0451	2.6677	.1136
	D	.4184	.1037	7.3727	.0101	.4866	.1370	10.7418	.0023
Switching	H	.0221	.0003	0.0210	.8855	-.0112	.0001	0.0037	.9518
Pauses	N	.3065	.0605	3.8018	.0613	.3326	.0567	2.4010	.1325

Note. Group abbreviations stand for the following: D = Down syndrome, H = heart-diseased, and N = normal. These statistics are based on analyses of average durations of turns and proportions of the other three parameters. The coefficients of accommodation are the standardized partial regression coefficients (β).

nature. That is, larger proportions of vocalizations and pauses for the mothers meant shorter proportions of vocalizations and pauses for the infants, and vice versa. Similarly, larger proportions of vocalizations and pauses for the infants meant shorter proportions of vocalizations and pauses for the mothers, and vice versa. It should be noted, however, that these inverse relationships were not necessary effects. Unlike turns, it is possible for accommodation to vocalizations and pauses to be reciprocal in nature.

As described above, the evidence of accommodation in vocalizations and pauses was fairly clear-cut. This was also the case for turns, for in no case did infant or maternal accommodation express itself through this parameter. More equivocal is the evidence for accommodation of switching pauses. In the Down group, both the mothers and infants exhibited significant accommodation. The magnitudes of these effects are considerable, with maternal switching pauses accounting for 10% of the variance in the switching pauses of infants with Down syndrome, and infant switching pauses accounting for 14% of the variance in maternal switching pauses. These two instances of switching-pause accommodation are in the form of reciprocal rather than compensatory behavior, unlike the findings for vocalizations and pauses. Normal infants seem to show a trend toward similar reciprocal accommodation for switching pauses, but the associated probability level for this group is just beyond the .05 criterion level.

Discussion

Interdyad Variance

There appeared to be considerable individual variability in the ways both the mothers and infants behaved, regardless of diagnostic group membership. Indeed, about 2/3 of indices of interdyad variance yielded significant effects. Moreover, these effects were quite large, ranging from 34% to 72%. Such pervasive individual differences support the prior notion (reviewed by Feldstein & Welkowitz, 1978) that the vocal parameters generated through AVTA are to some degree stable within individuals and that people have their own styles of communicating, which are detectable even on the non-semantic micro-level.

That infants as young as 3-5 months of age show so much individual variability suggests that personal style, or at least the roots of it, exist very early. Even more interesting is the fact that the at-risk infants displayed as much individual differences as the normal infants. Just as the early students of child behavior and development historically attended only to what the child is incapable of, so the at-risk or handicapped child still tends to be viewed in terms of his or her limitations. Evidence of stable individual differences in vocal behavior of "abnormal" children is a positive step toward debunking the myth of the blooming, buzzing world.

Autocorrelation

As was the case in the Jasnow and Feldstein (1986) study, little evidence was found for the presence of autocorrelation effects in the present study. However, there was one significant effect, and six others with probability levels ranging from .054 to .091. No apparent pattern emerged that might help explain why self-influence may have occurred in some cases but not in others.

It might be that these data point to subtle, but real, effects that may have been apparent if more dyads had been studied or if longer samples of behavior from each dyad were analyzed. It might also be that the defined "moment" of interaction, 30 sec here, and one minute in Jasnow and Feldstein's study, is too long to detect autocorrelation effects.

Although autocorrelation effects were negligible here and in the Jasnow and Feldstein (1986) study, it should continue to be viewed as a variable of great interest in research on vocal exchange. Autocorrelation presumably provides a direct gauge of how consistent an individual's behavior is across situations, and this behavior is conceivably as important as the ability to be influenced by a co-communicator. Certainly with the advent of methods like time-series regression, autocorrelation effects can be more directly assessed (as opposed to prior indirect assessments of consistency based on lack of interpersonal influence), and may greatly enhance our understanding of interpersonal communication.

Interpersonal Accommodation

Accommodation to prior behavior was not displayed by mothers or infants in any group and for any parameter. The finding that the infants did not accommodate to their mothers' prior behavior was not surprising in that Jasnow and Feldstein (1986) also did not find such an effect. It may be that the ability to accommodate to prior behavior develops over time and infants as young as these and the nine-month-olds in the Jasnow and Feldstein study simply have not yet developed the necessary memory or coordination to adapt to prior events. It may also be that accommodation to prior moment behavior does occur in infants, but is not apparent with such long units of analysis as used here or in the Jasnow and Feldstein study.

That the mothers also did not display accommodation to their infants' prior behavior when other studies have found prior accommodation in adult-adult interaction (Crown, 1984) and adult-infant interaction (Jasnow & Feldstein, 1986) suggests that something about the present study may have masked findings of prior influence. Again, perhaps the unit of measure was not of ideal length or the samples of behavior for each dyad were not large enough. Future research should examine these possibilities to determine the boundaries within which the effects of prior accommodation are likely to be found, if at all.

Results examining accommodation in the current moment indicated that for both mothers and infants, compensatory accommodation occurred across the vocalization and pause parameters. In addition, some degree of reciproal accommodation occurred for switching pauses. In no case was there accommodation of turn durations.

The lack of accommodation for turns is in concordance with the prior research on adult-adult (see Welkowitz & Feldstein, 1978), child-child (Welkowitz et al., 1976), and mother-child (Beebe et al., 1985; Jasnow & Feldstein, 1986) interaction. Unlike prior research, however, accommodation to switching pauses was minimal. It is possible that the lack of accommodation to switching pauses found here is related to the relatively lower coding reliabilities obtained for this parameter rather than to actual lack of accommodation.

It is not surprising that the mothers in all three groups accommodated their pauses to the infants' pauses, because other investigators have found this effect in adult-adult conversation (e.g., Welkowitz & Feldstein, 1976). However, the two studies that used AVTA to examine mother-infant vocal patterns (Beebe et al., 1985; Jasnow & Feldstein, 1986) did not find maternal accommodation to pauses. Also inconsistent with prior research is the finding that the infants accommodated their pauses to maternal pauses. Although older children have been found to accommodate their pauses to their partners' pauses (Welkowitz et al., 1976), infants have not displayed such behavior (Beebe et al., Jasnow & Feldstein).

The mother and infant accommodation to vocalizations found in the present study is just as difficult to explain as the findings for pauses. This again is contrary to the mass of findings in adult-adult interaction (with the exception of Crown, 1984) and the findings in child-child (Welkowitz et al., 1976) and mother-child (Beebe et al., 1985; Jasnow & Feldstein, 1986) interaction.

Why is it that the present findings of infant accommodation of vocalizations and pauses and maternal accommodation of vocalizations are not supported by prior research? Feldstein and Welkowitz (1978) discuss results of several studies showing that the vocalization parameter tends to be relatively stable over time and across situations. It might be conjectured that most of the variance in vocalization behavior is the result of autocorrelation and a much smaller proportion is the result of interpersonal effects. Perhaps because interpersonal effects are proportionately smaller, interpersonal accommodation to vocalizations is more difficult to detect. It may be that Welkowitz et al. (1978) and Beebe et al. (1985) did not find vocalization accommodation because they analyzed their data using intraclass correlations. Intraclass correlations may have masked the presence of such accommodation because this technique is not capable of assessing moment to moment and bidirectional effects.

A similar line of reasoning may hold for the present finding of infant pause accommodation, which is also at odds with prior findings. In light of evidence that infants and young children do not seem to accommodate to pauses, it had been suggested that perhaps pauses are more intrapersonal and accommodation to them develops later, while switching pauses serve an important turn-taking function and therefore accommodation to them develops earlier (Welkowitz et al., 1978). Extending this hypothesis is the idea that, like vocalizations at all ages, pauses in infancy are primarily under intrapersonal influence and hence more sensitive methods are required to detect the relatively smaller proportion of interpersonal influence.

This hypothesis, however, does not explain why Jasnow and Feldstein (1986), who used time-series regression, also did not find vocalization accommodation. Perhaps their one-minute unit of analysis, twice as long as the unit used in the present study, was too long to detect the subtle interpersonal effect on vocalizations. It may also be that for some as yet unexplained reason, analyses based on proportions are better able to index accommodation to vocalizations than analyses based on average durations. Indeed, it is probably not coincidental that the present study and that of Crown (1984) are the only two which analyzed the AVTA parameters in the form of proportions and the only two that have found significant vocalization accommodation. The differences in accommodation found by analyses based on proportions versus average durations could not be analyzed in the present study because coding reliabilities were not comparable enough. However, such analyses might in the future help to explain the above results.

Although the details of the findings of this study compared to others are not entirely consistent, the fact that a good deal of accommodation occurred is consistent with the literature on accommodation in both adults and children. That the accommodation was primarily compensatory in nature is also consistent. Much of the research analyzing turn-taking on the molar level (not using AVTA) has found this pattern to be prevalent among children (e.g. Bloom et al., 1976; Garvey & Berninger, 1981; Kaye & Charney, 1981; and Schaffer et al., 1977) and infants (e.g. Anderson et al., 1977; Bateson, 1975; Beebe et al., in press; and Schaffer et al). Although some of the studies that analyzed child and infant turn-taking on a more molecular level (using AVTA) have found reciprocal rather than compensatory accommodation (Beebe et al., 1985 and Welkowitz et al., 1976), this may have been a function of their data analytic technique. Indeed, the one prior study that analyzed dyadic interaction on the molecular level and used a technique capable of assessing moment-to-moment influences (TSR) found primarily compensatory accommodation (Jasnow & Feldstein, 1986).

The present findings seem to support the notion of the importance of interpersonal vocal accommodation in normal individuals and extend it to some at-risk groups. The fact that the three diagnostic groups shared practically identical profiles of accommodation is evidence of the generality of this behavior. One might speculate that because accommodation is so pervasive a phenomenon, it must serve some purpose. Perhaps, as Jasnow and Feldstein (1986) suggest, interpersonal accommodation serves an important social function by regulating communication.

As with the findings of pervasive individual differences in vocal behavior, it is heartening to discover that at-risk infants have more capabilities than we are inclined to give them credit for. Lower levels of accommodation might be expected for infants with Down syndrome based upon their documented developmental delays and later social and linguistic difficulties (e.g., Cicchetti & Sroufe, 1976; Cullen et al., 1981). One might also expect some degree of difficulty in accommodation for the heart-diseased infants since the presence of their illness often leads parents to treat them differently, i.e., to be anxious, guilt-ridden, depressed, and overprotective in dealing with their children (see D'Antonio, 1976 and Taylor, 1984 for a review). In addition, heart-diseased infants may have difficulty accommodating as a result of poor coordination of behaviors such as sucking, swallowing, and breathing during feeding (e.g., Gillon, 1973; Gudermuth, 1975). Perhaps the ability to accommodate at this age despite stressors such as mental deficiency and illness is a built-in survival mechanism to help see the child off to a good start in life outside the womb.

The question then arises as to how the infant with Down syndrome is able to accommodate as well as normal peers, yet grows into adulthood having interactional (e.g., turn-taking) and linguistic difficulties. In other words, if accommodation is necessary for ensuring competent social interaction, and individuals with Down syndrome are able to accommodate as well as other people do, why do they have certain social and linguistic difficulties? Perhaps the etiology of such difficulties is not a built-in social deficit per se, but is instead the result of a generalized cognitive deficit. In this case, one would expect the infant with Down syndrome to accommodate at the basic perceptual level. However, as the child grows, the demands for accommodation become greater and require more cognitive input, leaving the child unable to accommodate as well as other individuals. Or perhaps, as discussed by Cicchetti and Sroufe (1976), the child with Down syndrome is best characterized as one who is primarily quantitatively rather than qualitatively different from peers. That is, the child begins on par with peers, but over time merely falls behind because he or she is not developing as fast as "normal" children. To test these hypotheses, a longitudinal study of infants with Down syndrome compared to a control group is called for. We might indeed find that over age the ability to accommodate compared to peers declines.

On the other hand, we might find that the ability to vocally accommodate is simply not a powerful index of social responsivity in at-risk infants. Perhaps this is why the three diagnostic groups did not show differences in accommodation in this study. Research on the interactions of children with Down syndrome and their mothers shows that a major problem was that the children interrupt and do not take turns (Jones, 1977, 1980). If, as Schaffer et al. (1977) point out, there is a socially important mechanism which makes production of vocalizations and listening to vocalizations inherently incompatible, it might be that children with Down syndrome lack this mechanism rather than the more general ability to accommodate. Comparisons of simultaneous speech across diagnostic groups in future studies should shed some light on this question.

Perhaps maternal influences might partially explain why the at-risk infants seemed to accommodate as well as the "normal" infants. These mothers may be able to make their infants seem more competent than they truly are because they have had several months of practice reading and interpreting the cues of their babies. It could be that their behavior was organized in such a way as to make infant accommodation more probable. It would be interesting to study the interactions of mothers of "normal" infants interacting with at-risk infants and vice-versa to see whether accommodation varies for the two groups.

Future research should also not ignore the impact of maternal influences such as speech content and emotional factors on their at-risk infants. Several studies examining the content of maternal speech to their children with Down syndrome depicted these mothers as contributing to the child's problems by using more commands (e.g., Kogan et al., 1969; Buium et al., 1974), more and shorter utterances (Buium et al.), and faster utterances (Buckhalt et al., 1978). Yet in one of the better-controlled studies (Rondal, 1977), no such differences between the mothers of normal children and children with Down syndrome were found. Similarly, in the present study, which ignored conte of speech, all mothers accommodated equally as well. Again, a lc inal study involving the close scrutiny of changes in maternal accommodation over time would be of interest. Perhaps we will find that linguistic competency or degree of maternal adjustment to the child's handicap rather than age are the major determinants of maternal social responsivity to the child.

Another basic question left unanswered pertains to the nature of the phenomenon we call accommodation. It is assumed that certain perceptual and/or memory skills are necessary for accommodation to occur, and yet the infants with Down syndrome in this study accommodated despite their apparent inability to perceive timing and develop temporal expectancy (e.g., Schafer & Peeke, 1982). Could it be that accommodation is such a basic skill that it does not require "processing" in order to be carried out? Could it instead be that we have underestimated the perceptual and memorial abilities of individuals with Down syndrome because our methods of studying these abilities have not been adequate? It might be interesting not only to continue investigating the conditions under which interpersonal accommodation occurs, but also to begin investigating the mechanism which ensures its occurrance.

References

Alberti, L., Feldstein, S., Gross, H. S. McDaniel, F. G., & Welkowitz, J. (1975). An exploratory study of the chronography of psychotherapeutic interactions. Paper read at the Society for Psychotherapy Research, Boston.

Allen, T., Walker, K., Symonds, L., & Marcell, M. (1977). Intrasensory and intersensory perception of temporal sequences during infancy. Developmental Psychology, 13(3), 225-229.

Als, H., Tronick, E., & Brazelton, T. B. (1980). Analysis of face-to-face interaction in infant-adult dyads. In M. E. Lamb, S. J. Suomi, & G. R. Stephenson (Eds.), Social interaction analysis. Madison, Wisconsin: University of Wisconsin Press.

Anderson, B. J., Vietze, P., & Dokecki, P. R. (1977). Reciprocity in vocal interactions of mothers and infants. Child Development, 48, 1676-1681.

Barnet, A. B., Ohlrich, E. S., & Shanks, B. L. (1971). EEG evoked responses to repetitive auditory stimulation in normal and Down's Syndrome infants. Developmental Medicine and Child Neurology, 13, 321-329.

Bateson, M. C. (1975). Mother-infant exchanges: The epigenesis of conversational interaction. Annals of the New York Academy of Sciences, 263, 101-113.

Beebe, B., Feldstein, S., Jaffe, J., Mays, K., & Alson, D. (1985). Interpersonal timing: The application of an adult dialogue model to mother-infant vocal and kinesic interactions. In T. Field & N. Fox (Eds.), Social perception in infants (pp 217-247). Norwood, N.J.: Ablex.

Beebe, B., & Gerstman, L. (1980). The "packaging" of maternal stimulation in relation to infant facial-visual engagement. Merrill-Palmer Quarterly, 26(4), 321-339.

Beebe, B., Stern, D., & Jaffe, J. (1979). The kinesic rhythm of mother-infant interactions. In A. W. Siegman & S. Feldstein (Eds.), Of speech and time: Temporal patterns in interpersonal contexts (pp 23-34). Hillsdale, N. J.: Erlbaum Associates.

Beebe, B., Zelner, S., Feldstein, S., & Jaffe, J. (in press). Dyadic patterns of vocalization and gaze: Stability within and among dyads in mother-infant play. Child Development.

Bloom, L., Rocissano, L., & Hood, L. (1976). Adult-child discourse: Developmental interaction between information processing and linguistic knowledge. Cognitive psychology, 8, 521-552.

Brackbill, Y. (1971). Cumulative effects of continuous stimulation on arousal level in infants. Child Development, 42, 17-26.

Brazelton, T. B., Koslowski, B., & Main, M. (1974). The origins of reciprocity: The early mother-infant interaction. In M. Lewis & L. A. Rosenblum (Eds.), The effect of the infant on its caregiver (pp 49-76). New York: Wiley & Sons.

Buckhalt, J. A., Rutherford, R. B., & Goldberg, K. E. (1978). Verbal and nonverbal interaction of mothers with their Down's syndrome and nonretarded infants. American Journal of Mental Deficiency, 82, 337-343.

Buium, N., Rynders, J., & Turnure, J. (1974). Early maternal linguistic environment of normal and Down's syndrome language-learning children. American Journal of Mental Deficiency, 79(1), 52-58.

Cappella, J. N. (1981). Mutual influence in expressive behavior: Adult-adult and infant-adult dyadic interaction. Psychological Bulletin, 89(1), 101-132.

Cappella, J. N., & Greene, J. O. (1981). A discrepancy-arousal explanation of mutual influence in expressive behavior for adult and infant-adult interaction. Paper presented at the International Communication Association Meeting, Minneapolis.

Cappella, J. N., & Planalp, S. (1981). Talk and silence sequences in informal conversations. III: Interspeaker influence. Human Communication Research, 7, 117-132.

Cassotta, L., Feldstein, S., & Jaffe, J. (1964). AVTA: A device for automatic vocal transaction analysis. Journal of Experimental Analysis of Behavior, 7, 99-104.

Cicchetti, D., & Sroufe, L. A. (1976). The relationship between affective and cognitive development in Down's syndrome infants. Child Development, 47, 920-929.

Cohen, J., & Cohen, P. (1975). Applied multiple regression/correlation analysis for the behavioral sciences. Hillsdale, N.J.: Erlbaum Associates.

Crown, C. (1984). Interpersonal accommodation of voice and vision as a function of interpersonal attraction. Unpublished Doctoral Dissertation, University of Delaware.

Crown, C., & Feldstein, S. (1985). Psychological correlates of silence and sound in conversational interaction. In D. Tanner & M. Saville-Troike (Eds.), Perspectives on silence (pp. 31-54). New Jersey: Ablex.

Cullen, S. M., Cronk, C. E., Pueschel, S. M. Schnell, R. R. & Reed, R. B. (1981). Social development and feeding milestones of young Down's syndrome children. American Journal of Mental Deficiency, 85(4), 410-415.

D'Antonio, I. U. (1976). Mothers' responses to the functioning and behavior of cardiac children in child-rearing situations. Maternal-Child Nursing Journal, 5(4), 207-264 (Monograph).

DeCasper, A., & Fifer, W. (1980). Of human bonding: Newborns prefer their mothers' voices. Science, 208, 1174-1176.

DeMany, L., McKenzie, B., & Vurpillot, E. (1977). Rhythm perception in early infancy. Nature, 266, 718-719.

de Villiers, J. G., & de Villiers, P. A. (1978). Language acquisition. Cambridge, MA: Harvard University Press.

Feldstein, S., BenDebba, M., & Alberti, L. (1974). Distributional characteristics of simultaneous speech in conversation. Journal of the Acoustical Society of America, 55 (Supplement), 542. (Abstract)

Feldstein, S., Konstantareas, M., Oxman, J., & Webster, C. (1982). The chronography of interactions with autistic speakers: An initial report. Journal of Communication Disorders, 15, 451-460.

Feldstein, S., & Welkowitz, J. (1978). A chronography of conversation: In defense of an objective approach. In A. W. Siegman & S. Feldstein (Eds.), Nonverbal behavior and communication (pp. 329-378). Hillsdale, N.J.: Erlbaum Associates.

Fogel, A. (1977). Temporal organization in mother-infant face-to-face interaction. In H. R. Schaffer (Ed.), Studies of mother-infant interaction (pp 119-151). London: Academic Press.

Garvey, C., & BenDebba, M. (1974). Effects of age, sex, and partner on children's dyadic speech. Child Development, 45, 1159-1161.

Garvey, C., & Berninger, G. (1981). Timing and turn-taking in children's conversations. Discourse processes, 4(1), 27-57.

Garvey, C., & Hogan, R. (1973). Social speech and social interaction: Egocentrism revisited. Child Development, 44, 562-568.

Gibson, E. J., & Spelke, E. S. (1983). The development of perception. In J. H. Flavell & E. M. Markman (Eds.), Handbook of child psychology (4th edition) (pp 1-76). New York: Wiley & Sons.

Gillon, J. G. (1973). Behavior of newborns with cardiac distress. American Journal of Nursing, 73, 254-257.

Gliddon, J. B., Busk, J., & Galbraith, G. C. (1975). Visual evoked responses as a function of light intensity in Down's syndrome and nonretarded subjects. Psychophysiology, 12, 416-422.

Gottman, J. M. (1981). Time series analysis: A comprehensive introduction for social scientists. Cambridge: Cambridge University Press.

Gudermuth, S. (1975). Mothers' reports of early experiences of infants with congenital heart disease. Maternal-Child Nursing Journal, 4, 155-164.

Jaffe, J., & Feldstein, S. (1970). Rhythms of Dialogue. New York: Academic Press.

James, W. (1890). The Principles of Psychology. Dover Publications, Inc.

Jasnow, M., & Feldstein, S. (1986). Adult-like temporal characteristics of mother-infant vocal interactions. Child Development, 57, 754-761.

Jones, O. (1977). Mother-child communication with pre-linguistic Down's syndrome and normal infants. In R. R. Schafer (Ed.), Studies in mother-infant interaction (379-401). London: Academic Press.

Jones, O. (1980). Prelinguistic communication skills in Down's syndrome and normal infants. In T. Field, S. Goldberg, D. Stern, & A. Sostek (Eds.), High risk infants and children: Adult and peer interactions (pp 205-225). New York: Academic Press.

Kaye, K., & Charney, R. (1981). Conversational asymmetry between mothers and children. Journal of Child Language, 8, 35-49.

Kogan, K. L., Wimberger, H. C., & Bobbitt, R. A. (1969). Analysis of mother- child interaction in young mental retardates. Child Development, 40, 799-812.

Korner, A. F., & Thoman, E. B. (1972). The relative efficacy of contact and vestibular-proprioceptive stimulation in soothing neonates. Child Development, 43, 443-453.

Lamb, M. E., & Sherrod, L. R. (1981). Infant social cognition. Hillsdale, N.J.: Erlbaum Associates.

Lawson, K. (1980). Spatial and temporal congruity and auditory-visual integration in infants. Developmental Psychology, 16(3), 185-192.

Lewis, M., & Rosenblum, L. A. (1974). The effect of the infant on its caregiver. New York: Wiley & Sons.

Lichy, J., Vesely, C., Adler, J., & Zizka, J. (1975). Auditory evoked cortical responses in Down's syndrome. Electroencephalography and Clinical Neurophysiology, 38, 440.

Marcus, E. S., Welkowitz, J., Feldstein, S., & Jaffe, J. (1970). Psychological differentiation and the congruence of temporal speech patterns. Paper presented at the Eastern Psychological Association meetings, Atlantic City.

Masur, E. F. (1978). Preschool boys' speech modifications: The effect of listeners' linguistic levels and conversational responsiveness. Child Development, 49, 924-927..

Matarazzo, J. D., & Wiens, A. N. (1967). Interviewer influence on durations of interviewee silence. Journal of Experimental Research in Personality, 2, 56-69.

Millar, W. S., & Watson, J. S. (1979). The effect of delayed feedback on infant learning reexamined. Child Development, 50, 747-751.

Natale, M. (1978). Perceived empathy, warmth and genuineness as effected by interviewer timing of speech in a telephone interview. Psychotherapy: Theory, research and practice, 12, 145-152.

Ostrum, C. W. (1978). Time series analysis: Regression techniques. Beverly Hills: Sage Publications.

Petersen, G. A., & Sherrod, K. B. (1982). Relationship of maternal language to language development and language delay of children. American Journal of Mental Deficiency, 86(4), 391-398.

Pueschel, S. M. (1978). Characteristics of the child with Down's syndrome. In S. M. Pueschel (Ed.) Down's syndrome: Growing and Learning (pp 56-63). Mission, Kansas: Sheed Andrews & McMeel.

Rondal, J. A. (1977). Maternal speech to normal and Down's syndrome children matched for mean length of utterance. In C. E. Meyers (Ed.), Behavior in the profoundly and severely retarded: Research foundations for enhancing the quality of life. American Association on Mental Deficiency Monograph Number 3, Washington, D. C.

Rutter, D. R. (In press). Turn taking in schizophrenic patients. In S. Feldstein, C. Crown, & J. Welkowitz (Eds.), Speech sounds and silences: A social-psychological approach to clinical concerns. Hillsdale, N.J.: Erlbaum Associates.

Schafer, E. W. P., & Marcus, M. (1973). Self-stimulation alters human sensory brain responses. Science, 181, 175-177.

Schafer, E. W. P., & Peeke, H. V. S. (1982). Down syndrome individuals fail to habituate cortical evoked potentials. American Journal of Mental Deficiency, 87(3), 332-337.

Schaffer, H. R. (1977). Studies in mother-infant interaction. London: Academic Press.

Schaffer, H. R., Collis, G. M., & Parsons, G. (1977). Vocal interchange and visual regard in verbal and pre-verbal children. In H. R. Schaffer (Ed.), Studies in mother-infant interaction (pp 291-324). London: Academic Press.

Shatz, M., & Gelman, R. (1973). The development of communication skills: Modifications in the speech of young children as a function of listener. Monographs of the Society for Research in Child Development, 38 (5, Serial #152).

Spelke, E. (1976). Infants' intermodal perception of events. Cognitive Psychology, 8, 553-560.

Spelke, E., & Cortelyou, A. (1981). Perceptual aspects of social knowing: Looking and listening in infancy. In M. E. Lamb & L. R. Sherrod (Eds.), Infant social cognition (pp 61-84). Hillsdale, N.J.: Erlbaum Associates.

Stern, D. (1974). The structure of mother-infant play. Journal of the American Academy of Child Psychiatry, 13, 402-421.

Stern, D., Jaffe, J., Beebe, B., & Bennett, S. L. (1975). Vocalizing in unison and in alternation: Two modes of communication within the mother-infant dyad. Annals of the New York Academy of Sciences, 263, 89-100.

Straumanis, J. J., Shagass, C., & Overton, D. A. (1973). Somatosensory evoked responses in Down's syndrome. Archives of General Psychiatry, 29, 544-549.

Taylor, L. (1984). A study comparing the mutual gaze behavior of mothers and their handicapped infants and mothers and their non-handicapped infants: A preliminary report. Unpublished doctoral dissertation, University of Maryland, College Park.

Welkowitz, J., Cariffe, G., & Feldstein, S. (1976). Conversational congruence as a criterion of socialization in children. Child Development, 47, 269-272.

Welkowitz, J., & Feldstein, S. (1969). Dyadic interaction and induced differences in perceived similarity. Proceedings of the 77th Annual Convention of the American Psychological Association, 4, 343-344.

Welkowitz, J., & Feldstein, S. (1970). Relation of experimentally manipulated interpersonal perception and psychological differentiation to the temporal patterning of conversation. Proceedings of the 78th Annual Convention of the American Psychological Association, 5, 387-388.

Welkowitz, J., & Kuc, M. (1973). Interrelationships among warmth, genuineness, empathy, and temporal speech patterns in interpersonal interaction. Journal of Counseling and Clinical Psychology, 41, 472-473.