What Mothers Do to Support Infant Visual Attention: Sensitivities to Age and Hearing Status

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This article presents a descriptive, longitudinal study of maternal use of communicative strategies to accommodate and direct infant visual attention. The two questions that guided our research were whether maternal use of particular attention-related strategies changed as the child developed from 9 to 18 months of age and whether the mother's ability to make appropriate modifications in strategy use was disrupted when she was using a new mode of communication. Four groups of mother-infant dyads were included: deaf mothers with deaf children (Dd), hearing mothers with deaf children (Hd), deaf mothers with hearing children (Dh), and hearing mothers with hearing children (Hh) (n = 77). When the infants were 9, 12, and 18 months old, they were videotaped while they engaged in free play with their mothers. Using a time-sampling technique, videotapes were coded to determine the frequency with which mothers used specific attention-related strategies. Our findings showed group differences in the attention-related strategies used by deaf and hearing mothers. These group differences were consistent with the hypothesis that while mothers appeared to be sensitive to and tried to accommodate their children's communication needs, the mothers may have been limited by their own communicative experiences. With regard to changes in mothers' use of attention-related strategies over time, our hypothesis of a developmental transition in the chosen strategies was only partially supported. Attention strategies related to language did evidence a pattern of developmental progression; however, maternal use of strategies that directed the children's visual focus to an object or a social partner did not show any such trend. Overall, the patterns indicated in the data from this study suggest that bidirectional influences were operating to some degree in each of the four groups. Among mothers whose hearing status differs from their children, the use of certain attention-related strategies might need to be taught, particularly the use of specific strategies that may scaffold deaf infants' developing abilities to alternate attention between objects and persons.

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This article presents a descriptive, longitudinal study of maternal use of communicative strategies to accommodate and direct infant visual attention. Effects of both mother and infant hearing status were investigated during the developmental period from nine to 18 months of age. During this period infants typically acquire the ability to coordinate their visual attention between animate and inanimate aspects of the environment (Bakeman & Adamson, 1984).

Mother-infant interactions during the early months of life tend to be "face-to-face." That is, dyads engage in sustained periods of mutual gaze. Over the course of the first year of life, however, other dyadic attention patterns become more dominant. For example, infants' interest in objects typically increases significantly by six months of age, resulting in infants

spending greater periods of time looking at and visually exploring objects (Leung & Rheingold, 1981; Adamson, 1995). In addition, sustained periods of face-to-face interaction decrease as infants become mobile and capable of moving away from their mothers and exploring the environment on their own (Swisher, 1992). Acquisition of the ability to coordinate or systematically divide attention between objects and social partners (usually by looking from one to the other repeatedly) is, therefore, an important developmental milestone for infants. This attention pattern allows mother-infant dyads to establish a joint focus on an object or event while also allowing the infant to receive communicative information produced by the mother.

Episodes of joint attention accompanied by mother's language about the attention focus have been shown to be particularly supportive of hearing children's language acquisition (Tomasello, 1988). Of course, hearing children can process their mothers' vocal communications even when not looking directly at their mothers. However, additional affective information becomes available when the child looks at the speaker. In addition, the child's gaze indicates to the speaker an interest in receiving communication.

It is reasonable to assume that the ability to switch or coordinate gaze between objects and persons is even more important for language acquisition by deaf children, who must use vision for the dual purposes of receptive communication and exploration of the inanimate environment. Existing reports imply that deaf children's development of visual attention skills is related to the hearing status of their parents. For example, Wood (1982) as well as Woll and Kyle (1989) reported delays in visual attention abilities of young deaf children with hearing parents. In contrast, there are several reports that young deaf children with deaf parents develop visual attention skills at a typical rate—like that shown by hearing children whose parents are hearing (Gregory & Barlow, 1986; Harris, 1992; Swisher, 1989).

These differences in deaf children's visual attention skills are paralleled by reports that deaf and hearing mothers employ attention accommodation and directing strategies differently (Jamieson, 1994; Spencer, Bodner-Johnson, & Gutfreund, 1992). For example, the following set of communicative strategies has been observed in deaf mothers with deaf infants and toddlers: (1) modifying sign placement to sign within an infant's pre-existing visual focus instead in the typical adult signing space (Maestas y Moores, 1980); (2) signing directly on an infant's body to give tactile as well as visual input (Maestas y Moores); (3) waiting for the infant to look back spontaneously at the communication partner before signing (Spencer et al., 1992). In addition to these accommodative strategies, Woll and Kyle (1989) report that deaf mothers of deaf infants (12 to 21 months old) use a set of attention-related strategies that appear to "train" the infants to switch their gaze from objects back to their mothers (cf. Swisher, 1992). These strategies include tapping on an infant's arm or body and waving a hand within an infant's field of vision. (These two signals are also used in communications with older deaf children and with adults; however, the character or strength of the signal may differ with younger compared to older communication partners). In contrast with deaf mothers, hearing mothers of deaf children seem to have difficulties adjusting to the visual communication needs of deaf children. This group of mothers is apparently not as likely to employ the visual attention strategies described above that are used frequently by deaf mothers (Gutfreund, 1990). However, hearing mothers do modify vocal language directed toward hearing infants, employing a well-documented specialized set of modifications including raised pitch and increased rhymicity (Adamson, 1995). These modifications tend to attract hearing infants' attention to the vocal communication. Perhaps mothers are able to modify communication for infants only in a language mode with which they are experienced and fluent. This study explored whether this ability to modify for infants would be disrupted if a language mode new to the mother is being used.

Papousek and Papousek (1987) suggested that modifications in hearing mothers' spoken language when addressing infants occur at an "intuitive" or subconscious level. Koester (1992) proposed that these intuitive modifications derive from mothers' own habitual communicative experiences and are not limited to the vocal mode. Thus, deaf mothers' specific modifications in visual (and tactile) communications directed toward deaf infants and hearing mothers' modifications in speech directed toward hearing infants may occur

spontaneously and without conscious preplanning by the mothers. However, when mothers have infants whose perceptual processing abilities differ from their own, mothers' communication experiences will differ from those available to the infants. Thus, mothers may be less likely to make modifications spontaneously to suit the communication modes available to infants with "different" hearing status.

It is clear, however, that more than just mothers' own communicative experiences influence the communicative and attentional strategies they employ with their infants. For example, apparently both hearing mothers of hearing children and deaf mothers of deaf children continually change communicative strategies as the infants mature. Hearing mothers begin to produce shorter, well-formed spoken utterances when hearing infants begin to give evidence of the emergence of language skills. A similar process may explain the report by Harris, Clibbens, Chasin, and Tibbits (1989) that deaf mothers decrease their use of attention-related accommodations and directing strategies during deaf infants' second year of life, when they have acquired more advanced attention skills. Thus, at least when mother and infant hearing status match, mothers' attention-related communicative strategies appear to be affected by the infants' emerging communicative skills and behaviors. This would be consistent with Vygotsky's model of well-functioning dyads that move from more mother- to more child-regulated interactions as the child matures (Vygotsky, 1978).

Even when infant and mother hearing status does not match, there is evidence that mothers attempt to modify communications to respond to real or perceived needs of the infants. For example, Prendergast (1992) reported that half of the eight hearing mothers she studied appeared to meet the visual communication needs of their deaf toddlers. These hearing mothers signed as frequently as a comparison group of deaf mothers. In addition, the two groups of mothers modified a similar percentage of their signed utterances by repeating them, exaggerating the movement, or using an unconventional sign placement to accommodate deaf toddlers' attention (Prendergast, 1992). Similarly, Rea, Bonvillian, and Richards (1988) reported that deaf mothers attempted to accommodate the auditory abilities of their hearing children by vocalizing to them significantly more often than is typical with deaf children. This latter example is particularly interesting because it is not necessary for deaf mothers to vocalize to their hearing children for communication to take place. Hearing children share their deaf mothers' visual-manual channels for communication and usually develop their first language in sign.

The study reported here investigated the impact of variations in mother and child hearing status on mothers' strategies related to infant visual attention. Unlike earlier studies, here four different mother-infant groups were involved: deaf mothers and deaf infants (Dd), deaf mothers and hearing infants (Dh), hearing mothers and hearing infants (Hh), and hearing mothers and deaf infants (Hd). A primary goal of the study was to measure the extent to which maternal communicative experiences influence their use of attention-related communicative strategies. A second goal was to investigate with a larger and more diverse group of subjects the trend noted by Harris et al. from more to less frequent use of maternal attention accommodation and direction as infants mature.

Method

Subjects

The study included a total of 77 mother-infant dyads: 19 Dd, 19 Hd, 18 Dh, and 21 Hh. Deaf mothers (groups Dd and Dh) were recruited from several major North American metropolitan areas through print notices, contacts with early intervention programs, and personal contacts. Hearing mothers with hearing infants were recruited in similar ways from one of the areas. Hearing mothers with deaf infants were recruited in five major American metropolitan areas in order to identify enough infants with hearing loss diagnosed before nine months of age.

The groups of subjects were primarily Caucasian and of middle- to upper-socioeconomic status (SES). One mother in group Hh and one in group Dh was Asian-American, one mother in group Hd was of mixed ethnic heritage; all other mothers were Caucasian-American. All mothers were in their late twenties or early thirties and had graduated from high school. Most had some postsecondary education.

Mothers did not differ significantly on variables of education or age.

Interviews with mothers and administration of the Physical (motor skills) and Self-Help (adaptive/daily-living skills) subscales of the *Developmental Profile II* (Alpern, Boll, & Shearer, 1980) indicated that all infants were functioning within normal limits for age. Additional questions in the structured interview protocol indicated that most of the Hd children had delayed language acquisition (see also Spencer, 1993).

Infants in groups Dd and Hd had bilateral sensorineural hearing losses that had been identified before the age of nine months. A range of hearing levels was represented in each group. Group Dd included 12 infants with severe-profound or profound hearing levels, five with moderately-severe or severe hearing levels, one at the moderate level, and one initially at the mild level but progressing to moderate by 18 months. Group Hd included 12 infants with severe-profound or profound hearing levels, four at the moderately-severe to severe level, two at the moderate level, and one at the mild level.

All Hd children were enrolled in parent-infant education programs by the age of 12 months (all but one had been enrolled by nine months). Approximately half of the Hd infants were in programs that used signs in conjunction with speech while the other half were in oral programs that did not use signs. All Dd children were enrolled in parent-infant education programs by 12 months (with all but three were in programs by nine months of age). These children's programs used either American Sign Language (ASL) or a signing system along plus spoken language.

Data Collection

Longitudinal data were obtained from sessions of mother-infant play with toys videotaped in a laboratory setting when infants were within two weeks of 9, 12, and 18 months of age. Play sessions were one component of a series of data collection contexts. After a five-minute warm-up period, mother-infant play was videotaped for 15 minutes at 9 and 12 months and for 20 minutes at 18 months. A 10-minute portion of each session was coded for the current study. At 9 and 12 months, coding began after approximately five minutes, when dyadic behaviors indicated comfort in the situation and play had been established. At 18 months, coding began approximately one minute into the play session.

A set of toys was provided, including dolls and stuffed animals, tools and a toolbox, dishes and utensils, toy vehicles with riders, pop beads, grooming items, telephone, and a small wagon with wooden blocks. Each infant was allowed to play independently with the toys for a few minutes (with mother in the room) before mother joined in the play. Mothers were told that the investigators were interested in observing both communication and play behaviors in this situation and were asked to play with their babies as they would at home during free time.

Sessions were videotaped by two cameras behind one-way windows. Split-screen technology was used to merge the views from the two cameras and allow more accurate assessment of gestural communications and direction of gaze. Time was superimposed on the tape, marking minutes, seconds, and frames (1/30 second each).

Data Coding

Maternal communicative behaviors related to infant visual attention were coded for 10 minutes of the play session in 40 continuous 15-second time samples. Coders indicated each target behavior that occurred at least once in each of the 15-second segments. The categories of attention-related behaviors were not mutually exclusive; therefore, any given time segment could be coded for multiple target behaviors.

Codes suggested by the reports from Erting, Prezioso, and Hynes (1994), Harris et al. (1989), and Maestas y Moores (1980) were modified and expanded by the first author. Maternal attention-related behaviors that were coded included (1) production of signs and gestures in the normal adult signing space, (2) attention-accommodation as shown by modification in sign or gesture location to sign on the infant's body or in the infant's pre-existing line of vision, and (3) production of specific visual or tactile signals designed to redirect infants' attention. Signals for redirecting attention included the following: (a) presenting an object (moving, shaking, manipulating an object to obtain at-

tention to it); (b) tapping on or pointing to an object to direct infant's attention to it; (c) tapping on the infant's body; (d) waving hand in infant's line of vision; and (e) tapping on the floor. Tapping on the floor typically occurred when the mother was sitting and could easily strike the floor with the palm of her hand. Although we initially planned to differentiate between use of an object to bring attention to mother as opposed to promoting attention solely to the object itself, the coders were unable to achieve acceptable reliability on that distinction. Therefore, any use of an object to attract or redirect attention was included in the first category. Tapping on the child's body, as well as waving in the visual field or tapping on the floor, were attempts to redirect the child's attention from an object or event and up to the mother. Because waving and tapping the floor were found to occur relatively infrequently, they were combined for analyses.

Three additional measures were computed from the codes described above. The first was the frequency of segments in which any signing/gesturing occurred. Because the codes were not mutually exclusive, it was not possible to merely add up the frequency of segments in which mothers signed in the normal adult space and the frequency of segments in which modified language was observed. The original coding sheets were reviewed and the number of segments that contained any signing/gesturing (in either normal space or modified space) was calculated. Segments that contained both modified signing/gesturing and signing in the normal location were counted only once. The second measure was the frequency of segments containing signing/gesturing without overt use of an attention accommodating or directing strategy. The third measure was the occurrence of signals for redirecting attention without subsequent signing or gesturing.

Twenty percent (16) of the tapes were coded independently by three coders and compared with coding prepared by the first author. The tapes chosen for estimating reliability represented as evenly as possible the four hearing status groups and the three ages. Cohen's kappas (which take into account the likelihood of chance agreement) computed for the coder-trainer comparisons ranged from .91–.92 for signing/gesturing in normal adult location, from .85–.87 for signing/gesturing in modified location, from .94–.96 for presenting objects, from .91–.94 for tapping/pointing to objects, from .91–.94 for tapping child, from .83–.86 for waving, and from .82–.84 for tapping on the floor. Simple percentage of agreement was above 90% for all codes.

Results

Analyses

Multivariate analysis of variance (ANOVA, for repeated measures) was used to compare mothers' production of the set of attention redirecting signals among groups over the three infant ages observed. Multivariate F was estimated using Pillais criterion; univariate ANOVA and Duncan's multiple comparison tests were used to follow up significant multivariate group effects. Age effects were further investigated using paired t-tests.

An additional series of ANOVAs (with dyadic hearing status as between-group and infant age as within-group factor) compared groups of mothers on (a) frequency of segments in which signs and gestures occurred, (b) percentage of signs and gestures produced in modified locations, and (c) signing without overt accommodation or attention-directing. Duncan's tests and paired t-tests were again used to follow up significant ANOVA effects.

Table 1 provides means and standard deviations (SDs) for the time-sampled rate of production of the subcategories of visual and tactile attention-redirecting signals produced by the mothers at the three infant ages. MANOVA showed a significant group by age by type of attention-redirecting signal interaction ($F[18,210] = 2.11, p < .01$).

Repeated measures ANOVA showed a significant between-group effect for hearing status ($F[3,73] = 3.27, p = .026$) and within-group effect for age of child ($F[2,72] = 12.01, p < .001$) on the frequency of time segments that contained presenting/moving objects. Group by age interaction was not significant. Therefore, follow-up comparisons compared the groups on frequency of presenting/moving objects averaged over the three ages. Groups Hd and DH significantly exceeded group Hh. Age effects were then investigated by summing across groups and using paired t-tests to compare frequency of presenting/moving objects at 9

Table 1 Maternal attention-redirecting strategies for hearing status groups at three ages (means and standard deviations)

	Deaf mothers/deaf infants (n = 19)			Hearing mothers/deaf infants (n = 19)			Deaf mothers/hearing infants (n = 18)			Hearing mothers/hearing infants (n = 21)		
Strategy	9 Mo.	12 Mo.	18 Mo.	9 Mo.	12 Mo.	18 Mo.	9 Mo.	12 Mo.	18 Mo.	9 Mo.	12 Mo.	18 Mo.
Present	25.5	23.6	20.7	30.8	23.8	24.6	27.0	26.1	22.2	21.4	21.8	19.1
object	(6.8)	(7.6)	(6.6)	(7.5)	(10.1)	(8.0)	(6.1)	(8.0)	(8.1)	(7.1)	(7.2)	(7.7)
Tap	2.4	5.8	5.7	2.4	3.8	1.9	4.3	4.0	4.7	2.1	3.8	3.7
object	(2.5)	(4.0)	(5.0)	(3.1)	(3.7)	(1.7)	(3.3)	(3.0)	(3.1)	(2.3)	(4.7)	(3.9)
Tap child	8.4	10.7	8.7	1.2	1.6	1.1	4.2	4.8	7.9	.4	.3	.0
	(6.1)	(5.8)	(5.5)	(1.8)	(3.3)	(1.6)	(4.0)	(5.1)	(6.5)	(.9)	(.7)	(.0)
Wave/	1.9	1.9	3.4	.5	.3	.4	.3	1.2	2.1	.0	.0	.1
tap floor	(3.1)	(2.4)	(3.7)	(1.4)	(.7)	(1.0)	(.6)	(1.8)	(2.1)	(.0)	(.0)	(.5)

Frequencies are number of time segments containing each strategy from total of 40 segments.

Table 2 Maternal signs and/or conventional gestures for hearing status groups at three ages (means and standard deviations)

	Frequency of 15-second time segments containing signs/gestures		
Group	9 Mo.	12 Mo.	18 Mo.
Deaf mothers/deaf infants (n = 19)	20.5	27.0	29.4
	(8.0)	(6.7)	(4.6)
Hearing mothers/deaf infants (n = 19)	8.6	9.5	12.4
	(7.8)	(7.8)	(10.5)
Deaf mothers/hearing infants (n = 18)	15.6	21.6	24.1
	(7.2)	(9.0)	(8.4)
Hearing mothers/hearing infants (n = 21)	1.5	2.9	2.1
	(2.5)	(3.7)	(3.3)

Frequencies are number of time segments containing one or more signs or gestures from total of 40 time segments.

and 12 months and at 12 and 18 months. Mothers' use of this strategy was found to decline significantly from 9 to 12 months (t = 2.54, p = .013) and there was an additional decline between 12 and 18 months (t = 2.21, p = .030).

Group differences approached significance for tapping on (or pointing at) objects (F [3,73] = 2.64, p = .056) and the group by age interaction effect similarly approached but did not reach significance. However, age was a significant factor (F [2,72] = 5.21, p = .008). Follow-up paired t-tests identified a significant increase between 9 and 12 months (t = −3.07, p = .003) but no significant change between 12 and 18 months.

Wave in visual field/tap on floor occurred rarely for all groups. (It should be noted that the waving signal provided the bulk of occurrences in this subcategory.) A significant group difference was identified (F [3,73] = 17.44, p < .001) as well as a significant age difference (F [2,72] = 3.81, p = .027). The group by age interaction was not significant. Follow-up tests showed that group Dd exceeded all other groups, and group Dh exceeded the two groups with hearing mothers. Follow-up paired t-tests indicated a significant increase between 12 and 18 months (t = −2.57, p = .012).

A significant group by age interaction was found for the frequency of time segments in which mothers tapped directly on the child's limbs or body (F [6,146] = 2.56, p = .022). At 9 and 12 months, group Dd exceeded all other groups and group Dh exceeded the two groups with hearing mothers. At 18 months, the two groups of deaf mothers no longer differed from each other, and both groups of deaf mothers exceeded both groups of hearing mothers.

Table 2 gives the frequency of time segments out of a possible 40 in which mothers produced at least one

Table 3 Maternal attention-redirecting strategies related to language for hearing status groups at three ages (means and standard deviations)

	Deaf mothers/deaf infants (n = 19)			Hearing mothers/deaf infants (n = 19)			Deaf mothers/hearing infants (n = 18)		
Strategy	9 Mo.	12 Mo.	18 Mo.	9 Mo.	12 Mo.	18 Mo.	9 Mo.	12 Mo.	18 Mo.
% of modified signs	.55	.49	.27	.53	.53	.31	.45	.38	.22
	(.27)	(.26)	(.24)	(.35)	(.32)	(.30)	(.29)	(.32)	(.21)
Strategies not followed	12.9	8.7	5.6	24.7	19.3	17.4	17.4	13.2	10.5
by sign/gesture[a]	(5.7)	(4.4)	(3.4)	(7.1)	(8.9)	(7.7)	(6.9)	(7.0)	(6.8)
% of signs not	.12	.17	.24	.22	.21	.35	.15	.18	.26
preceded by strategy	(.11)	(.15)	(.14)	(.32)	(.23)	(.22)	(.16)	(.14)	(.15)

[a]Frequency of time segments out of a total of 40 possible time segments in which this occurred.

sign or gesture. Not surprisingly, the groups of mothers differed in the rate of sign/gesture production (F [3,73] = 71.60, $p < .001$). Mothers in dyads with at least one deaf member produced more signed or gestured communication at each of the three ages than did hearing mothers of hearing infants. In addition, the two groups in which mothers were deaf produced more signs and gestures than the group of hearing mothers with deaf infants. A significant effect was also found for age (F[2,72] = 19.67, $p < .001$) along with a significant group by age interaction (F [6,146] = 2.89, $p = .011$). The two groups with deaf mothers increased production of signs and gestures primarily between the 9 and 12 months sessions (Dd: t = -3.46, $p = .003$; Dh: $t = -3.07$, $p = .007$). No such increase was seen for either group of hearing mothers.

Mothers' performance on the additional measures related to signing/gesturing was compared across the three groups with at least one deaf member. Group Hh was omitted because of the low rate of gesture production. Table 3 presents means and SDs for maternal use of attention-redirecting strategies related to their use of signs/gestures.

A preliminary analysis showed that signs and gestures produced in a modified location occurred in significantly more time segments for groups Dd and Dh than for group Hd. However, that was found to be a reflection of the increased total sign/gesture production by the deaf mothers. Because of this difference in raw frequency, a subsequent analysis compared the proportion of signs/gestures with modified location across the three groups. All analyses using proportions were submitted to the arc sine transformation in order to eliminate nonnormative distribution of variance. There was no significant group difference on this measure. The mothers did not differ in their general tendency to accommodate infant attention by modifying sign/gesture location after differences in initial frequency were controlled. The three groups were also similar in that they decreased the proportion of location-modified signs/gestures over time (F[2,44] = 14.60, $p < .001$).

An additional analysis addressed how likely mothers were to produce signs/gestures without the use of any special modifications (i.e., accommodations of attention focus or attention-redirecting signals). After conducting arc sine transformations, proportions were again compared. There was much within-group variability on the proportion of time segments containing signs or gestures unaccompanied by an attention-related modification. Group differences were not significant. However, there was a significant effect for infant age (F [2,46] = 11.40, $p < .001$). Production of "spontaneous" signs/gestures represented an increasing proportion of those produced by mothers in all three groups as their infants matured and were presumably more likely to look up without mothers' active intervention. This tended to occur primarily between 12 and 18 months of age ($t = -2.89$, $p = .006$).

Finally, ANOVA was used to compare the rate at which mothers used strategies to redirect infant attention but did not accompany those strategies with any signing or gesturing. Both group (F [2,53] = 21.46, $p < .001$) and age (F [2,52] = 34.09, $p < .001$) effects were significant. Despite similar decreases in this measure with age, Hd mothers were more likely than either

group of deaf mothers to use an attention-redirecting strategy in the absence of visually-based language or gestures.

Discussion

The goal of this study was to describe the visual and tactile attention-related strategies used by deaf and hearing mothers with their infants over a nine-month period. The purpose of doing so was twofold: to describe group differences in the use of attention-related strategies and to elucidate developmental changes in mothers' selection of strategies as their infants developed from 9 to 18 months of age. Researchers who have investigated maternal use of attention-related strategies over time have included a small number of cases; however, their findings suggest that there is a developmental progression in the strategies deaf mothers use (Harris et al., 1989). It was of special interest to ascertain the degree to which mothers' choices of strategies were tied to their own habitual communication modes and patterns or, alternatively, were modified to suit their infants' hearing status. We found that mothers make some modifications in their habitual communication patterns to accommodate the needs they perceive their children as having; however, the mothers' own experiences may limit their ability to successfully accommodate sensory and communicative needs that are different from their own.

Clear differences were observed in visual-tactile strategy use by Dd mothers and Hh mothers in this study, indicating that deaf mothers of deaf infants do use specific communicative strategies that compliment and support their infants' behaviors and attentional needs. This provides evidence that the "model" of interactive behaviors typical of hearing mothers with hearing children may be inadequate for dyads in which the infant is deaf.

Evidence of the degree to which mothers spontaneously modify their own habitual communicative behaviors to accommodate attention needs of infants with different hearing status can be seen in the interactions between hearing mothers with deaf infants. One modification made by hearing mothers of deaf infants compared to hearing mothers with hearing infants was the increased tendency to move objects into their children's line of vision. The other strategy Hd mothers were prone to use, tapping on or pointing to an object, also served to direct their children's visual attention to an object. The frequent use of these strategies demonstrates the hearing mothers' awareness of the need and their efforts to establish a shared focus of attention with their deaf infants. Like both groups of deaf mothers, Hd mothers showed a decrease over time in their use of use of strategies that redirected infants' visual attention towards an object. Hd mothers' use of these particular attention-related strategies, therefore, indicated sensitivity to their infants' maturing abilities to attend and to receive communications.

While the use of strategies designed to direct infants' visual focus to objects can be effective at establishing joint attention, it may not promote infants' coordinating or switching attention between objects and social partners. However, other strategies (including tapping on their children directly or waving in their visual field) appear to be effective means for mothers to attract their deaf infants' attention away from an object and back to the mothers. Although Hd mothers evidenced similarities in their use of strategies designed to direct their deaf infants' attention to objects, Hd mothers did not adopt the strategies of tapping directly on the child or of waving in the visual field. At each age, deaf mothers used these strategies at a higher rate than hearing mothers. These strategies, which may scaffold deaf infants' developing abilities to alternate attention between objects and persons, appear to be transmitted culturally. In the absence of such direct tuition, however, these strategies appear not to be generated by hearing mothers, who may remain dependent upon their own habitual auditory attention signals or on increased use of objects to obtain attention. It may well be that the strategies of tapping on the child or waving a hand in the child's visual field are believed intrusive from the perspective of hearing cultural norms.

The other group that provides evidence of mothers' ability to spontaneously modify communicative behaviors to meet perceptual needs different from their own are the Dh mothers. Like Hd mothers, Dh mothers also showed relatively high rates of object movement to redirect attention. Dh mothers also produced fewer taps on the child and fewer wave/tap on floor

signals during the earlier two ages observed than did Dd mothers. This may be a reflection of Dh mothers' modifying their habitual communication patterns based on their expectations of or uncertainty about behaviors "appropriate" for hearing children. This is consistent with other studies that have shown that Dh mothers make modifications in their communicative patterns with hearing infants. For example, Rea et al. (1988) reported increased vocalizing by Dh mothers. In addition, vocalizations may serve to obtain the attention of hearing infants and may therefore tend to decrease the mothers' use of the more culturally normative signals of tapping on the child and waving. By 18 months, the tap on child signal was used more often by both groups of deaf mothers than by the hearing mothers. If deaf mothers were initially more ambivalent about the best attention strategies for hearing children, this ambivalence may resolve when expressive signing skills emerge—as was the case by 18 months for most of the Dh infants in this study.

Mothers' use of redirecting strategies indicates that patterns of use are in some cases tied to mothers' own communicative experiences but are in other cases influenced by characteristics of their children. For example, hearing mothers, (who rarely tap other adults or wave to obtain their attention) evidence significantly low rates of these strategies with their young deaf children. This is the case, although these strategies may be important in helping deaf children learn to coordinate attention between an object and a social partner. Yet, both groups of mothers whose hearing status differs from their children clearly evidence patterns of strategy use that appear to reflect their attempts to meet their children's perceptual needs (e.g., Hd mothers' high rate of presenting objects to their children to establish joint attention and Dh mothers' initially low rates of waving and tapping their children). In sum, it appears that mothers make some modifications in their habitual communication patterns to accommodate the needs they perceive their children as having; however, especially in the Hd situation, the mothers' own experiences may limit their ability to successfully accommodate sensory and communicative needs different from their own.

A second goal of this study was to determine whether the attention strategies used by deaf mothers tended to move from being more adult-regulated to more child-regulated as their infants matured. Mothers' use of attention-directing strategies did not fully support this hypothesis. For example, the frequency of tapping on the child was relatively stable over time for all groups except Dh mothers, who increased their use until it matched that of Dd mothers at 18 months. However, waving in the visual field did show a significant increase over time. A developmental transition from adult- to child-regulated attention patterns was more clearly evident in mothers' use of attention-accommodating strategies related to languages such as modifying the location of signing/gesturing and preceding signing/gesturing with overt attention-directing strategies.

The number of segments in which deaf mothers attempted to get their children's attention without then signing decreased significantly over time. Hearing mothers of deaf children also decreased their frequency of attempting to gain their children's attention without then signing, but the frequency with which they made bids for their children's attention without subsequent signing remained twice the rate of deaf mothers. As a result, Hd children who looked up in response to their mothers' bids for attention frequently received only minimal information. This is consistent with Swisher's observations that "young deaf children of hearing parents are less likely than young hearing children and young deaf children of deaf parents to engage in communicative interactions that are visually rewarding or meaningful . . ." (1992, pp. 93–94). As a result, she posited that Hd children were less likely to develop the habit of looking at their parents and therefore limited the likelihood that they would receive their mothers' input (Swisher, 1992).

Both groups of deaf mothers signed at a significantly higher rate than hearing mothers; however, hearing and deaf mothers used a similar proportion of modified (and nonmodified) signs. Mothers in all three groups modified their signs approximately half of the time when their children were 9 and 12 months of age. This pattern of accommodation decreased steadily between 9 and 18 months. By the time their children were 18 months of age, approximately 75% of mothers'

signs were produced in the normal location. Between 9 and 18 months, mothers also increased their likelihood of signing without first using a visual-tactile strategy to obtain their children's attention. These results support previous reports that deaf mothers change characteristics of their signing to accommodate their children's attentional needs. Between 12 and 18 months, when deaf children's ability to coordinate attention between an object and a social partner has been shown to increase (Harris et al., 1989), deaf mothers in this study became more likely to allow their children to regulate their reception of language by waiting for the children to look at their mothers or simply assuming they would look up to see signs rather than mothers' moving signs into the children's line of vision. While hearing mothers used less overall signed language, they also showed sensitivity to their children's visual needs and modified their signing in proportions similar to deaf mothers to accommodate their children's maturation.

Overall, the patterns indicated in the data from this study suggest that bi-directional influences were operating to some degree in each of the four groups. Both hearing mothers of deaf infants and deaf mothers of hearing infants modified their communicative behaviors and attention signals to some degree in attempts to accommodate their infants' sensory abilities and attention needs. For example, deaf mothers' relatively low production of tactile and visual attention redirection signals with hearing infants during the first year of life may have been a response to actual or expected differences in the infants' interactive behaviors due to the infants' ability to perceive auditory stimuli unavailable to the mothers.

Hearing mothers also gave evidence of communicative modifications in efforts to establish shared attention with their deaf infants. To this end, they produced increased rates of object movements to redirect attention and modified the location of signs and gestures to accommodate infants' preexisting attention focus. However, hearing mothers appeared to lack knowledge about and appreciation of direct signals such as tapping on the child and waving in the visual field, which are relatively common in communications of deaf mothers with deaf infants and which appear to support deaf infants' developing coordinated person-object attention.

Conclusion

Findings from this study have several implications for teachers and interventionists as well as for researchers. Most importantly, these data suggest that hearing mothers of deaf infants need to be taught to use the signals of tapping on child and of waving in child's visual field that deaf mothers seem to use to promote development of flexible visual attention in children without access to auditory stimuli. However, the data also confirm that the attention-related strategies used by deaf mothers of deaf infants are not static but change as the infants and their characteristics change. Thus, it would not be appropriate to teach hearing mothers the signals used by deaf mothers without also providing guidance on their appropriate use in ways sensitive to infants' developing abilities. Before such instruction can be provided with confidence, some additional investigation is needed of deaf mothers' use of these strategies that signal their children to "look at me." The time-sampling method we employed may have served to obscure some finer developmental changes that a more detailed analysis might identify. In addition, our impression that the nature (or degree of insistence) with which the signal is used changes over time could profitably be investigated using more descriptive qualitative methods. Despite the need for further refinement of our knowledge of such signals, initial information for hearing parents of deaf infants about attention-redirecting signals and instruction in their use should not be withheld. Lacking definitive data-based descriptions, their sensitive use may be most profitably demonstrated in parent-infant programs by deaf adults who can employ them in intuitive ways.

These findings also suggest that more detailed descriptive analyses are needed of deaf mothers' attention-related behaviors with their hearing infants. Such analyses should include the mothers' use of vocal attention-related signals to determine whether they benefit or complicate hearing infants' attention development when a visual language is being acquired.

Finally, it should be noted that all four groups of mothers gave evidence of sensitivity to their children's attentional needs—even if their response to those needs may not have been as effective as possible due to

a lack of knowledge about the relative value of specific strategies. It is important that persons providing intervention services for parents recognize and acknowledge their efforts while providing information to facilitate and augment those efforts.

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