YOUNG INFANTS DEMONSTRATE A PREFERENCE FOR
INFANT DIRECTED TALK

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Abstract

Young Infants Indicate Preference for Infant Directed Talk

This research was designed to assess 7-week-old infants' preference for infant directed and adult directed talk (IDT and ADT) using the infant controlled habituation/dishabituation looking procedure. Infants were presented with short audio recordings of either a female or a male speaking in IDT during habituation and ADT during dishabituation or the reverse. In the control conditions, the stimulus did not change. Infants demonstrated preference for IDT over ADT in both male and female speaker conditions. They also demonstrated preference for the female speaker used in this study over the male speaker. Interactions among the dependent variables (first three looks), and the independent variables (infant gender, and style of speaking as well as infant gender, and speaker gender), suggest that the preference might not be as robust as the preference found in infants over 4 months. Evidence for discrimination between IDT and ADT was inferred from the between group demonstration of preference, but no evidence of within infant discrimination was found. Because the evidence suggests that 7-week-old infants demonstrate weaker preference for IDT over ADT than do infants of 4 months, it is assumed that infant preferences follow a developmental sequence. Thus, it is possible that developing preferences are influenced by experiential factors.
# Table of Contents

Abstract

List of Tables and Figures

Acknowledgements

Introduction  
- Role of IDT in Language and Emotional Development
- Responses of Infant over 4 months of Age
- Responses of Infants under 4 months of Age
- Research Questions

Methodology  
- Subjects
- Apparatus and Procedure
- Visual Stimulus
- Auditory Stimuli
- Experimental Design
- Inter-observer agreement

Results  
- Preference
- Discrimination

Discussion  
- Preference for IDT over ADT
- Preference for the female over the male speaker
- Evidence for discrimination
- General conclusions

References
List of Tables

1. Table 1 38
2. Table 2 39
3. Table 3 40

List of Figures

1. Figure 1 42
2. Figure 2 43
3. Figure 3 44
4. Figure 4 45
5. Figure 5 46
6. Figure 6 47
7. Figure 7 48
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When addressing infants, people of most language environments alter their style of speech (e.g., Ferguson, 1964; Fernald & Kuhl, 1987; Grieser & Kuhl, 1988; Kess & Kess, 1986; Papousek, Papousek, & Bornstein, 1982; but for opposing evidence see Ratner & Pye, 1984). This style of speech has been referred to as baby talk (Ferguson, 1964), motherese (Fernald, 1985), maternal speech (Penman, Cross, Milgrom-Friedman, & Meares, 1983), and parentese (Werker, 1987). Since parents, non-parents, children, and people inexperienced with infants all use this speaking style when addressing infants (Fernald, 1984; Jacobson, Boersma, Fields, & Olson, 1983; Gleason, 1975), the phrase infant directed talk has been advocated by Werker and McLeod (1989).

The differences between infant directed talk (IDT) and adult directed talk (ADT) are illustrated in Figure 1. These figures represent the pitch extractions (plotted against time) taken from the recordings of a female speaker. The IDT has a higher average fundamental frequency than ADT, elongated vowels, long pauses between utterances, and a large pitch range which includes sweeping intonation contours. In addition, the IDT may have a shorter mean length of utterance and increased use of questions and repetitions (e.g., Fernald, 1984; Snow, 1977; Stern, Speiker & Barnett, 1983).

These modifications to the speech stream occur almost universally (but see Ratner & Pye, 1984), so researchers have begun to ask what role IDT might play in language and/or emotional development, to investigate the age at which infants might become sensitive to the special characteristics of IDT, and to assess the possibility that infants
have a perceptual predisposition to attend preferentially to IDT over ADT. This research was designed to address the second and possibly the third question by assessing 7-week-old infants' responsiveness to IDT and ADT in both male and female speakers. If infants of 7 weeks do not indicate a preference for IDT over ADT in both male and female speakers, it would suggest that very young infants do not have a perceptual predisposition to attend preferentially to IDT over ADT but rather, that this preference must be acquired as a function of experience. If, however, infants do show a preference for IDT over ADT, the preference for IDT at such a young age could be interpreted as consistent with a perceptual predisposition hypothesis. On the other hand, it also could be consistent with an experiential hypothesis. That is, since infants of 7 weeks may have had more experience with IDT than with ADT, this differential experience may be driving the preference rather than the preference being driven by a perceptual predisposition. Moreover, most 7-week-old infants have had more experience with female caregivers than with male caregivers. A less robust preference for male IDT than for female IDT would suggest that experiential factors may be influencing infants' preferences.

Conclusively resolving the issue of the extent to which infants' preferences for IDT are based on perceptual predispositions versus experiences, is beyond the scope of this research, but this research does address the question of the age at which infants may begin to show a preference for the special qualities of IDT. Given that most developmental processes involve a series of interactions between initial biases and environmental experiences, it is interesting to focus on the age at which a preference for IDT becomes robust. Once it has been demonstrated that infants' preference for IDT has begun to emerge, we can begin to assess the impact of IDT on development. In addition, since all of the work with young infants to date has focused on female IDT, it is of interest to know whether infants of 7 weeks are responsive to a male speaker's IDT as well as to a female's IDT.
Role of IDT in Language and Emotional Development.

The particular characteristics of IDT have been hypothesized to play a role in both language and emotional development. In Vygotskian terms, IDT may provide a scaffold of social context in which language or emotional development can proceed. Features that accentuate both the components of language and a speaker's emotional state may be exaggerated in IDT and thus may provide an environment that facilitates learning.

IDT may accentuate the pragmatic, suprasegmental and segmental aspects of language. For example, the extended pause durations of IDT may assist the infant in learning the pragmatics of turn taking (e.g. Stern et al, 1983; Ginsburg & Kilbourne, 1988). In addition, longer pauses may be instrumental in allowing infants to excise words and phrases from the speech stream (Hirsh-Pasek, Nelson, Juczyk, Cassidy, Druss, & Kennedy, 1987). Since one of the tasks necessary for understanding language is to be able to extract sounds from the speech stream, this aspect of IDT would be one way that infant language development could be scaffolded.

Exaggeration of other suprasegmental aspects of speech may have an effect on infants' perception of the smaller segments. For example, the speed of utterance may affect perception of syllables (Miller & Dexter, 1988). Karzon (1985) found that when infants were presented with multi-syllabic stimuli differing in only one feature in medial position (e.g. maRana versus maLana), their ability to discriminate between the stimuli was enhanced when the differing feature was exaggerated with the prosody of IDT. Thus, the prosodic variations inherent in IDT may facilitate an infant's perception of segments, syllables, words, and clauses.

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Pragmatics is generally considered to be a study of the social, emotional, and cultural functions of speech; suprasegmentals are defined as those components of speech that are superimposed on the segments; and segments are the phones and phonemes.
Another way to assess the importance of IDT in language development is to examine the effect of lack of experience with IDT, or reduced amounts of IDT, on language development. If experience with IDT is important, it would follow that infants who receive less IDT (or IDT which is in some way distorted) would show delayed language development. Evidence suggests that the people of the Quiche-Mayan culture use a consistently high pitch when speaking ADT, so the pitch range is constrained and Quiche speakers cannot greatly alter their pitch when addressing infants (Ratner & Pye, 1984). Children from this culture seem to have a delay in language acquisition relative to North American children. (N.A. parents generally have large fundamental frequency differences between IDT and ADT: Fernald, 1989.) Although other cultural differences may be responsible for the disparate timing in onset of language, the relative delay seen in Quiche-Mayan is consistent with the hypothesis that experience with IDT facilitates language acquisition.

Several researchers have studied the affective component of IDT to investigate its potential impact on emotional development. The exaggerated emotional components inherent in IDT may be the most salient components to infants (Fernald, 1989). The affective prosodic contours (Fernald, in press), the exaggerated facial expressions, and the rocking movements associated with IDT (Stern et al, 1983) may combine to produce a compelling auditory and visual stimulus for the pre-linguistic infant. Such multimodal experiences (Sullivan & Horowitz, 1983) may facilitate emotional attachment between infants and caregivers which in turn could provide motivation for the infant to attempt to interact with their caregivers. That is, mechanisms of reciprocal facilitation with regard to interest, affect, and attachment may be at work within the context of IDT.

If the affective component of speech is exaggerated in IDT (Fernald, 1989) and if an adult’s use of positive affect peaks when the infant is about 4-months-old (Penman et al, 1983), one would expect that infants of 4 months would show increased affective
responsiveness to IDT. Indeed, Werker and McLeod (1989) obtained evidence of affective responsiveness to IDT when infants are about 4 months. Werker and McLeod also report that adults demonstrated a preference for infants who were showing positive affect as a result of watching IDT. Such reciprocity between caretakers and infants is indicative of the transactional nature of the emotional context of IDT. That is, the parents modify the speech stream, which results in greater attentional and affective responsiveness in infants, which results in a greater desire in the adults to interact with the infant.

**Responses of Infants Over 4 Months of Age**

Research has shown that IDT is salient to infants over 4 months. For example, in an early study Friedlander (1968) found that infants of 11 to 15 months of age preferred their mother's IDT over the IDT of a strange female and over organ music. Additionally, these infants showed a preference for their mother's IDT over her ADT. Unfortunately, the scripts for the IDT and the ADT were not matched. This meant that infants' preferences could have been due to lexical rather than prosodic differences.

In a much later study, Fernald (1985) tested 4-month-old infants in a two choice head turn procedure. They demonstrated a preference for a female's IDT by choosing to listen to the female's IDT over her ADT. In an attempt to begin to assess which components of the ADT and IDT stimuli were responsible for the preference, Fernald low-pass filtered the speech to remove the lexical information. Even under these conditions, the infants demonstrated a preference for IDT over ADT. That is, the words used did not appear to be the important factor in IDT.

Subsequently, Fernald and Kuhl (1987) assessed the importance of fundamental frequency, intensity, and timing to infant preference for IDT. They reported that 4-month-old infants showed a preference for stimuli that contained the fundamental frequency (F0) and temporal factors of an IDT speech sample (intensity held constant) over
the same components taken from an ADT sample. The preference disappears, however, when intensity and temporal characteristics were allowed to vary ($F_0$ was held constant) and when only temporal factors were allowed to vary ($F_0$ and intensity held constant). This suggests that the pitch variations are the most salient component of the IDT for 4-month-old infants.

Werker and McLeod (1989) investigated whether the preferences for IDT generalize to a male speaker and whether infants show greater attentional and affective responses to IDT. Audio-visual (AV) recordings were made of one male and one female speaking either to an infant or to an adult using the same script. These AV recordings were presented to two groups of infants (4 to 5.5 months and 7.5 to 9 months). Attentional preference was measured by longer looking time when the stimulus was IDT than when it was ADT. Affective responsiveness was subjectively rated by coders watching silent videos taken of the infants while they were watching the IDT and the ADT. Both age groups of infants displayed not only attentional preferences but also affective preferences for the IDT over the ADT in both the male and the female conditions. Such evidence supports the hypothesis that infants over 4 months of age are more attentive, more affectively responsive, and more interactive when presented with IDT than when presented with ADT.

Responses of Infants Under 4 Months of Age

Studies of young infants' auditory capabilities suggest that infants younger than four months should be able to discriminate between some of the particular features of IDT and those of ADT. For example, infants can discriminate between different pitch contours and tempo changes (Trehub, 1987; Trehub, Thorpe & Morrongiello, 1987) so it is possible that they can use such cues to discriminate between the different pitches and tempos of IDT and ADT. Additionally, very young infants have shown a preference for
frequency variations that include rising pitch contours (Morse, 1972; Eisenberg, Corsins & Rupp, 1966), which is another characteristic of speech directed towards young infants. At two months, infants have even responded preferentially to "soft" over "hard" tones used by adults when reading a rhyme (Culp, 1974)

Responses of infants under 4 months to IDT and ADT were studied by Mehler, Bertoncini, and Barriere (1978). They tested 4-6 week-old infants in a high amplitude sucking procedure. When both the mother and a strange female spoke in ADT, the infants demonstrated a weak preference for their own mother's voice over the voice of the strange female. The preference was considered weak because infants produced more sucking to hear mother’s voice in one condition only - when they heard the stranger's ADT first. When they heard their mother’s ADT first, they did not increase their sucking rate when the stimuli changed to the stranger's ADT. However, when both the stimuli were IDT, the infants' preferences for their mother’s voice were robust. Although this evidence suggests that young infants prefer IDT, they also may process a familiar voice differently from an unfamiliar voice when it is in IDT. Unfortunately, within speaker comparisons were not directly assessed so it is unclear whether they prefer IDT over ADT when produced by the same speaker.

With respect to within speaker preference for IDT over ADT, Cooper and Aslin (1989; See also Cooper, 1988) provide a brief report of a study in which infants of 4 weeks indicated a preference for IDT over ADT. In this study, when the infants looked in the direction of a checkerboard, they were presented with alternating stimuli of simple two or three word phrases of IDT and ADT spoken by a female. These phrases were repeated as long as the infant was looking toward the speaker. When the first look was dropped from the analysis, the infants' mean duration of looking time was significantly greater when they were presented with female IDT than with female ADT. The rationale for dropping the first look was so that infant preference could be assessed independently
of the long first looks (Cooper, personal communication). Apparently, the mean of the first looks were not significantly different between IDT and ADT conditions, although the means were in the correct direction.

Within speaker preference for IDT over ADT was assessed in 6-8-week-old infants in our lab (Werker, 1987). These younger infants were run in the same procedure as the older age groups already discussed (4 to 5.5 months, and 7.5 to 9 months; Werker & McLeod, 1989). In reminder, infants were presented with audio-video tapes of a male and a female speaking either in IDT or ADT. Whereas the older infants did demonstrate attentional and affective preferences for the same speaker’s IDT over ADT in both the male and the female speaker conditions, the infants between 6 and 8 weeks did not. Indeed, they did not show any differential behaviour. It was unclear whether the youngest infants simply did not have a preference for the IDT over the ADT or whether they lacked the more fundamental ability to discriminate between the two stimuli. If 4-week-old infants do have a preference for IDT over ADT as suggested by Cooper and Aslin’s evidence (1989), it is important to ask why the 6- to 8-week-old infants in the Werker (1987) study failed to demonstrate a preference for IDT.

It is possible that infants of 4 weeks have a preference for IDT but that the preference drops out at about two months and does not return until about 4 months. Such a U shaped function has been described with respect to infants’ abilities to turn their head toward a sound source (Muir, Abraham, Forbes, & Harris 1979; Muir, Clifton & Clarkson, 1989). It also is possible that 4-week-old infants have, at best, a weak preference for IDT over ADT. Alternatively, the procedure used by Werker and McLeod may have been too difficult for 6- to 8-week-old infants. In the procedure, an attempt was made to keep the task as natural as possible. As a result, the infants were not required to fixate on the screen before the presentation of the stimuli began. It was reasoned that if IDT attracts and maintains an infant’s attention, then infants should
choose to direct their attention to the monitor when the audio-visual recordings began. Evidence suggests that infants of about 2 months of age may not be able to reliably turn their heads toward a sound source (Muir et al, 1979; Muir et al, 1989) suggests that the task may have been beyond the capabilities of the younger infants.

Another procedural issue was the duration of each presentation. In the procedure used by Werker and McLeod (1989), the predetermined duration of each presentation was one minute. It is possible that the 6- to 8-week-old infants may have needed a longer time to process the information (Hunter & Ames, 1988). If the infant happened to be attending when the stimulus came on, s/he may have looked at the screen for the full presentation due to visual and auditory capture. If this occurred in a large proportion of the trials, it would result in no differential looking between the IDT trials and the ADT trials due to a ceiling effect. An analysis of the data revealed that for many infants this was the case.

For the above reasons researchers are unsure of the capabilities of 7-week-old infants. To summarize, they may not have a preference for IDT over ADT, they may have a preference earlier than 7 weeks that declines or drops out at around 7 weeks, or they may have a preference for IDT over ADT that is quite weak. If the preference is weak, it may be demonstrated only under certain testing conditions. One other alternative is possible. Infants of 7 weeks may have a preference, but because of statistical probabilities, did not show it in the Werker (1987) study. That is, it is possible that the Werker study included a sample of infants who, by chance, did not demonstrate a preference.

A more sensitive procedure than the one used by Werker and McLeod (1989), might allow a more precise assessment of the preference of infants of 7 weeks of age. Given the possibility that 7-week-old infants might again fail to demonstrate a preference for IDT over ADT, it was necessary to rule out the possibility that infants of this age
cannot discriminate between IDT and ADT. A procedure appropriate for measuring discrimination as well as preference in younger infants, the infant controlled habituation-dishabituation procedure (Horowitz, 1975) was used in this study.

An additional unanswered question is how infants under 4 months respond to a male speaker's IDT and ADT. Neonatal preference for the mother's voice over the father's voice (DeCasper & Prescott, 1984) may not be relevant in relation to preference for IDT over ADT within one male speaker. In addition, preference for the mother's voice may be due to prenatal exposure. Evidence of 7-week-old infants' preference for a male speaker's IDT over his ADT would not only help to support a perceptual predisposition hypothesis but also would give support to male caregivers and would encourage fathers to interact with their infants.

Research Questions

This research was designed to address the following questions: (1) Do 7-week-old infants demonstrate a preference for IDT over ADT? (2) Is preference for IDT over ADT evident for both male and female speakers? (3) If infants fail to demonstrate a preference, do they still show evidence of discrimination between IDT and ADT spoken by a single speaker?

If infants of 7 weeks do prefer IDT over ADT, they should have longer looks during early IDT habituation trials than during early ADT habituation trials and this pattern should hold across both speakers. Clearly, if preference is indicated, then

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2 Two measures which were rejected as indications of preference were shorter inter-trial times during IDT habituation trials (the time not looking at the screen) and longer total looking time during the habituation phase when IDT was the stimulus than when ADT was the stimulus. The first measure was rejected because in some cases it was necessary to draw the infant's attention back to the monitor in order to continue the procedure. If the infant did not look back to the monitor, a trial could not begin. In these cases, the observers would use non-speech noises to attract the attention of the infant and this would influence inter-trial times.

The second measure was rejected because total looking time to habituation
discrimination can be inferred (Fantz & Nevis, 1967). If, however, infants failed to demonstrate a preference for IDT over ADT, discrimination still could be evidenced by a significant recovery in looking time during the dishabituation phase of the experiment when the auditory stimulus changed (experimental conditions) but not when it remained constant (control conditions).

Methodology

Subjects

The infants were recruited by visiting post-partum mothers in the hospital. When the infants reached approximately 6 weeks of age, the mothers were contacted by phone, given full details of the procedure, and asked if they were interested in participating. Only infants of 7 weeks who were full term (+/- 2 weeks) without significant health problems (based on parental reports) were included. A total of 177 infants were run in this procedure. Of this total, 105 infants did not complete the habituation/dishabituation phase of the procedure: 59 due to state changes, 13 due to low observer agreements, 19 due to equipment failures and 14 for various other reasons such as training.

Apparatus and Procedure

The 9.6' x 7' testing room was draped with black curtains. A wooden divider concealed the observers from the infant (see Figure 2). A 16 inch JVC television monitor, is probably more representative of the time required by infants of 7 weeks to reach habituation rather than a measure of preference. In addition, evidence suggests that infants who have long first looks in an habituation procedure will have less trials to habituation than infants who have short first looks (Horowitz, 1989). Such evidence is consistent with the idea that total looking time indicates processing time necessary to reach habituation and is not indicative of habituation.
which presented the visual and auditory stimuli, projected through a gap in the divider. The infant faced the monitor looking over the seated parent's shoulder. In accordance with precautions stated by Ames, Hunter, Black, Lithgow, and Newman (1978), two observers monitored the infants' looking behaviour. To mask the auditory stimuli, the parent wore headphones through which continuous vocal music was played at 85 db. It was not possible to increase the db for the parent because the head phones leaked sound at higher levels which the infant may have been able to hear. This sound level was judged to be loud enough to at least partially mask the stimuli which were presented at approximately 75 db. In addition, the parents were not informed of the order of presentation of stimuli until after the procedure was completed. The observers wore headphones delivering vocal music at approximately 100 db. which was loud enough to fully mask the stimuli. The observers also wore ear plugs to protect their ears from this high sound level. In addition, at all times at least one of the two observers was unaware of the condition under which the infant had been run.

The procedure selected for this study was the infant controlled habituation-dishabituation looking procedure (Horowitz, 1975). In this study, once the habituation criterion was reached, infants in the experimental conditions were presented with a new auditory stimulus while the visual stimulus remained constant and infants in the control conditions were presented with the same auditory as well as visual stimulus.

To begin this procedure, a red fixation light was flashed by one of the observers to attract the baby's attention. When an observer judged that the infant was looking in the direction of the monitor, s/he pressed a button connected to a Hewlett-Packard computer via a micro-chip interface. When both observers indicated that the infant was looking, the computer initiated a trial by turning on the VCR. The VCR then projected both the visual stimulus and the appropriate auditory stimulus to the testing room monitor. In accordance with the infant controlled procedure, the trial began only when
the infant was looking in the direction of the monitor and continued only for as long as
the infant continued looking. When both observers judged that the infant was no longer
looking, they released the buttons and the computer turned off the presentation. This
procedure was repeated for all trials in both the habituation and the dishabituation
phases.

When the infant reached habituation criterion (calculated by the computer), the
computer caused the VCR to switch to presentation of the dishabituation stimulus. The
observers were unaware that the change had occurred because they were wearing
headphones and could not hear the stimuli. At the end of the second dishabituation trial,
a red light signaled the end of the procedure to the observers.

When setting the habituation criterion, two issues had to be addressed. The first
concerned the trials on which the criterion would be set. When the infant-controlled
habituation-dishabituation procedure is used to assess visual discrimination, researchers
have used the mean of the first three looks as the criterion mean (e.g. Miller, 1983).
When used to assess auditory discrimination, however, the mean of the two highest of
the first three trials has been used (e.g. Best, McRoberts, & Sithole, 1988). The rationale
for this difference is that during auditory discrimination tasks, the infant is being asked
to process both visual and auditory stimuli and this may result in more variable looking
behaviours during initial looks. For example, some infants may behave as if they are
"surprised" by the onset of the first trial, causing strong "capture" effects and thus long
first looks. On the other hand, some infants may be "surprised" with the offset of a trial
possibly causing short second looks. By using the average of the two highest of the first
three trials as the basis of the habituation criterion, it was hoped that effects of within
infant variability would be reduced and the criterion would not be too strict.

\[3\] An analysis of the first three looks was performed to assess the
possibility that the two highest of the first three looks is a more stable
estimate of initial looking behaviour.
The second issue in determining habituation criterion was deciding when an infant had habituated. In this study, the operational definition of habituation was that infants should have two consecutive looks below 50% of the mean of the two highest of the first three trials. This measure is stricter than measures such as the average of two trials used by other researchers (e.g. Best, et al., 1988). Thus, a less strict value was used to set the criterion (mean of the two highest) and a more strict value was used to determine when habituation had been reached (two consecutive trials). By establishing this habituation criterion, it was believed that a balance between strict and lax criteria was reached (but see the discussion).

**Visual Stimulus**

In both the habituation and the dishabituation phases of the experiment, the visual stimulus was a black and white checkerboard of 1 3/4 inch squares projected onto a 16 inch T.V. monitor. The infants were positioned 2 1/2 feet away from the monitor with a visual angle of 25° horizontally and 20° vertically. This is well within visual acuity and accommodation ranges of 7-week-old infants.

**Auditory Stimuli**

The auditory stimuli for both the female and the male speaker conditions were repeating segments of speech that were between 12 and 16 seconds of identical scripts. These segments were presented at approximately 75 db.

The segments used for the female speaker were selected from the entire 60 second speech samples used in the Werker (1987) and the Werker and McLeod (1989) studies. An analysis of the fundamental frequency ($F_o$) extractions indicated differences between $F_o$ contours of ADT and IDT in the selected segments. The mean of the $F_o$ for the female speaker IDT was 233.053 with a standard deviation of 102.482, and for her ADT the mean
was 205.750 with a standard deviation of 58.334. Thus both the average $F_0$ and the variability of $F_0$ were greater in the IDT than in the ADT. Because of these results and because infants of 4 months had demonstrated a robust preference for this female's IDT, it was decided that her speech samples would also be used in this study. Figure 1 illustrates some of the female speaker's speech samples in both IDT and ADT.

An analysis of $F_0$ extractions from the male speaker's IDT and ADT used in the Werker and McLeod (1989) study revealed that the pitch contours in the male speaker's IDT were not as broad as those in the female speaker's IDT. These large pitch variations have been shown to be a significant attentional factor in the IDT (Fernald & Kuhl, 1987). Recall that the infants in the Werker and McLeod study (1989) demonstrated a weaker preference for the male speaker's IDT than for the female speaker's IDT. Since this research was designed to give young infants every opportunity to demonstrate preference, it was decided that the same female speaker would be used, but new speech samples would be used for the male speaker. New male speaker samples were obtained from a father speaking to his own 3-month-old infant for the IDT sample, and then to an adult for the ADT sample. These new samples were analyzed and for the male IDT the mean $F_0$ was 162.268 and the standard deviation was 89.512. For the male ADT the mean $F_0$ was 116.625 and the standard deviation was 45.376. As in the female speaker samples, these descriptive statistics reveal a greater variability and a higher overall fundamental frequency in the IDT than in the ADT. Note, however, that the range of variability was less in the male speaker's IDT than in the female speaker's IDT.

These new male speaker samples were tested with naive adult subjects who rated them at the same time as re-rating the Werker and McLeod samples. The majority of raters judged the new male IDT as "happy" speech directed towards 0- to 4-year-old children and there was more agreement among raters for descriptions of this stimulus than there was for the Werker and McLeod IDT male. The new male ADT was rated
as "neutral" speech directed to 19- to 35-year-old people, and again, there was more agreement among raters. Moreover, the ratings for the new male speaker samples were judged similarly to the female speaker's stimuli.

An attempt was made to match the scripts for both the new male and the female segments of speech, but matching caused the ADT stimulus to be shorter than the IDT stimulus. To match the duration of utterances, therefore, a longer section of the ADT script was used. Even with the extra words in the ADT, the IDT samples were longer in duration than the ADT samples. Duration for the female ADT was 15.1 seconds and for the female IDT, 16.3 seconds. Duration for the male speaker's ADT was 13.2 seconds and for the male's IDT, 16.1 seconds.

The extra lexical content in the ADT script could make these stimuli more complex and should, in principle, cause infants to require more processing time (longer looks). Thus, the longer lexical content of the ADT stimulus would work against the prediction of longer looking times when IDT is presented and make the study a conservative test. Although the magnitude of such an effect is unknown, if infants still demonstrated preference for the IDT, it could indicate a robust preference. It should be noted that the differences between the durations of the ADT and the IDT are largely due to extended pauses and elongated vowels that are an essential part of the structure of IDT. The pauses alone should not induce longer looking times because it has been demonstrated that the temporal factors in IDT are not strong enough to draw the attention of infants when other factors are held constant (Fernald and Kuhl, 1987).

NOTE: The underlined portion is the extra content included in the ADT in order to have similar duration of utterances in both the IDT and the ADT tapes.

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4 IDT SCRIPT
I love these long mornings don't you? I wish they could last all day. Well, at least it's Friday and we can putter around all day Saturday.

ADT SCRIPT
I love these long mornings don't you? I wish they could last all day. Well, at least it’s Friday and we can putter around all day Saturday. Are you going to help me with that? Are you?
Experimental Design (See Figure 3)

Six groups of 12 infants were tested using the habituation-dishabituation procedure. In the four experimental groups, the visual stimulus remained constant for both the habituation and the dishabituation phase of the experiment whereas the auditory stimuli changed during the dishabituation phase. Infants were presented with either the female voice (24 infants) or the male voice (24 infants). Half the infants in each group were habituated to ADT and dishabituated to IDT and the other half were tested in the reverse order. These groups were balanced for gender of the infant.

Two control groups were run in which both the auditory and the visual stimuli remained constant. In the female speaker control condition, 12 infants were presented with a female speaker’s ADT for both the habituation and the dishabituation phases, and in the male speaker control condition, 12 infants were presented with the male speaker’s IDT for both the habituation and the dishabituation phases. Thus, a total of 72 infants completed this procedure.

Inter-observer agreement

Overall inter-observer disagreement was calculated for each infant. An observer could disagree on the onset of a trial (was the infant looking) and the offset of a trial (was the infant looking away). These durations were calculated by the computer, summed, and reported as a percentage of total time that the infant was presented with the stimuli (the total of all trial durations). If the percentage of disagreement between observers was greater than 15%, the subject’s data was excluded. Two subjects in the female speaker groups and 7 subjects in the male speaker groups were excluded for this reason. Of the remaining subjects, overall observer disagreement averaged 6.90% for the female speaker experimental groups, 7.91% for the male speaker experimental groups, and
8.76% for the two control groups.

A more detailed analysis of the agreement measures also was conducted. In this descriptive analysis, the distributional pattern of all the trial disagreement durations for all infants was examined. It was found that disagreements over 5 seconds constituted outliers. Thus, it seemed reasonable to drop all cases where disagreement was more than 5 seconds. In addition, since the habituation criterion was set at 50% of the average of the two highest of the first three trials, an observer disagreement under 5 seconds on one of the two highest trials could only affect the habituation criterion by a maximum of 2.5 seconds. In the female control conditions it was necessary to exclude 2 infants due to disagreement durations over 5 seconds.

Results

There were three specific hypotheses in this research; two involving preference and one involving discrimination. The results for preference will be discussed first, followed by the results for discrimination.

Preference

In the first analysis, preference for IDT over ADT was assessed by comparing looking time across groups during the criterion setting trials. In this 2 (style of speaking: IDT vs ADT) x 2 (speaker gender) X 2 (infant gender) ANOVA, there were significant main effects for both style of speaking, F(1,40) = 5.30, p < .03, and speaker gender, F(1,40)

5 Only the four experimental groups were balanced for gender. Because the control groups only had one order for each gender of speaker (male IDT and female ADT), they were not included in the analyses for preference.

6 The analyses were performed using BMDP, P2V. In this program, between group analyses are termed ANOVAs, and between/within analyses are called mixed ANOVAs (also see Glass and Hopkins, 1985, for this distinction).
= 8.56, p < .006, but there were no significant interactions. Infants who observed IDT looked longer than those who observed ADT (M = 64.562 vs M = 40.506) and infants who observed the female speaker looked longer than those who observed the male speaker (M = 67.821 vs M = 37.246).

It was possible that using the criterion mean as the dependent variable, increased the likelihood that significant differences would be found because this measure did not include short looks. Thus, a second analysis was run using the mean of the first three looks as the dependent variable. There were still main effects for IDT over ADT, F(1,40) = 9.27, p < .004, and female speaker over male speaker, F(1,40) = 4.64, p < .04. No significant interactions occurred.

The significant main effects were not due to the looking behaviours of a few infants. Of the 24 infants who were presented with IDT, 15 had mean looking times during the first three trials that were greater than the overall average of both groups of infants, while of the infants who were presented with ADT only 7 of 24 did. A similar pattern was found for speaker preferences. When presented with the female speaker, 15 of the 24 infants looked longer than the overall average and, when presented with the male speaker, only 6 of 24 infants looked longer than the average. These results indicate that most infants' looking behaviour conformed to the expected pattern of preference for IDT over ADT and for the female speaker over the male speaker. Thus, the significant differences were not due to only a few outliers.

In order to assess the possibility that the criterion mean was a more stable indicator of looking time, a third analysis was conducted to probe looking time during each of the first three looks. Note that the first three looks also were the first three trials because in the infant controlled procedure, the trial length is determined by the looking duration of the infant. The between group factors were again style of speaking (IDT vs ADT), speaker gender, and infant gender, and a repeated measure was added
(the first three looks).

The data were analyzed in a 2 (style) x 2 (speaker gender) x 2 (infant gender) x 3 (three looks) mixed ANOVA. As in the previous analysis, there were significant main effects for style of speaking, $F(1,40) = 4.64, p < .04$, and for speaker gender, $F(1,40) = 9.27, p < .004$. As well, there was a significant main effect for the first three looks, $F(2,80) = 12.91, p < .0000$, a 2 way interaction between the first three looks and style of speaking, $F(2,80) = 3.21, p < .05$, a 2 way interaction between first three looks and infant gender, $F(2,80) = 8.74, p < .0004$, a 3 way interaction among the first three looks, style of speaking, and infant gender $F(2,80) = 3.26, p < .04$, and a 3 way interaction among the first three looks, speaker gender, and infant gender $F(2,80) = 4.25, p < .02$ (See Table 1). The main effects for preference for IDT over ADT ($M = 47.13$ vs $M = 31.15$) and preference for the female speaker over the male speaker ($M = 57.93$ vs $M = 27.84$) must be considered in the context of the higher order interactions. In addition, the main effect for trials, which indicated that infants had looked longer during the first trial than during both of the other two trials, Tukey (Glass & Hopkins, 1985, p 231); $q(1,80) = 6.39, q(2,80) = 6.04, p < .05$, must be considered in relation to the 3 way interactions. Note, however, that there was no main effect for infant gender.

The first 3 way interaction to be investigated was among infant gender, style of speaking, and first three looks. The two 2 way interactions (infant gender x first three looks and style of speaking x first three looks) were subordinate to this 3 way interaction. It was analyzed by asking which combination of infant gender and three looks resulted in a significant difference in looking times for IDT versus ADT (style of speaking). Simple main effect analyses revealed that during the first look, the male infants looked significantly longer when presented with IDT ($M = 130.492$) than when presented with

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7 The test for Sphericity was significant, indicating that assumptions for compound symmetry had been met. However, equal n's meant that even if the assumptions had not been met, no adjustment would have been necessary.
ADT ($M = 50.971$), $F(1,80) = 20.612$, $p < .0001$. During the second and third looks, however, the male infants did not have significantly longer looking durations for IDT than for ADT, although the means were in the expected direction for the third look. The female infants did not have significantly different looking durations for IDT and ADT in any of the individual first three looks (See Table 2), but the means for all three looks were in the expected direction.

An investigation of the 3 way interaction among speaker gender, infant gender, and the first three looks was performed to assess which combinations of infant gender and three looks had significantly different looking durations for male and female speakers. Simple main effects analyses revealed that during the first look, male infants had significantly longer looking times when the female speaker was presented ($M = 124.043$) than when the male speaker was presented ($M = 57.421$), $F(1,80) = 14.47$, $p < .001$). There was no significant difference in looking times for speaker for the male infants during the second or third looks. The female infants demonstrated a preference for the female speaker ($M = 56.716$) over the male speaker ($M = 12.903$) during the third look, $F = 6.257$, $p < .01$, but not during the first or second look (see Table 3). With a Bonferroni correction in the alpha levels, only the male infants looking durations in the first look maintained significance (Bonferroni correction for .05 = .008). The looking times were in the expected direction, albeit non-significant, for both male and female infants on each of the first three trials.

**Discrimination**

Discrimination between IDT and ADT can be inferred from an indication of preference for IDT over ADT, as was outlined in the introduction. Because the infants in the experimental groups demonstrated preference for IDT over ADT, it can be inferred from this between group analysis that infants of 7 weeks are able to discriminate between
IDT and ADT. In addition, the experimental design allowed an assessment of within infant discrimination. In this analysis, evidence of discrimination between IDT and ADT whether delivered by a male or a female, would be shown by differential recovery in looking time during the dishabituation phase of the experiment. Specifically, a greater increase in looking time during the dishabituation phase in the experimental groups than in the control groups would indicate that infants were able to discriminate between IDT and ADT. This analysis assessed within infant discrimination, whereas the preference measures assessed between infant discrimination. As well, this analysis provided evidence of discrimination during the final trials rather than during the initial trials.

It was decided to collapse speaker gender in all groups because the infants were expected to demonstrate recovery in the experimental conditions irrespective of speaker gender. To determine if infant gender also could be collapsed, an initial analysis of the experimental groups was conducted. No significant main effect or interactions for infant gender were found when the repeated measure was the mean of the last two habituation trials (hab) and the mean of the two dishabituation trials (dis). For this reason, infant gender was collapsed in the subsequent analyses.

The groups were compared on three orders of presentation, IDT to ADT, ADT to IDT, and No Change to assess differential recovery between the experimental conditions (the first two orders) and the two control conditions (no change). The repeated measure was the mean of the last two habituation trials (hab) and the mean of the two dishabituation trials (dis). In this 3 (order of presentation of stimuli) x 2 (hab/dis) mixed ANOVA, main effects were found for both order of presentation of stimuli, $F(2,69) = 3.33$, $p < .04$, and hab/dis means, $F(2,69) = 28.99$, $p < .000$. To infer that recovery in looking time differed among the groups, an interaction between order of presentation of stimuli and the repeated measure would have been necessary. Since no significant interaction occurred, discrimination could not be inferred from this measure.
The main effect for order of presentation of stimuli indicates that the average between the habituation and dishabituation means differed significantly among the three groups. A Tukey analysis revealed that the infants who heard IDT during habituation and ADT during dishabituation had significantly longer looking times during the average of the hab/dis means than the other two groups, q = 4.806, p < .05. Note that the significant difference in this measure was not indicative of discrimination between IDT and ADT, but rather is probably another indication of preference. To illustrate this point, three factors relating to the infant controlled habituation/dishabituation paradigm need to be considered. First, the duration of each trial was determined by the looking behaviour of the infant. Second, an infant was expected to look longer for a preferred stimulus than for a non-preferred stimulus, at least in early trials. Third, because of the way that habituation was operationalized, looking time during the final two habituation trials was influenced by the looking behaviour of that infant in the first three trials. The combination of these three factors would result in higher mean looking time during the final two habituation trials for a preferred stimulus (IDT) than for a non-preferred stimulus (ADT).

To assess the differences among the groups’ habituation means, a 6 (group) by 1 (habituation mean) ANOVA was conducted. The results indicated that the 6 groups differed on the mean of the last two habituation trials, F(5.66) = 3.19, p < .01. Specifically, infants who were presented with the female speaker’s IDT had a habituation mean significantly greater than the habituation means for both control groups, Tukey q = 4.76 and q= 4.416, p <.05, and greater than the habituation mean of infants who heard the male speaker’s ADT, q= 4.408, p <.05. The significant main effect for order of presentation of stimuli in the previous analysis, therefore probably was due to preference for IDT over ADT.

Two other analyses of discrimination were possible; equating the groups on the
habituation mean by covariance, or performing a log transformation on the habituation and dishabituation means. Neither of these analyses resulted in significant interactions. Thus, there was no indication of within infant discrimination between IDT and ADT.

Discussion

The three hypotheses for this research were that infants of 7 weeks would demonstrate a preference for IDT over ADT, that the preference would be evident in both the female and the male speaker conditions, and that if they failed to demonstrate preference they would at least show the ability to discriminate between IDT and ADT. The results will be discussed in three sections; infants’ demonstration of preference for IDT over ADT, evidence of preference for the female speaker over the male speaker (which was not an a priori prediction), and indications of discrimination. General conclusions will be discussed in a final section.

Preference for IDT over ADT

When analyzing the mean of the two highest of the first three trials (criterion mean) for infants in the experimental groups, it was clear that infants demonstrated a preference for IDT over ADT. Even when the mean of the first three trials was analyzed, the main effects for IDT over ADT were significant. These results confirm the hypothesis that infants of 7 weeks prefer IDT to ADT. Because there was no interaction between speaker gender and style of speaking, in either of the analyses, it can be concluded that the preference for IDT over ADT holds for both male and female speakers.

It might be possible to conclude on the basis of the previous analyses, that infants of 7 weeks demonstrated a robust preference for IDT over ADT. However, a third analysis was conducted to assess the supposition that the criterion mean might be a more
stable estimate of early looking behaviour in 7-week-old infants. In this analysis, looking
time during each of the first three looks was the dependent variable. There were
significant main effects for style of speaking and for speaker gender, as in the first and
second analysis, but an additional main effect for the first three looks was revealed.
Moreover, unlike the first analysis, both 2 and 3 way interactions were significant\(^8\).

The three way interaction among first three looks, infant gender, and style of
speaking showed that the male infants looked longer in the first trial for IDT than for
ADT. They did not have significantly different look durations in either the second or
third trial, although the looking durations were in the expected direction for the third
trial. The female infants did not significantly differ in their looking time for IDT and
ADT during any of the first three trials. However, the means for female infants were in
the expected direction for all three trials.

These results suggest two things. First, the criterion mean does appear to be a
more stable estimate of early looking behaviour than assessing each of the individual first
three looks. Interactions were apparent only when examining the first three looks and
were not present when the criterion mean or the mean of the first three looks was
analyzed. The occurrence of a cleaner data pattern tends to support the assumption that
when the infant controlled habituation-dishabituation looking procedure is used to
measure auditory discrimination, a more stable pattern of initial looking behaviour
emerges when using mean looks than when using individual looks.

Perhaps more perplexing, however, is the possibility that preference for IDT over
ADT is not as robust as the first two analyses might suggest. That is, it appears that
differential looking time to IDT over ADT was due primarily to the male infants in the

\(^8\) The interactions involving speaker gender will be discussed in the
following section on preference for the female speaker over the male speaker.
Notice, however, that there were no interactions between style of speaking (IDT
vs ADT) and speaker gender indicating that preference for IDT over ADT was
independent of the preference for the female speaker over the male speaker.
first of the three looks. However, two factors suggest that this conclusion may not be warranted. First, it is important to remember that there was not a significant main effect for infant gender. Furthermore, in each of the first three trials, female infants looked longer for IDT than for ADT, and male infants looked longer for IDT than for ADT in two of the first three trials. Thus the overall pattern of looking time for IDT over ADT was in the expected direction, which suggests that both male and female infants contributed to the overall pattern of preference for IDT over ADT. Future research would have to address this question specifically before any firm conclusions could be drawn about infant gender differences in preference for IDT over ADT.

Second, the small cell size for these interactions (six) warrants caution as the behaviour of only one infant could determine whether an interaction was significant. Moreover, the looking behaviour of infants of 7 weeks is highly variable as illustrated by the very large Sums of Squares. Interactions may occur often when analyzing data from infants of 7 weeks because of the within and between group variability. Numerous studies with infants of this age suggest that interactions concerning infant gender may not be stable (Ames, personal communication). In other words, it is possible that in a replication of this study female infants would show significantly greater looking times to IDT than to ADT, but male infants would not. Alternatively, the look on which the durations vary might differ in future studies. With large variances and small cell sizes, it is not wise to attribute too much meaning to the direction of interactions which may be spurious (see the discussion of speaker preferences below).

**Preference for the female speaker over the male speaker**

When analyzing infant preferences using the criterion mean and the mean of the first three looks, it was found that infants demonstrated a clear preference for the female speaker over the male speaker. Analysis of the first three looks, however, revealed a 3
way interaction among infant gender, speaker gender, and first three looks. Simple main effects analyses revealed that during the first look but not the second or the third looks, the male infants looked significantly longer when the female speaker was presented than when the male speaker was presented. Female infants also demonstrated a preference for the female speaker over the male speaker, but in the third trial, not in the first or the second trial. In absolute terms, the mean looking times were longer for the female speaker over the male speaker for both female and male infants in all of the first three trials. These gender differences over trials indicate that the suggestion concerning arbitrary differences among infants first three looks (in IDT/ADT preference section above) is valid.

Although preference for the female speaker over the male speaker was not an a priori hypothesis, it might have been expected given the finding of weaker preference for the male speaker than the female speaker in the Werker and McLeod (1989) study. The female's speech used in the present study were segments taken from the female speaker in the Werker and McLeod (1989) study but a new male speaker was recorded for the male speech segments. As described in the methodology section, the rationale for using the same female speaker was that the her stimuli were assumed to be good examples of IDT and ADT and it was important to use stimuli which had been already been demonstrated to be preferred by infants. It is of interest that the preference for the female speaker was present in this 7-week-old sample of infants with the new male speaker. Nevertheless, no statements can be made about a priori infant preferences for female speakers over male speakers for two reasons. First, only one speaker of each gender was used in this study. It is possible that this female speaker has some special qualities that draw the attention of infants and her speech may even be preferred over

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9 Note, however, that the indication of female infants' preference did not withstand the Bonferroni reduction of the alpha level.
other female speakers.

Second, it is possible that the differential preferences are a result of differential experiences with male and female caregivers. A preference for female speakers may even be related to prenatal experiences when the maternal voice is believed to be the most salient auditory stimulus (Fifer & Moon, 1988). Indeed, neonates have been shown to demonstrate preference for higher pitched tones (Trehub, 1987) and for a female speaker over a male speaker (for a review, see Cooper & Aslin, 1989). Thus, it would be more appropriate to say that infants demonstrated a preference for this female speaker over this male speaker. More research is needed before any conclusions about young infants' speaker gender preferences can been made.

Evidence for discrimination

Preference for IDT over ADT requires that infants of 7 weeks are able to discriminate IDT from ADT. Thus, 7-week-old infants must be able to discriminate between the stimuli. Nevertheless, evidence of within infant discrimination between IDT and ADT was not found when comparing the experimental groups to the control groups in the dishabituation phase of the experiment. Recall that it was necessary to find a significant interaction in order to infer discrimination. Since there was no interaction, discrimination could not be inferred from the three group comparison of the habituation and dishabituation means. It is important to note that it is not that infants did not show recovery in looking time, but rather that recovery was not significantly different between the experimental and control groups.

The lack of differential recovery in the experimental and control conditions can be explained, in part, with reference to the habituation criterion. That is, the habituation criterion in this study may have been too strict. Evidence suggests that whenever looking time is depressed, an increase in looking time during the following trials is expected.
whether or not there is a change in the stimulus (Dannemiller, 1984). Since the recovery in looking time was significant for both the experimental and the control conditions, it is possible that the habituation criterion was too strict. Significant recovery in all conditions would reduce the likelihood of finding a significant interaction.

General conclusions

Infants of 7 weeks demonstrate a preference for IDT over ADT and for the particular female speaker used in this study over this particular male speaker despite the lack of within infant evidence for discrimination. These findings help to clarify the lack of preference for the younger infants in the Werker study (1987) and the significant (but possibly weak) preference in the Cooper and Aslin study (1989). The Werker and McLeod (1989) infants of 4 to 5.5 and 7.5 to 9 months of age responded preferentially to IDT over ADT, but when 6- to 8-week-old infants were run in the same procedure, they did not show any preference for IDT over ADT (Werker, 1987). In contrast, Cooper and Aslin (1989) reported that infants 4 weeks of age showed a preference for IDT over ADT. Three hypotheses were presented to explain the lack of preference in the Werker (1987) study. The first possibility was that infants of 7 weeks do not have a preference for IDT over ADT and that the conclusion in the Cooper and Aslin study was overstated. The second possibility was that if infants of 1 month do demonstrate a preference for IDT over ADT (as reported by Cooper & Aslin, 1989), the ability may decline or drop out at about 7 weeks and return by about four months. Both of these hypotheses must be rejected since infants of 7 weeks demonstrated a preference for IDT over ADT in the present study.

The third possibility for lack of evidence of preference for IDT over ADT in the Werker (1987) study, was that the procedure was simply not sensitive enough to reveal preference for IDT over ADT in 7-week-old infants. Since the infants in this study
demonstrated preference for IDT over ADT, it can be inferred that either the task required of 7-week-old infants in the Werker (1987) study was too difficult, or the dependent variable used was not sensitive enough.

Other researchers have shown that by 4 months, both male and female infants demonstrate preference for IDT over ADT in both the male and the female speaker conditions (e.g. Fernald, 1984; Fernald, 1989; Fernald, in press; Fernald and Kuhl, 1987; Werker & McLeod, 1989). Thus, the preference in 4-month-old infants is consistent and strong. The 7-week-old infants in this study demonstrated a significant preference for IDT over ADT in both the female speaker and the male speaker conditions, but when analyzing the individual first three looks, the preference did not appear to either consistent or strong. Preference was indicated by longer looking times to IDT than ADT in 5 of the 6 trials tested, but the only difference that reached statistical significance was the looking behaviour of male infants in the first look. Although one may conclude that the interactions are spurious and may be simply a result of inherent variability in looking behaviours of young infants, it is also possible that preference for IDT over ADT in 7-week-old infants is less robust than the preference found in 4-month-old infants.

Preference for the female speaker over the male speaker has been demonstrated by 4-month-old infants. In the current study, 7-week-old infants also demonstrated preference for the female speaker over the male. As mentioned, this preference could simply be an artifact resulting from the particular female and male voices used. Alternatively, it could indicate either that male voices do not have the relevant acoustic qualities necessary to attract the attention of infants or that individual differences in the amount of exposure infants have had to male voices result in preference differences.

It was not possible to assess differential preferences for female IDT versus male IDT in this study because there was no interaction between speaker gender and style of speaking. There was no indication of preference for the female speaker's IDT over the
male speaker's IDT when the means of the last two habituation trials were compared.

The almost universal occurrence of IDT has led to the suggestion that infants have a perceptual predisposition to attend to IDT over ADT (e.g., Fernald, 1984). As mentioned in the introduction, evidence of preference in 7-week-old infants does not necessarily imply a biological preference for IDT over ADT or for a female speaker over a male speaker. Indeed, the evidence presented herein suggests that infants of 7 weeks of age may not have as robust a preference for IDT over ADT as infants of 4 months. This would suggest that whether or not there is a perceptual predisposition toward IDT, there is a developmental progression in the stability of preference for IDT over ADT.

It is possible that experience enhances or facilitates the development of preference. For example, evidence suggests that neonates prefer their mother's voice over that of another female (DeCasper & Fifer, 1980). The infants do not, however, show a preference for their father's voice over that of their mother or over a strange female's voice (DeCasper & Prescott, 1984). Interestingly, the preference may be the result of prenatal exposure to the maternal voice, which is believed to be the most salient acoustic stimulus prenatally (Rubel, 1985; Fifer & Moon, 1988). The preference for a female's voice over a male's voice found in the present study may be due, in part, to the prenatally biased experiences or even to differential postnatal experiences with female over male caretakers.

Future studies are needed to assess the relationship between differential experience with IDT and ADT and differential preference for IDT over ADT. One way in which the effect of experience might be assessed would be to see if infants demonstrate a preference for IDT in a language that is non-familiar. If the preference for IDT over ADT is less in non-ambient language than in the parental native language, it could be inferred that experience plays a role in infants' developing preferences for native language IDT. This research is presently underway in our lab.

Much research is needed before any firm conclusions can be drawn about the
degree to which early preferences reflect biological predispositions for female speakers or IDT. Regardless, these results indicate that a preference for IDT over ADT is evident by 7 weeks of age. This allows researchers to begin to consider the influences that preference for IDT may have on early language and emotional development.
References


List of Tables

Table 1. Source table for the 2 (Style of speaking: IDT vs ADT) x 2 (speaker gender) x 2 (infant gender) x 3 (first three looks) Mixed ANOVA to assess preference.

Table 2. Source table of the simple main effects for the 3 Way interaction among infant gender (Male vs Female), style of speaking (IDT VS ADT), and the first three looks (L1,L2,L3), to assess at which combination of infant gender and three looks do the IDT and ADT looking times vary.

Table 3. Source table of the simple main effects for the 3 Way interaction among infant gender (female infant vs male infant), speaker gender (female vs male), and first three looks (L1, L2, L3), to assess at which combination of speaker gender and first three looks do the looking times vary for speaker gender.
Table 1

Source table for the 2 (Style of speaking: IDT vs ADT) x 2 (speaker gender) x 2 (infant gender) x 3 (first three looks) Mixed ANOVA to assess preference.

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P<.001 ***
P<.01 **
P<.05 *

Sphericity Test Tail Probability = .07
Greenhouse-Geisser Adjustment = .8859
Table 2

Source table of the simple main effects for the 3 Way interaction among infant gender (Male vs Female), style of speaking (IDT VS ADT), and the first three looks (L1,L2,L3), to assess at which combination of infant gender and three looks do the IDT and ADT looking times vary. Note that the first three looks are also the first three trials (see text).

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<td>.012</td>
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<tr>
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<td>Omnibus Error</td>
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<td>1,840.751</td>
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</table>

P<.001 ***
P<.01 **
P<.05 *
Table 3

Source table of the simple main effects for the 3 Way interaction among infant gender (female infant vs male infant), speaker gender (female vs male), and first three looks (L1, L2, L3), to assess at which combination of speaker gender and first three looks do the looking times vary for speaker gender.

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
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<tbody>
<tr>
<td>Female Inf x L1</td>
<td>86.914</td>
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<tr>
<td>Female Inf x L2</td>
<td>34.587</td>
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<td>Female Inf x L3</td>
<td>11,518.309</td>
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<td>11,518.309</td>
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<tr>
<td>Male Inf x L1</td>
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<tr>
<td>Male Inf x L2</td>
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<td>Male Inf x L3</td>
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</tr>
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P<.001 ***
P<.01 **
P<.05 *


List of Figures

Figure 1. Fundamental frequencies taken from the recordings of female speaking to an infant (IDT) in the top figure and to an adult (ADT) in the bottom.

Figure 2. A side view of the testing room which was draped in black curtains. Observers are screened from the parent and infant, and everyone except the infant wears headphones to mask the stimuli.

Figure 3. The experimental design. "Female" and "Male" refer to the gender of the speaker. Each of the experimental groups was balanced for infant gender.

Figure 4. Looking time to IDT versus ADT trials for male infants during each of the first three looks.

Figure 5. Looking time to IDT versus ADT trials for female infants during each of the first three looks.

Figure 6. Looking time to female versus male speakers for male infants during each of the first three looks.

Figure 7. Looking time to female versus male speakers for female infants during each of the first three looks.
FEMALE INFANT DIRECTED TALK

I LOVE THESE LONG MORNINGS, DON'T YOU? I WISH THEY COULD LAST ALL DAY.

TIME IN SECONDS 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0

FEMALE ADULT DIRECTED TALK

I LOVE THESE LONG MORNINGS, DON'T YOU? I WISH THEY COULD LAST ALL DAY. WELL, AT LEAST IT'S FRIDAY...
FIGURE 2.
# EXPERIMENTAL DESIGN

<table>
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<tr>
<th>EXPERIMENTAL CONDITIONS</th>
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<tr>
<td>MALE</td>
<td>IDT</td>
<td>IDT</td>
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</tr>
</tbody>
</table>

N=72
FIGURE 4.

IDT VS ADT
MALE INFANTS

FIRST THREE LOOKS
FIRST LOOK P< .01
FIGURE 5.

IDT VS ADT
FEMALE INFANTS

MEAN DURATION

IDT  ADT

FIRST THREE LOOKS
FIGURE 6.

FEMALE VS MALE SPEAKER
FEMALE INFANTS

FIRST THREE LOOKS
THIRD LOOK P< .05
FIGURE 7.

FEMALE VS MALE SPEAKER
MALE INFANTS

FIRST THREE LOOKS
FIRST LOOK P < .001