

Degrees of phonetic enhancement by speech clinicians towards speech- /language- impaired children

Leanne Secen & Tae-Jin Yoon

McMaster University

secenl@mcmaster.ca; tjyoon@mcmaster.ca

Acoustic phonetic studies on the speech of speech clinicians were conducted, when speech clinicians communicated with speech and/or language impaired children through regular, one-to-one training sessions. The participants in this study included three speech clinicians and twelve children with a speech and/or language disorder. Four children of different severities of the speech and/or language disorder were assigned to each speech clinician. The speech clinician read a short script to the child, and in isolation (serving as a baseline). Each scenario contained one target sentence to be studied in terms of mean pitch, maximum pitch and minimum pitch. Results show that while mean and maximum pitches increasingly differ from baseline, to high-level comprehension and to low-level comprehension children, the minimum pitch value does not differ across the levels of comprehension. This study illustrates the way linguistic phonetic enhancement is achieved by speech clinicians for facilitating communicative comprehension by children with speech and/or language impairment.

1 Introduction

The diagnosis of Autism Spectrum Disorder among adolescents and children poses a range of difficulties including physical disorders (e.g. motor skills) and communication skills including social interaction, and exhibiting and processing emotion (Adrien *et al.* 1991). The social aspect of Autism so commonly defines this disorder and thus is often referred to as a “social learning disorder” (Landry & Bryson 2004, Smith & Camarata 1999). Specifically with regards to communication skills, speech and/or language impaired children have difficulty with the acquirement and development of such social interaction. These delays in communication can affect children’s ability to interact effectively and negatively influence other areas of development. Therefore, research on an effective means of communication between caregiver and a child with a speech and/or language disorder will lead to great benefit on behalf of children and their caregivers.

Recent studies have confirmed that speech clinicians interacting with speech and/or language impaired children, specifically Autism Spectrum

Disorder, use similar cues to that of infant-directed speech (Ochs *et al.* 2005, Baranek 1999). Most studies regarding infant-directed speech deal with children in the first few years of life. Children with a speech and/or language disorder on the Autism Spectrum result in difficulties in social, verbal and communicative behaviour (Parisse 1999). Thus it makes logical sense that characteristics of infant-directed speech would be similar to those directed towards children with Autism Spectrum Disorder.

Speech is simplified and exaggerated when directed toward typically developing children in terms of linguistic structure (Trainor *et al.* 1997). It is observed that not only parents but also children as young as four-years-old use infant-directed speech towards their two-year-old siblings (Shatz & Gelman 1973). A slower speech rate, wide pitch range and enhanced voicing distinctions are characteristics of infant-directed speech (Trainor & Desjardins 2002, Trainor *et al.* 1997). The simplified and enhanced input is thought to serve a number of purposes: First, the unique linguistic characteristics serves to maintain the attention through arousal of the child (Cooper *et al.* 1997). Second, the infant becomes familiarized with the emotional cues of speech that will permit in the development of social ties and bonds, and other relationships (Bergeson & Trehub 2002). Finally, it helps to aid the language acquisition process by emphasizing certain aspects of linguistic structure that should be of focus (Cooper *et al.* 1997, Werker *et al.* 1994).

The characteristics of infant-directed speech, however, are not static but rather in constant changes over time (Fernald 1992), presumably adjusted to the child's developmental and communicative needs. For example, at the earlier stage of child's development, high-pitched sounds are important to draw the attention of child (Fernald 1994, Trainor & Zacharias 1998). However, as the child undergoes various developmental stages, lower levels of prosody suffice to serve the same function.

Given that there are many different levels of communicative skills in speech and/or language impaired children, we may hypothesize that similar patterns may emerge when the prosody of caregivers is examined. In this paper, we will examine the levels of pitch of speech clinicians who communicate with these children through regular, one-to-one speech training sessions. Even though recent studies indicate the similarity between infant-directed speech and that of speech clinicians (Ochs *et al.* 2005, Baranek 1999), whether impaired levels of comprehension by speech and/or language impaired children affects the degree of prosodic enhancement in the speech of the caregiver such as speech clinicians warrants investigation.

We would expect that there will be differences in the speech characteristics of the speech clinicians between when they interact with children with a low level of comprehension and when they communicate with children with a high level of comprehension. Specifically, if the main goal of speech communication

is to help children with language acquisition as well as to maintain attention of the child, it would be predicted that a lower level of comprehension would induce a more exaggerated form of speech by the speech clinician.

2 Methods

2.1 Participants

Two groups of participants, speech clinicians and children diagnosed with a speech and/or language disorder, were recruited for this study. Three speech clinicians (two Speech-Language Pathologists and one Communicative Disorder Assistant) were recruited for the experiment. All three were female, and affiliated with Building Blocks Speech Pathology in Hamilton, Ontario. The twelve children recruited for the experiment are clients of Building Blocks Speech Pathology. All children had some type of speech and/or language impairment that stemmed from a neurological disorder. The large majority of these children fell on the Autism Spectrum Disorder but there was a single case of Down Syndrome as well. The children ranged from age six to thirteen, including seven boys and five girls. The three speech clinicians collectively categorized the 12 children based on their level of comprehension, as either *low comprehension* or *high comprehension*.

The low comprehension group provided such cues as minimal to no eye contact, a minimal length of time able to remain seated and a significant number of instances of highly repetitive behaviours. It is important to note that although speech production was taken into consideration, it didn't function as a sole determining factor. The high comprehension group could remain engaged in activity for a lengthier amount of time, increased amount of eye contact, most often with an ease of speech production and better overall social skills.

2.2 Procedure

Each speech clinician was assigned to four children based on the speech clinicians' past experience with the child as well as the child's comfort level with the speech clinician. Each group of four children consisted of two low level comprehension children and two high level comprehension children.

Prior to the one-to-one speech training session, the speech clinicians were instructed to read a short script to the child containing twelve simple scenarios. The speech clinician wore a microphone headpiece while reading the script. A picture, corresponding with each scenario, was presented to the child. This was to keep the child engaged during the recording. An example scenario is: "*The little girl is getting dressed for school. She can wear a red dress or a green dress.*" where "*She can wear a red dress or a green dress*" is the target utterance. The

speech clinician, experimenter and child were present during the recording. Sometimes the parent/guardian sat in during the recording as well. Upon completion of the script, the microphone was turned off and the experimenter exited the recording room.

Approximately two to three weeks following the script recording between speech clinician and child, the speech clinician was instructed to read the script in isolation. The script read in isolation was to serve as a baseline and as a means of comparison. Questions inserted into the script to engage the child were omitted and only target utterances were recorded. The speech clinician was instructed to read the script as if speaking to a typically developing child.

3 Results

Each of the twelve scenarios within the script contained a target utterance for a total of twelve target utterances. Each of these target utterances was in terms of mean pitch, maximum pitch, minimum pitch and duration. Waveforms and Spectrograms with superimposed F0 contours are presented in Figure 1 for the three groups containing the target utterance “*There is a big ball and a little ball.*”

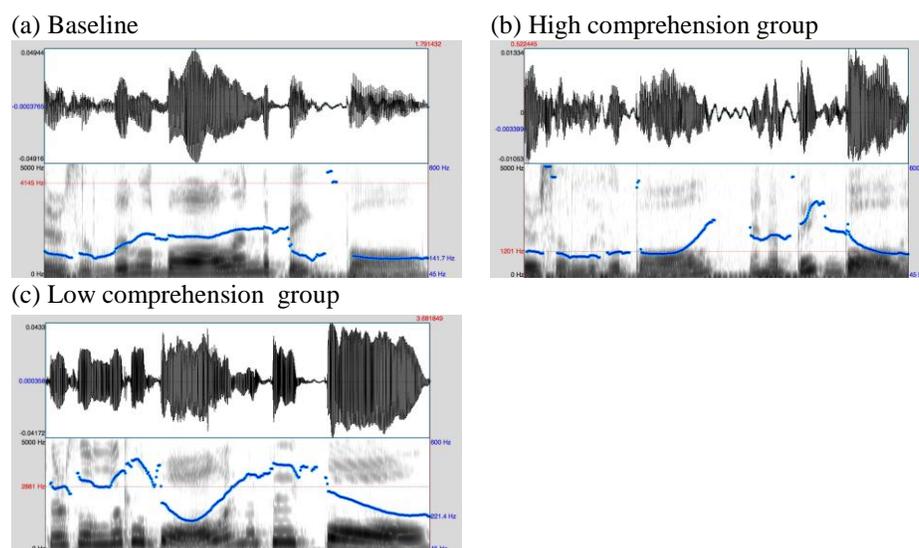


Figure 1. Waveforms and spectrograms with superimposed F0 contours uttered by a speech clinician in three different contexts

For a statistical analysis, we performed a 3 (low comprehension vs. high comprehension vs. baseline) x 3 (three speech clinicians) factorial ANOVA. The results of the main effect of degree of comprehension of utterance mean pitch, utterance maximum pitch and utterance minimum pitch are presented in Figure 2.

The factorial ANOVA indicates that there is significant effect for degree of comprehension in terms of utterance mean pitch $F(2,169) = 21.80, p < .05$. There is a large effect, $\eta^2 = .205$ (cf. Figure 2a). The low comprehension group induced a significantly higher mean pitch than the high comprehension group and the baseline measure. There was no significant difference between the high comprehension group and the baseline measure. The baseline group in this instance has a steady pitch contour that does not vary drastically, as shown in Figure 1a.

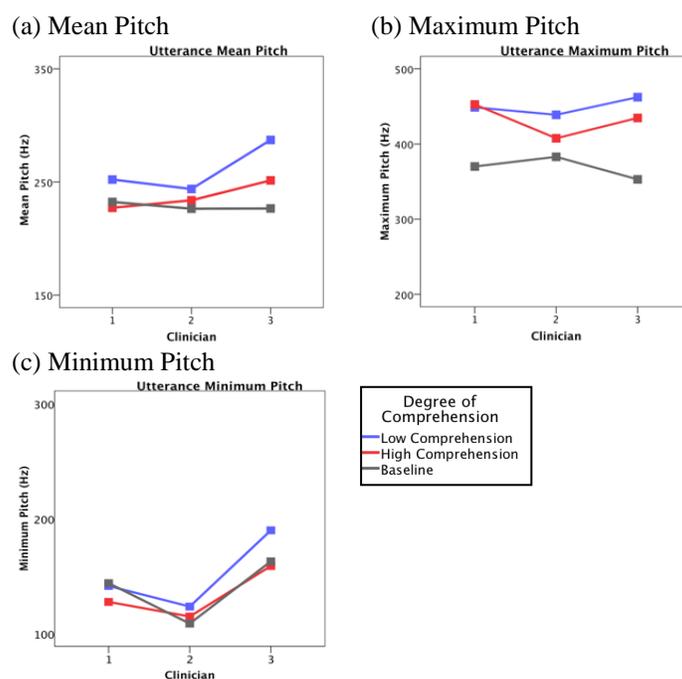


Figure 2. Results of the main effects of degree of comprehension of utterance mean pitch, utterance maximum pitch, and utterance minimum pitch

A significant effect for degree of comprehension in terms of utterance maximum pitch, as in Figure 2b, was determined $F(2, 169) = 18.05, p < .05$. Again, there is a large effect, $\eta^2 = .176$. Unlike utterance mean pitch, there was no significant difference between the low comprehension group and the high comprehension group. However, both of these groups induced a significantly higher pitch than the baseline measure.

In terms of minimum pitch (cf. Figure 2c), there was no significant effect for degree of comprehension $F(2, 169) = 20.0, n.s$. The low comprehension group, high comprehension group and baseline measure induced a similar level

of minimum pitch. In all three cases, there was no individual variation among speech clinicians. This “invariant nature of minimum pitch” (Pierrehumbert 1980) may function to maximize salience via pitch differences. In other words, the constancy of the minimum pitch serves as a baseline whereas the fluctuations in the higher levels of pitch determine the greatness of the pitch range. Although the minimum pitch is similar between the high comprehension group, the low comprehension group and the baseline measure, the fluctuations in the mean pitch between these two levels of comprehension are significantly different. The pitch range induced by the low comprehension group is much greater in comparison to the pitch range induced by the high comprehension group. The minimum pitch seems to be unaffected by extraneous factors. Similar findings have been reported in Kim *et al.* (2006), in that the minimum pitch is more or less invariant in naturally occurring speech corpora.

4 Discussion and Conclusions

The results of the current study are in line with previous studies in that interaction with children diagnosed with a speech and/or language disorder induces different degrees of phonetic properties such as pitch and duration (Ochs *et al.* 2005; Baranek, 1999). The higher pitch could serve as functions of maintaining the child’s attention, assisting the child with the interpretation of emotional signals, and hence, aiding the language acquisition process.

In terms of infant-directed speech towards typically developing children, Stern *et al.* (1983) and Papusek (1993) make note that the exaggeration and emphasis of the characteristics of this modified speech depend on the age of the child. That is, a younger age induces a more exaggerated form of infant-directed speech. A parallel line can be drawn between the differences in a younger age and older age in comparison to a low comprehension level and a high comprehension level. A younger age and a lower comprehension level both would give much less of a response in comparison to their counterparts. This would induce greater exaggeration of the modified speech by the caregiver.

Overall, a lower level comprehension induces a higher pitch in terms of mean pitch, in comparison to a high level comprehension. This is most likely due to the lack of feedback from the children in the low comprehension group in an attempt to engage the child in activity. The maximum pitch does not differ between the low and high comprehension groups, although significantly higher than the baseline measure. Minimum pitch remains constant across the low comprehension, high comprehension and baseline measure.

The modulation of the pitch range dependent on the level of comprehension may be linked to the conveyance of emotion using the medium of prosodic features. It is known that the emotional prosody with a loving and warm tonal properties is important in attracting child’s attention (Trainor *et al.* 2000;

Trainor 1996). Children with Autism Spectrum Disorder have difficulty in recognizing emotions (Kuusikko *et al.* 2009). Speech clinicians tend to use higher levels of phonetics properties when interacting with the low comprehension group in comparison to the higher comprehension group in an attempt to additionally stress the emotional aspect of the speech. That is, an enhancement of pitch levels will reflect the emotional development.

Acknowledgments

A special thanks goes to the speech clinicians and clients at Building Blocks Speech Pathology for participating in this study. We would also like to thank the McMaster University Faculty of Humanities and the Vice-President (Research) and NSERC for their financial support.

References

- Adrien, J.L., Faure, M., Perrot, A., Hameury, L., Garreau, B., Barthelemy, C. & Sauvage, D. (1991). Autism and Family Home Movies: Preliminary Findings. *Journal of Autism and Developmental Disorders*, 21, 43-49.
- Baranek, G.T. (1999). Autism During Infancy: A Retrospective Video Analysis of Sensory-Motor and Social Behaviors at 9-12 Months of Age. *Journal of Autism and Developmental Disorders*, 29(3), 213-224.
- Bergeson, T.R. & Trehub, S.E. (2002). Absolute Pitch and Tempo in Mothers' Songs to Infants. *Psychological Science* (13)1, 72-75.
- Cooper, R.P., Abraham, J., Berman, S. & Staska, M. (1997). The Development of Infants' Preference for Motherese. *Infant Behavior and Development*, 20(4), 477-488.
- Fernald, A. (1992). Meaningful melodies in mothers' speech to infants. In H. Papousek, U. Jurgens, & M. Papousek (Eds.), *Nonverbal vocal communication: Comparative and developmental approaches* (pp. 262-282). Cambridge, England: Cambridge University Press.
- Kim, H., Yoon, T., Cole, H. & Hasegawa-Johnson, M. (2006). Acoustic Differentiation Between L- and L-L% in Switchboard and Radio News Corpus. *Proceedings of the 3rd ICSA International Conference on Speech Prosody*. Dresden, Germany.
- Kuusikko S., Haapsamo, H., Jansson-Verkasalo, E., Hurtig, T., Mattila, M., Ebeling, H., Jussila, K., Bölte, S., & Moilanen, I. (2009). Emotion Recognition in Children and Adolescents with Autism Spectrum Disorders. *J Autism Dev Disord*, 39, 938-945.

- Landry, R. & Bryson, S.E. (2004). Impaired disengagement of attention in young children with autism. *Journal of Child Psychology and Psychiatry*, 45(6), 1115-1122.
- Ochs, E., Solomon, O., & Sterponi, L. (2005). Limitations and Transformations of Habitus in Child-Directed Communication. *Discourse Studies*, 7, 547-83.
- Papousek, H. (1993). Transmission of the Communicative Competence: Genetic, Cultural, When, and How? *International Journal of Psychology*, 28(5), 709-717.
- Parisse, C. (1999). Cognition and language acquisition in normal and autistic children. *Journal of Neurolinguistics*, 12, 247-269.
- Pierrehumbert, J. (1980). The phonology and phonetics of English intonation, Ph.D. Dissertation, MIT.
- Smith, A.E. & Camarata S. Using Teacher-Implemented Instruction to Increase Language Intelligibility of Children with Autism. *Journal of Positive Behavior Interventions*, 1(141), 141-150.
- Shatz, M. & Gelman, R. (1973). The Development of Communication Skills: Modifications in the Speech of Young Children as a Function of Listener. *Monographs of the Society for Research in Child Development*, 38(5), 1-42.
- Stern, D., Spieker, S., Barnett, R. & MacKain, K. (1983). The Prosody of Maternal Speech: Infant Age and Context Related Changes. *Journal of Child Language*, 10(1), 1-15.
- Trainor, L. (1996). Infant Preferences for Infant-Directed Versus Noninfant-Directed Playsongs and Lullabies. *Infant Behaviour and Development*, 19, 83-92.
- Trainor L., Austin, C., & Desjardins, R. (2000). Is Infant-Directed Speech Prosody a Result of the Vocal Expression of Emotion? *Psychological Science*, 11(3), 188-195.
- Trainor, L., Clark E.D., Huntley, A., & Adams, B.A. (1997). The Acoustic Basis of Preferences for Infant-Directed Singing. *Infant Behavior and Development*, 20(3), 383-396.
- Trainor, L. & Zacharias C.A. (1998). Infants prefer high-pitched singing. *Infant Behaviour and Development*, 21(4), 799-806.
- Werker, J.F., Pegg, J.E. & McLeod P.J. (1994). A Cross-Language Investigation of Infant Preference for Infant-Directed Communication. *Infant Behaviour and Development*, 17, 323-333.