Comparison of Nonverbal Sensitivity Between Normal Hearing and Hearing-Impaired Children of Bangladesh

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ABSTRACT

This study, with its potential to significantly impact professional practice, has compared the nonverbal sensitivity (NVS) of 6-16-year-old normal hearing (NH) children and hearing impaired (HI) children. In total, 20 children participated in this study, with two groups made, one with ten NH children and the other with ten hearing-aid-user HI children. The Face and Body-only Profile of Nonverbal Sensitivity (FBo-PONS) test was administered to measure NVS in both groups. The test scores were evaluated and analysed separately regarding the overall score, body-only cue score, and face-only cue score. The findings, which have direct implications for communication therapy and rehabilitation, showed lower accuracy in decoding nonverbal cues in HI than in NH children. However, in individual cue comparison, HI children scored less in body-only nonverbal cue decoding and were almost similar to NH children in face-only nonverbal cue decoding. Problems in NVS can affect communication competence, thereby influencing the ability to form interpersonal relationships. However, this essential part of communication is often less considered in communication therapy and rehabilitation.

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Introduction

Nonverbal communication (NVC) is the counterpart of verbal communication and a crucial indicator of typical language development. (Hall et al., 2019; McNeill, 2000; Mundy et al., 1995). Verbal language is considered the primary mode of communication (McLaughlin, 2011); however, to achieve communication competence and establish fruitful social relations, comprehension, and reciprocation of NVC are required (Hall et al., 2009; Hall & Knapp, 2021; Matsumoto et al., 2016). A set of human behaviors (e.g., gesture, eye contact, body language, facial expression, paralanguage) that are not strictly linguistic but convey meaning are often labeled as NVC, but the overall NVC is more widespread and intricate than just nonlinguistic means, it encompasses all communication modes except spoken or written words (Hall & Knapp, 2021; Knapp et al., 2014; Matsumoto et al., 2016). NVC dispels the ambiguity of spoken words and adds a garnish of emotions and to verbal language. In general, it has three aspects in communication: one concerned with the sending of nonverbal cues (encoding), the second concerned with accurate perceiving (decoding), and the last is concerned with the interaction between encoding and decoding. (Knapp et al., 2014). A specific part of this vast study area is nonverbal sensitivity (NVS), which concerns only the accurate interpretation of nonverbal cues.

Efficacious social interaction is the foundation of social competence. Being ineptitude in NVS restrains a person from comprehending the intended verbal message; as a result, it affects related response production (Castelli et al., 2008; Magill-Evans et al., 1995; Russell et al., 1987). On the contrary, nonverbally sensitive populations demonstrate better academic performance and are professionally competent, and NVS also facilitates the client-therapist rapport-building (Knapp et al., 2014; Riggio & Darioly, 2015; Rosenthal et al., 2013).

Also, similar to NVC, NVS is considered to have some culture-specific features, but the cross-cultural similarities cannot be ignored. Studies depicted cross-cultural similarities of NVS after they found that six facial emotional expressions with high accuracy in decoding and encoding across different cultures (Ekman, 2003; Ekman & Friesen, 1969; Feldman & Thayer, 1980). The free flow of information in different cultures or simply the universal neurological composition of the human brain can be the reason behind this. (Knapp et al., 2014). For this reason, it was possible to develop universally validated tools to measure the NVS. (Riggio & Darioly, 2015; Rosenthal et al., 2013).

Nonverbal Sensitivity (NVS) in Typically Developing Children

Nonverbal communication ability develops from infancy, even before the emergence of verbal language (Hall et al., 2008; Hodgins & Koestner, 1992). During the first few months newborns communicate with their caregiver through facial expression and crying, and they learn this by imitating the nonverbal cues of others (Knapp et al., 2014; Trees, 2000; Xue et al., 2015). They also respond to visual cues within eight to twelve inch range and assimilate feelings of warmth and love with the smell of their mother (Dil, 1984; Trees, 2000; Xue et al., 2015). Before the expression of the first word, the child uses nonverbal means to communicate, but the verbal and nonverbal cues are parallelly encoded (Knott, 1979). Gradually child learns to balance between nonverbal and verbal means of communication. If the child continues to use nonverbal means even after the verbal language emergence period then the child is considered to have language delay (Dale et al., 2003; McLaughlin, 2011).

NVS develops highly during adolescence, till mid-thirties, and after that it gradually decreases (Knapp et al., 2014). However, its role in language development, personality, and thought processing is lifelong (Castelli et al., 2008). These senses impact the formation of thoughts and personality. In terms of comprehension children rely more on verbal means at young age, but older children rely more on mixed formation and adults focus more on nonverbal tonal quality during comprehension (Bugental et al., 1970; Morton & Trehub, 2001). A child can encode gestures from an early age, which is not only used as a medium of communication for a child but also can predict the nouns that a child will acquire while developing two-word utterances (Goldin-Meadow & Alibali, 2013). Melzer et al. (2015) found that nonverbal intelligence contributes to the explanation of the variance in children’s lexical and grammatical skills; however, it can explain some relation between NVS and language competence.

Hearing Impairment and Nonverbal Sensitivity (NVS)

As NVS starts developing right after birth, it is hypothesized that HI children may fail to develop sensitivity to auditory nonverbal cues. However, it should not affect the sensitivity of other nonverbal means. Contradicting this Knapp et al. (2014) stated that young HI children are not proficient in making voluntary expressions. Although they can process facial expression of emotions, they possess deficit in processing prosodic feature of emotion (Hopyan-Misakyan et al., 2009). The cause of this can be the parallel relation between verbally expressive and paralinguistic features (Rosenthal et al., 2013). Type of hearing loss interacts with the NVS differently. Only bilateral hearing loss is found to be negatively correlated with nonverbal intelligence (Emmett & Francis, 2014).

During developmental years, HI children employs their residual sensory abilities to make sense of their surrounding and up to two years they show parallel quantity of communication, after that the required preverbal skills for language development are delayed for apparent cause of deficit in audiological sensory input (Halliday et al., 2017; Kutz et al., 2003). Schlumberger et al. (2004) distantly supported the notion that HI does not affect the nonverbal development profoundly but affects the neuropsychological development sequence linked with the hearing ability and NVS. Studies also proposed that deteriorated NVS due to HI affects the ability to quality use of spontaneous speech (Werfel et al., 2020). However, as NVS of NH population interacts with various factors, it can be assumed that it is similar for HI population too.

Measuring Nonverbal Sensitivity (NVS)

NVS measuring tools are used as research and diagnostic tools but most NVS measuring tools are categorized as 'Performance-based measuring tools' and 'Self-report measures.' Performance-based sensitivity measures were the earliest and were used to assess the individual's competence in reading and decoding nonverbal cues.

From the standpoint of measurement, performance measures are superior to other methods because there is an objectively correct answer (Riggio & Darioly, 2015). One of the earliest measures of NVS is the Brief Affect Recognition Test (BART). It included micro-expressions of six basic emotions in 110 black-and-white photos, and participants were asked to judge the emotions (Ekman & Friesen, 1974). Later, a Profile of Nonverbal Sensitivity (PONS) was developed, which is the most widely researched performance-based measure of NVS. It is a

thin-slice methodology-based, well-established research tool (Hall & Bernieri, 2004; Murphy et al., 2015). The full PONS test consists of 220 short (two seconds) visual, audio, and audio-visual stimuli presented through a 47-minute black-and-white video. These stimuli presented 20 short situations through 11 (NVC) channels, portrayed by a 24-year-old female model. There existed an answer sheet with 220 pairs of options (for each scene, two options). The task taker needs to watch and listen to the video and select the preferred answer that they think resembles the scene. Different types of PONS were introduced, which are quite reliable, like the full version. Face and body PONS (FBo- PONS) (consists of 40 face and body only stimuli), MiniPONS (consists of 64 combined stimuli from the full test), Audio PONS (consists of 40 voice only without picture stimuli), Brief exposure of PONS, Still Photos PONS, are mostly used PONS apart from full PONS (Rosenthal et al., 2013).

Apart from PONS, Diagnostic Analysis of Nonverbal Accuracy (DANVA), Japanese and Caucasian Brief Affect Recognition Test (JACBART), Multimodal Emotion Recognition Test (MERT), and Contextual and Affective Sensitivity Tests (CAST) are renowned performance-based NVS measuring tools.

As NVS has several culture-specific characteristics, the reliability of NVS measuring in different cultures can be questioned. Keeping this in mind researcher performed several cross-cultural validation studies to determine the validity of these measuring tools. For instance PONS was performed on more than 2000 participants with approximately 60 participants from 20 diverse nations and every culture scored (r = 0.7) considerably better than expected (Rosenthal et al., 2013). In general, the NVS measuring tools are developed on the principle of universal inherent nonverbal cue decoding ability (Knapp et al., 2014).

Nonverbal Sensitivity (NVS) in Communication Studies

The evidence of NVC study can be found back in the ancient Greece and Rome (Arif, 2015; Knapp, 2006); however, the most renowned scientific study of NVC was by Charles Darwin in 1872, he explained that the expressions have a communicative role and grater social engagement require more significant variation of expressions (Knapp, 2006).

The studies of NVC encapsulates the NVS and IS topics too. In earlier studies, NVS was mainly studied associated with emotional expression (Ekman & Friesen, 1974) which worked as a base to various studies till date, and it is considered that NVS can be a predictor of emotional intelligence (EI) (Fernández-Abascal & Martín-Díaz, 2019). After the development of PONS test the investigation on NVS was accelerated. With the measuring tool, primary studies were done to determine the gender difference of NVS. Also the validation studies of PONS facilitated several studies, which established the relation between higher PONS score (better NVS) and well-adjusted personality, professional competence, better academic performance, and better interpersonal relationship (Knapp et al., 2014; Riggio & Darioly, 2015; Rosenthal et al., 2013).

NVS was most extensively studied in the field of psychology and communication research sector. In communication disorders, NVS was measured between different neurological disorders and typical group to identify the deviation of the former group. These investigations suggested that children with Autism Spectrum Disorder and Down Syndrome are less nonverbally expressive and they find it challenging to utilize different NVC components combined like typical group (Chiang et al., 2008; Dil, 1984; Fidler et al., 2005) and Learning Disability affects the quality of social interaction due to decreased NVS though the quantity of communication remains normal (Lekhanova & Glukhova, 2016; Stone & La Greca, 1984).

The clinical implication of NVC is the least documented area within the enormous realm of NVC studies, but these minute number of exploration suggested that higher NVS facilitates the client patient relationship and helps in forming patient oriented goals (Finset & Piccolo, 2011; Knapp et al., 2014). In SLP, various nonverbal cues are now used as a part of total communication therapy (Connor et al., 2000), and knowledge of NVS abets the SLT in planning rehabilitation procedure. In Bangladesh, researchers have explored NVC symbols, features, and socio-cultural aspects (Arif, 2015; Islam & Kirillova, 2020). Only few studies addressed the clinical implication of NVC as a linguistic item (Farhan et al., 2021).

Rationale of the Study

In Bangladesh, Speech and language pathology (SLP) is an emerging field (Alam et al., 2023), and research in the SLP field mainly focuses on the analysis of the linguistic and cultural features of the Bengali language. Moreover, the rehabilitation of HI children follows almost a linear procedure of either device use and speech therapy or use of sign language. The idea of how well a HI child can understand a nonverbal cue will give an insight to the SLT about extraverbal linguistic strength while planning the therapy, also to accommodate the skill into the process. This study gives a perception on the relation between rehabilitation and NVS, which helps the SLT to assume further communicative competence. Also better NVS results in better interpersonal relationships and this study opened a new horizon of ideas in client-therapist rapport building. (Finset & Piccolo, 2011).

Present Study

This study aimed to explore the impact of auditory perception in nonverbal communication and compared the nonverbal decoding ability of HI and NH Bangladeshi children. This study analysed the NVS of HI and NH children by performing the FBo-PONS test. Differences between both groups' scores were compared, and the correlation between rehabilitation age (RA) and PONS was identified. Thus this study addresses the following research questions:

a) Is there any significant difference in the nonverbal decoding ability of HI and NH children?

b) Is there any correlation between the length of hearing aid use and NVS?

c) Is there any within-group difference between different nonverbal cue decoding?

Methods

Participants with Hearing Impairment

The HI group consisted of 10 children (three females, seven males) with moderate to severe bilateral hearing loss aged 6 to 16 years with a mean age of 12.2 years. Participants were all from HICARE School, Dhaka, Bangladesh. Participants' hearing profiles were collected from children's parents, teachers, and audiologists. (See Table 1). All participants were in the rehabilitation process and had frequent exposure to socially interactive environments. Though NVS develops from infancy to adulthood; still, studies have suggested that the PONS score improves from middle childhood to late adolescence and have considered the age range of 6 to 16 years for children to measure social perception ability and NVS (Emmett & Francis, 2014; Magill-Evans et al., 1995; Riggio & Darioly, 2015). All participants were hearing aid users, but their rehabilitation age was different and they had congenital hearing loss (prelingually HI). Cochlear implanted may differ in NVS score from the hearing aid user due to their rehabilitation type (Schlumberger et al., 2004). That is why persons with cochlear implants and unilateral HI were excluded to serve the objective of the study.

Table 1: Description of HI participants

Participants	Sex	CA	RA (years of using hearing aid)	Academic Class	Level of HI
1	F	8	6	3	Moderate
2	M	9	6	3	Moderate
3	M	10	6	3	Severe
4	F	10	4	3	Severe
5	M	12	5	4	Severe
6	M	13	8	4	Severe
7	M	14	8	7	Severe
8	M	15	10	8	Severe
9	M	15	12	8	Severe
10	F	16	11	8	Moderate

**Note: F= Female, M=Male, CA= Chronological Age, RA= Rehabilitation Age, HI= Hearing Impairment*

Participants with Normal hearing (NH)

The NH group consisted of 10 children, female and male ratio equal to the HI group. All participants were 6-16 years old, with a mean age of 12.3 years, and from Dhaka city. Participants' medical profile was collected from their parents (see Table 2). The similar age range of both groups was followed due to the absence of medical, cognitive, neurological, and developmental delay and comparatively similar academic levels according to age; which indicates almost similar mental age and previous studies claimed that HI does not affect intelligence (Glymour et al., 2012; Mayberry, 2002).

Table 2: Description of NH participants

Participants	Sex	CA	Academic Class
1	F	6	1
2	F	6	1
3	M	9	4
4	M	10	5
5	F	11	6
6	M	11	6
7	M	11	6
8	M	12	7
9	M	13	7
10	M	15	8

**Note: F= Female, M=Male, CA= Chronological Age.*

Sampling procedure

This study followed the purposive sampling. Though purposive sampling is often considered to have high chance of biasedness, but this procedure ensures methodological consistency and accurately serves the purpose of the study (Campbell et al., 2020). For this study the researcher intended to follow the purposive sampling as there was scare of appropriate participants which restricted the ability to follow other sampling procedure.

Data Collection

Data Collection Tool

The face and body only (PONS) test was used to collect NVS data. It is composed of 40 pure face and body stimuli derived from the full PONS, presented through a 7-minute black and white video. The duration of each stimulus was 2 seconds, and this form of PONS did not include any sound (Bänziger et al., 2011; Janusik, 2017). The face and body PONS have a 0.63 overall reliability. The PONS has a median test–retest reliability of 0.69 and the internal consistency of PONS test ranges from 0.86 to 0.92 also (Ambady et al., 1995; Ivan, 2011) , The visual channel scores correlates significantly with the full PONS (Hall et al., 2009; Rosenthal et al., 2013). (See Table 3)

Table 3: Full PONS Stimuli Design

Audio	Video				
	No cue	Face Cues	Body Cues	Figure (face+body) cues	Marginals
No cues	--	20	20	20	Video 60
RS cues	20	20	20	20	RS 80
CF cues	20	20	20	20	CF 80
Marginals	Tone 40	Face 60	Body 60	Figure 60	Total 220

**Note: RS = random-spliced voice, CF = electronically content-filtered voice.*

Stimuli

In face and body PONS test, participants were exposed to 40 different 2-second black and white videos which depicted 20 different affective situations. These different situations are presented through visual channel of NVC, and all stimuli are categorized by positivity, negativity, dominance, and submissiveness. Each stimulus was presented 2-3 times per the participant’s need. The answer sheet, which contained 40 pairs of responses, was previously provided. The researcher translated these responses into Bengali from the original face and body PONS answer sheet. Bengali translation was done to culturally adopt the test in Bangladesh; for this, authorized permission of the original developer was taken through email. In the answer sheet, one stimuli response is repeated twice (once through the body-only mode, once through face only mode). The video file was retrieved from the website of Northeastern University Library.

Procedure

The data collection was done by the researcher herself with the face and body PONS test video and answer sheet. The video was presented through SM-A52F/DS Android phone. The device was placed at a comfortable distance from the participant and had the researcher during the test to ensure a similar interstimulus interval. At first, the test was briefly explained to the participants, and the response sheet was provided. The first response and the task were detailed to clarify the process. The stimulus was repeated (maximum twice) per the participant's need. Participants selected one option from the answer sheet for each presented video. For younger participants, the researcher read the responses and asked the participants to choose one. After each video presentation client was given 9-12 seconds to respond (Rigo & Lieberman, 1989). The whole test was performed individually for each participant in a distraction and external noise-free SLT room setting.

Instrumentation and Recording

The researcher collected all the NVS data through the PONS test answer sheet, and participants' names, ages, academic levels, brief medical histories, rehabilitation ages (for the HI group), and levels of impairment (for the HI group) were collected before the test. The researcher stores all documents with permission granted by the institution and participants' parents. Each participant's response was individually evaluated and scored. This study did not require the participant's verbal or physical reaction, so no audio and video recordings were done.

Scoring and Data Analysis

This study implied the quantitative method of comparing the NVS of hearing-impaired and TH children. Participants' answer sheets were evaluated according to the PONS test scoring manual, which provided the correct answer for each response. (Riggio & Darioly, 2015; Rosenthal et al., 2013). Different types of cue responses were scored separately. Descriptive statistics were calculated for age, face-only stimuli, body-only stimuli, and total face and body PONS score and t-test, correlation analysis test was done afterward. The significance level was 0.05.

For reliability analysis of the scoring, the intra-judged reliability assessment was performed. The intra-judge agreement was found to be 97%.

Result

The following section demonstrated the findings of this study, including the demographic information, comparison between face and body PONS test scores of the HI group and NH group, comparison between face PONS and body PONS scores individually, within-group

comparison of face and body NV stimuli, and correlation analysis between RA and face and body PONS score.

Table 4: Demographic characteristics of the HI and NH group

Groups	Sex	Frequency	CA Range	MA	N
HI	Male	7	6 - 16	12.2	10
	Female	3			
NH	Male	7	6 - 16	12.3	10
	Female	3			

**Note: HI = Hearing impaired, NH = Normal Hearing, CA= Chronological age, MA= Mean age, N= Total number.*

Table 4 shows the demographic information of the HI and NH children. All participants were between 6 to 16 years old; among them, 70% were male and 30% were female. The mean age of the HI and NH groups was 12.2 and 12.3, respectively. Each group had an equal number of participants, with a total of 20.

Table 5: Comparison of face and body PONS scores of HI and NH

Groups	M	SD
NH	26.70	3.9454
HI	23.20	3.1198

t	df	MD	Sig. (2-tailed)	95% Confidence Interval of the Difference	
				Lower	Upper
2.20	18	3.5	0.041*	0.15828	6.84172

**The mean difference is significant at the 0.05 level – Independent sample t-test. Notes: M= mean, SD= standard deviation, MD= mean difference, df= degree of freedom*

In Table 5, the t-test was statistically significant ($p = 0.041 < 0.05$), with the mean face and body PONS score of the NH group (M= 26.70, SD= 3.9454) was significantly higher (mean difference 3.50, 95% Confidence Interval [0.158, 6.842]) than the HI group (M= 23.20, SD=3.1198), $t(18) = 2.20$, $p < 0.05$, two-tailed. The result means the NH group has more NVS than the HI group.

Table 6: Comparison of face-only PONS score of NH and HI

Groups	M	SD
NH	12.90	2.1833
HI	13.10	1.9692

t	df	MD	Sig. (2-tailed)	95% Confidence Interval of the Difference	
				Lower	Upper
-0.215	18	-0.2	0.832	-215334	1.75334

**The mean difference is not significant at the 0.05 level – Independent sample t-test.*

Table 6, the t-test was statistically not significant ($p = 0.832 > 0.05$), which means there is no substantial difference between both groups' face-only PONS scores.

Table 7: Comparison of body-only PONS score of NH and HI

Groups	M	SD
NH	13.80	2.4404
HI	10.10	2.5582

t	df	MD	Sig. (2-tailed)	95% Confidence Interval of the Difference	
				Lower	Upper
3.309	18	3.7	0.004*	1.3511	6.0489

**The mean difference is significant at the 0.05 level – Independent sample t-test.*

In Table 7, the t-test was statistically significant ($p = 0.004 < 0.05$), with the mean body PONS score of the NH group (M= 13.80, SD= 2.4404) was significantly higher (mean difference 3.7, 95% Confidence Interval [1.3511, 6.0489]) than the HI group (M= 10.10, SD= 2.5582), $t(18) = 3.309$, $p < 0.05$, two-tailed. The result means the NH group is more nonverbally sensitive to nonverbal body cues than the HI group.

Table 8: Comparison of face-only and body-only PONS scores of the NH group.

Groups	M	SD
b-PONS	13.80	2.4404
f-PONS	12.90	2.1833

t	df	MD	Sig. (2-tailed)	95% Confidence Interval of the Difference	
				Lower	Upper
0.869	18	0.90	0.396	-1.2755	3.0755

**The mean difference is not significant at the 0.05 level – Independent sample t-test.*
Note: b-PONS= body PONS, f-PONS= face PONS, M= mean, SD= standard deviation, df= degree of freedom, MD= mean difference

In Table 8, the t-test was statistically not significant (p = 0.396>0.05), which means there is no substantial difference between the NH group's face-only and body-only PONS scores. This means the NH group has almost equal NVS to both face and body cues.

Table 9: Comparison of face-only and body-only PONS scores of the HI group.

Groups	M	SD
b-PONS	10.10	2.5582
f-PONS	13.10	1.9692

t	df	MD	Sig. (2-tailed)	95% Confidence Interval of the Difference	
				Lower	Upper
-2.939	18	-3.00	0.009*	-5.1448	-0.8552

**The mean difference is significant at the 0.05 level – Independent sample t-test.*
Note: b-PONS= body PONS, f-PONS= face PONS, M= mean, SD= standard deviation, df= degree of freedom, MD= mean difference.

In Table 9, the t-test was statistically significant (p = 0.009<0.05), with the mean face PONS score of the HI group (M= 13.10, SD= 2.55821) was significantly higher (mean difference -3.00, 95% Confidence Interval [-5.1448, -0.85518]) than the body PONS score of HI group (M= 10.10, SD= 2.5582), t (18) = -2.939, p <0.05, two-tailed. The result means the HI group has more NVS to nonverbal face cues than the body cues.

Discussion

The result of this study suggests that the HI group performed lower than the NH group in the overall face and body-only Profile of Nonverbal Sensitivity (FBo-PONS) test. However, in individual face-only and body-only comparisons, the HI group scored lower in body PONS and relatively similar in face PONS. Within group comparison, the HI group scored higher in face PONS, and NH scored almost equal in both types of NV cues. The findings also support a strong positive correlation between the rehabilitation age of HI group and the face and body PONS score. Most of the outcomes are supported by previous studies on HI and the PONS test, which suggests a lower score of the HI group in the PONS test (Rigo & Lieberman, 1989; Schlumberger et al., 2004).

Comparison of FBo-PONS score of HI and NH group

This study calculated the FBo-PONS score and compared the scores of the HI and NH groups, and the results indicated to lower score of the HI group in total FBo-PONS. Efficient studies regarding the FBo-PONS score of HI children were not available; however, studies on and EI and other nonverbal intelligence tests, which can predict the result of PONS score, suggested that HI can affect the NVS (Fernández-Abascal & Martín-Díaz, 2019; Knapp et al., 2014). Also studies with different age group (HI older adults) supported the notion of adverse effect of HI on NVS (Rigo & Lieberman, 1989). NH group's mean score of FBo-PONS was comparable to the validation test of Rosenthal et al. (1979), in which the mean score of FBo-PONS was 29.97, SD = 2.35. The reason for the slight difference between the validation test and present study can be the age, as the validation test comprised young adults, and this study included children, and the PONS score has a strong correlation with age (Ivan et al., 2011; Rosenthal et al., 2013).

In the individual comparison of face-only cue and body-only cue, HI group scored less in body-only PONS than the NH group. For face-only PONS, there was no evidence of a significant difference between both group scores. Generally, the NVS of facial cues is expected to be more accurate than body cues, as facial cues are more controlled, and controlled cues are easier to decode (Ekman & Friesen, 1969). However, previous studies by McLeod & Rosenthal (1983) and Rigo & Lieberman (1989) suggested a comparatively higher score in body-only PONS than face-only PONS compared to the NH group, which contradicted the present study result. This variance may have occurred due to the different age ranges and sample sizes.

Comparison of face-only cue and body-only cue within the NH group

The result of within-group comparison of both body and face cues practically similar scores. It can be claimed by this result that NH children can decode face cues and body cues equally, and this argument is supported by previous studies. Validation studies by Rosenthal et al. (1979) proposed a positive correlation between face and body cues. Also, Ivan et al.'s (2011) study regarding DANVA and PONS tests on college and university students showed comparatively similar mean scores for face and body cues.

Comparison of face-only cue and body-only cue within the HI group

A significant difference between face and body cue PONS scores, was found in the HI group, which indicated that the HI group decodes facial cues more accurately than body cues. Even though, lipreading has no effect on the PONS test, still person with HI tend to focus more on the face than body cues while interpreting messages (Knapp et al., 2014; McNeill, 2000; Rigo & Lieberman, 1989). Also, studies suggested delayed development of complex motor sequence in HI children, with or without rehabilitation (Schlumberger et al., 2004); this can be a reason for a less accurate body PONS score. Sample size can also be a factor in this result.

Additional finding

A positive correlation was found between RA and PONS scores in the correlation analysis test, which indicated that the PONS test score increases with RA. This result supports the previous study that suggested, that the length of hearing aid using and residual aided Speech Intelligibility Index are jointly correlated with better communication outcome (Bruce Tomblin et al., 2014; Schlumberger et al., 2004). Emmett & Francis (2014) proposed that only bilateral hearing loss affects the nonverbal intelligence of children. However, present study finding can not be strongly proposed due to the sample size. This study pursued to find the impact of HI on the decoding ability of visual nonverbal cues without audio stimulus. FBo-PONS score of the HI group suggested no correlation between CA and PONS scores. Past investigations recommended that hearing aids moderate the impact of hearing loss on language development (Bruce Tomblin et al., 2014). Better rehabilitation procedure not only improves verbal communication but also facilitates the NVS. Also, rehabilitation onset can be influential in this scenario. Further research on RA, rehabilitation onset and NVS correlation needs to be conducted with a larger sample size.

Clinical Implications

NVS is closely connected with effective communication skills and may indicate to the future language competence, EI and professional performance (Hall et al., 2019; Mundy et al., 1995; Rosenthal et al., 2013). This study will provide the SLTs a knowledge of NVS of HI children which will facilitate them in planning therapy for effective outcome. NVS score will source the idea of best communication mode which can help the therapists and caregivers in rapport building with HI children. This research will also help the SLTs to narrower down the possible cause of communication incompetence during the rehabilitation process.

Conclusion

This study's findings demonstrated that hearing impairment not only affects the auditory perception of nonverbal cues but considerably affects the NVS. Test scores showed a significant difference in total FBo-PONS test. In individual analysis, HI participants were found to be less nonverbally sensitive to body-only nonverbal cues and better decoders of face-only nonverbal cue. Within the group the NH participants were found to be equally sensitive to face cues and body cues, but the HI participants showed more efficiency in decoding nonverbal face cues. This study enriches the study realm of NVC and linguistic feature analysis of Bengali language. Also, it will shed light to the importance of considering NVC in therapy procedures. SLTs will also be able to imply the knowledge in rapport building with clients.

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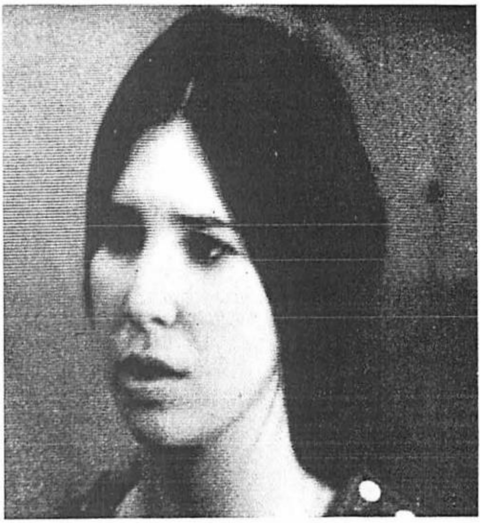
Appendix 1: Sample still pictures of face and body only PONS video

Face cue

Body cue

Face cue



Body cue