ORIGINAL RESEARCH PAPER Volume-8 | Issue-9 | September - 2019 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARATIVE STUDY OF AUDITORY REACTION TIME, SYNTHETIC SENSES IN BLIND CHILDREN WITH NORMAL CHILDREN

Physiology

Dr. Mrs. Joshi. Ruth. Nitin Professor, Department of Physiology, Smt Kashibai Medical College & General Hospital, Narhe, Pune ,Maharashtra

Dr. Joshi Nitin. Bhalchandra* Professor, Department of Physiology, Smt Kashibai Medical College & General Hospital, Narhe, Pune, Maharashtra *Corresponding Author

ABSTRACT

In the blind children with loss of vision, the tactile and auditory stimuli increase the activity in visual cortex of the blind .We have tested and compared the auditory reaction time with the help of response analyzer and the synthetic senses by doing two point discrimination, object identification and identification of surface texture in the blind and normal children belonging to the age group 8-16 years. The results showed significant change i.e. the auditory reaction time is faster in blind children as compared to normal sighted children .The synthetic senses are also enhanced in blind children as compared to the normal sighted children. This is due to constant training, continuous Braille teaching and plastic changes in the visual cortex of the blind. With active use of non-visual sensory input like auditory cues and synthetic sensations, the blind individuals can maintain gait, posture and orientation to effect safe walking.

KEYWORDS

Auditory Reaction Time, Synthetic Senses, Response Analyzer, Plasticity

INTRODUCTION

To maintain homeostasis and survival of any being whether an animal or a human being, optimum and appropriate sensory information is very essential. Vision and hearing are one of the special senses gifted to a human being's life.

Loss of any one sense may sharpen and increase a person's dependency on other senses for better survival. With the loss of vision one has to depend on sense of audition, touch, olfaction etc. to ascertain the information from environment.

It has been seen that in early blindness, the visual and parietal codices of monkey show decrease in proportion of neurons responding to visual stimuli and increase in proportion of neurons responding to active somatic exploration of surroundings after the loss of visual information in blind attributing to plasticity of CNS. (1)

Similar plastic changes have also been seen in human beings. Tactile and auditory stimuli increase metabolic activity in visual cortex of blind individuals. Blind individuals must rely on tactile and auditory senses for day- to-day activity.

Now a days the blind people have also started living life with more meaning and pleasure as that of normal due to this ability of enhancing their other senses because of loss of vision. Thereby it has made this study more interesting and has aroused curiosity to find out whether really there is any difference in tactile sensibility and reaction time in congenital blind as compared to normal sighted.

We have tested the auditory reaction time with the help of response analyzer in the age group of 8 — 16 years to see whether the adaptive changes start from childhood.

METHODS

Subject:

The present study was conducted in 50 congenitally blind and 50 normal sighted children.

The blind children were taken from Dnyana Prabodhini Andh Shala, Kolhapur and the control group from Dr. Anandrao Gaikwad High School and Carnran Marathi School, Miraj.

Age group 8 — 16 years (for both blind and normal sighted.) Detailed history regarding past, present illness was taken in both blind and normal children and there was no illness in both. General as well as systemic examination was also done in both groups

and there was no systemic disease. The entire normal school going children were subjected to visual acuity tests and there was no refractive error found.

Blind status:

Congenitally blind in whom the perception of light was absent.

Procedure for testing in blind.

The various parameters that were tested in blind children were.

a) Auditory reaction time.
b) Synthetic senses.
i) Two point discrimination.
ii) Object identification.
Iii) Identification of surface texture.

In normal sighted children keeping the subjects blindfolded, they were checked for the synthetic senses.

1. The auditory reaction time:

It is measured by response analyzer, which is a advanced instrument to test performance of human being in the field of reflexes to various types of stimuli.

The stimulus used for auditory reaction time (ART) was a continuous buzzer with fixed intensity and frequency.

The room in which the auditory reaction time was measured was sound proof .The instrument was kept on the table. The subject was made to sit comfortably on the chair opposite the examiner. The subject was asked to press the switch as soon as he heard the buzzer. The reaction time was displayed in milliseconds. The ART was recorded with right and left hand. Initially the subjects were made familiar and 3 readings were taken and lowest most reading was taken.

2. Synthetic senses:

a) **Two point discrimination** (2'3)

Compass aesthesiometer with thickness of point less than 0.25 mm was used. The points were made blunt so that it will not injure the subject. The site used to test was distal phalanx of index finger of both hands. Stimulus intensity was chosen to be that which subject could perceive as constant touch without the perception of discomfort or pain.

Method:

Initially the distance between the two points was increased. Subject was asked to tell whether he or she felt one or two points of testing instrument. If he or she could perceive the distance was reduced until he or she could feel two separate points. The distance was checked only for three times. The inter point distance was taken as mean two point distance. This was also done in sighted children who were blindfolded.

b) Object identification:

Here twelve objects were tested. All subjects from both the blind and sighted groups were given the objects to identify. The objects given for identification are

PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

i. Key
ii. Battery cells
iii. Tooth paste caps
iv. Nail
v. Safety pin (medium size)
vi. Button
vii. Hook
viii. Five rupee coin
ix. Two rupee coin
x. One rupee coin
xi. Fifty paise coin
xii. Twenty five paise coin

Total time required for identification of all objects was calculated. At the same time number of objects identified in the first 60 seconds were also noted down and for each object that was correctly identified a score of one point was allotted. The same procedure was followed for both the groups but the control group was blind folded. Two readings were taken. (23)

c) Identification of surface texture: Ten different grades of iron polish sand papers were taken. Ten grades were 36, 60, 80, 100, 120, 180, 220, 320, 400, and 600. (in order of increasing smoothness). These grades are manufacturer's specification.

These papers were mounted on cards, dimensions of sand paper was 7mm x l0mm. The test was divided into three sets. In Set I only five sand papers of following grades were taken: 36, 60, 180, 220, and 320. In Set II eight sand papers of following grades were taken: 36, 60, 80, 120, 180, 220, 320, and 400. In Set III all ten sand papers were used, the grades were as follows: 36, 60, 80, 100, 120, 180, 220, 320, 400, and 600. Sufficient trials for at least five times were given.

In Set I: Total time required to arrange five papers according to their gradations (rough to smooth) was noted.

In Set II: Total time required to arrange eight papers according to their gradations (rough to smooth) was noted.

In Set Ill: Total time required to arrange ten papers according to their gradations (rough to smooth) was noted.

Same procedure was done in sighted by blindfolding them.(2'3)

TABLE 1
Comparison of auditory reaction time (milliseconds) between normal (n=50) & blind (n=50) children (8-16 years)

Auditory reaction time	Normal	Blind	P value
Right hand	255.6 ± 26.32	196.2 ±36.52	P< 0.01
Left hand	268.76 ± 39.29	215.85 ± 43.12	P< 0.01

TABLE 2
Comparison of tactile (two-point) discrimination in millimetre between normal (n=50) & blind (n=50) children (8-16)years

Tactile (two-point) discrimination	Normal	Blind	P value
Right hand	3.78 ±1.21	1.86 ± 0.90	P < 0.01
Left hand	3.92 ± 0.95	2.02 ± 0.82	P< 0.01

TABLE 3
Comparison of object identification (stereognosis) in seconds & scoring for object identification between normal (n=50) & blind (n=50) children (8-16) years

	Normal	Blind	P value
Object identification (seconds)	45.48 ± 12.83	28.3 ± 8.05	P < 0.01
Scoring for object identification (points)	10.22 ± 1.26	11.32 ± 0.89	P < 0.01

TABLE 4
Comparison of surface texture (set I, II,III) between normal (n = 50) & blind (n = 50) children (8-16)years

	Normal	Blind	P value
Set I	59.4 ± 9.41	49.72 ± 10.51	P< 0.01
SetII	93.86 ± 18.14	80.98± 18.38	P< 0.01
Set III	126.76 ± 28.77	109.88± 29.59	P<0.05

RESULT
The auditory reaction time and the various synthetic senses are measured and its results are stated in Table 1, 2, 3 & 4. It is seen that the auditory reaction time in both the right & left hand of blind children is much better and faster as compared to the normal sighted children and was statistically significant. This result is similar to the study of Teija Kujala et al The synthetic senses, the two point discrimination, object identification & surface texture was enhanced in blind as that of normal. This also was found to be statistically significant and is in accordance with studies done by Christine B .Novak et al.(I '2'3)

DISCUSSION
1) Plasticity: [4,5,6,7]
Throughout life, specific molecular, biochemical, electrophysiological & structural changes take place in the neurons of CNS & in neuronal networks in response to activity & behaviour. These plastic changes are part of structural & physiological substrate for recovery of function after injury, learning & memory.

Brain plasticity is a major factor considered in adaptation to other sensory modalities when particular one sensation is deprived. It is the adaptive capacity of CNS to modify to its own reorganization & function.

The plastic reorganization of sensory function in blind occurs maybe due to formation of new nonvisual cortico-cortical connections, like transcallosal connections, direct subcottical projection to extrastriate areas, residual inputs from visual area. The occipital cortex is also activated by auditory stimuli due to cross modal neural organization (visual cortex responding to auditory stimuli)

The plastic process occurs early during development. The cortical connections of sensory units of cortex have extensive convergence and divergence with connections that can become weak with disuse and strong with use. Plasticity occurs from one sensory modality to another. This shows the malleability of brain and its ability to adapt. Plastic changes cause increased cortical representation in sensory cortex which improves the sensibility of hand, thus decreasing all the values of synthetic senses implying pronounced tactile sensations in blind than sighted.

2) Peripheral causes of blindness: [8]
In congenitally blind 60% of cases are due to peripheral causes & 15% due to neurological disease. Some of the peripheral causes are:
i. Congenital cataracts
ii. Congenital malformation
iii. Mother's rubella during pregnancy
iv. Congenital agenesis of eyeball
v. Congenital glaucoma and bilateral retinal aplasia

Infections and cataract are common causes of peripheral blindness in infants and children. Thus the major causes of blindness are peripheral and not central.

Therefore the central nervous system is not affected on whole, keeping the neurons, neuronal circuits and pathways intact so that the other sensations like audition and touch get specialized through these circuits and exposing it for plastic changes to occur, thus improving the processing of non-visual modalities.

3) Increase in glucose metabolism in the visual cortex [9,10]
There is higher glucose metabolic activity taking place in the visual cortex during auditory and tactile tasks in the blind. There is also increased blood flow to this area improving the metabolic activity in this area thus making it available for other sensory modalities.

4) Training: [11-16]
The blind children are continuously trained and habituated to depend on their auditory and touch sensations. Therefore heavy auditory inputs to the visual cortex have caused adaptive changes and thus the blind react to auditory stimuli earlier than normal sighted children leading to shorter auditory response time.

The somatosensory area also widens up due to continuous heavy non visual input during training. Training is required in blind since they must depend on tactile senses to interpret information due to lack of vision. This is achieved by giving continuous Braille teaching to the blind in the respective blind school as well as providing objects and

PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

helping to train them in identifying and differentiating the differences in size, shape, texture, consistency etc. This type of training is regularly being given to the blind children in school from where the data is collected. Thus this adaptation and habituation pronounces all the tactile senses in blind children.

In brief studies have shown that the blind people process auditory language stimuli faster than sighted and some language functions may be reorganized. The blind people encode verbal material and show improved memory encoding than the sighted. Early blind subjects use visual areas for tactile mental imagery functions and various other sensory modalities. With active use of non-visual sensory input like auditory cues and synthetic sensations the blind individuals can maintain gait, posture and provide orientation to effect safe walking.(17-21)

Special note to kindly consider :

The above study was done during the year 2001-2002 at Government Medical College , Miraj and is an unpublished data. We are always grateful to this college for allowing us to conduct this study.

Similar studies were done later in the forthcoming years [22-25] in congenitally blind adults and younger group of 14-16 years. Only auditory reaction time was considered This existing study was done in congenital blind children between the age group of 8-16 years. Along with auditory reaction time synthetic senses were also tested in this study where remarkable significance was found.

REFERENCES

1) Teija Kujala, Kimmo Alho, Petri Paaviliainen ; Neural plasticity in processing of sound location by the early blind, an event related potential study. Electroencephalography and Clinical Neurophysiology 1992, 84: 469-472
2) Christine B Novak et al; Development of new measure of fine sensory 'Unction. Plastic and Reconstructive Surgery.Aug 1993,Vol 92, No2:301-310.
3) Christine B Novak et al; Establishment of reliability in the evaluation of hand sensibility. Plastic and Reconstructive Surgety.Aug 1993,Vol 92,No2:312-322
4) Alvaro Pascual-Leone and Fernando Torres; Plasticity of the sensory motor cortex representation of the readingv finger in Braille readers. Brain 1993, 116: 39-52.
5) K.Alho, T.Kujala, Paaviliainen; Auditory processing in visual brain areas of the early blind: evidence from event related potential. Electroencephalography and Clinical Neurophysiology 1993, 86: 418-427
6) Baseler HA et al; Topographic organization of human visual areas in the absence of input from primary cottex. J Neuroscience 1999 April 1: 19(7): 2619-2627
7) William F Ganong; Review of Medical Physiology 21gt edition. Cutaneous, deep and visceral sensation; Cortical plasticity: 134-135.
8) Stephen J.H.Miller, Parsons disease of eye 18th edition; Examination of retinal function: 109-110. The causes and prevention of blindness: 413
9) Paul Bach-Y-Rita; Brain plasticity as a basis for recovery of functions in humans. Neuropsychologia 1990 vol 28, 6: 547-554
10) De Voider AG et al; Changes in occipital cortex activity in early blind humans using a sensory substitution device. Brain Res 1999 April 24: 826(1): 128-34
11) Leclerc C, Saint-Amour D, Lavoie ME; Brain functional reorganization in early blind humans revealed by auditory event related potentials. Neuroreport 2000 Feb 28; 11(3): 545-50
12) Roder B, Roster F, Neville HJ; Event relatwed potentials during auditory language processing in congenitally blind and sighted people. Neuropsychologia 2000; 38(11): 1482-502
13) Morrongiello. BA, Humphrey (1K; Tactual object exploration and recognition in blind and sighted children. Perception 1994; 23(7): 833- 48
14) Uhl F et at; Tactile mental imagery in sighted person and in patients suffering from peripheral blindness early in life. Electroencephalography and Clinical Neurophysiology 1994; 91: 249-255
15) Sadato N, Pascual-Leone A, (lrapnan J; Activation of the piiinaiy visual cortex by Braille reading in blind subjects. Nature 1996 April 11; 30(6574): 526-28
16) Sadato N, Pascual-Leone A, Gragm an J;Neural networks for Braille reading by the blind. Brain 1998 July: 121(7): 1213-29
17) NakainuraT; Quantitative analysis of gait in the visually impaired. Disabil Rehab 1997 May; 19(5): 194-197
18) Easton RD et at; Auditory cues for orientation and postural control in sighted and congenitally blind people. Exp Brain Res 1998 Feb; 118(4): 541-50
19) Liotti M et at; Auditory attention in the congenitally blind: where, when and what gets reorganized? Neuroreport 1998 April 20; 9(6): 1007-12
20) Roder B, Roster F, Neville HJ; Auditory memory in congenitally blind adults: A behavioural electrophysiological investigation. Brain Res Cogn Res 2001 April, 11(2): 298-303
21) De Volder AG, Toyama H, Kimura Y; Auditory triggered mental imagery of shape involves visual association areas in early blind humans. Neuroimage 2001 July; 14(1): 129-39
22) Collignon O, DeVolder A; Congenitally blind participants react faster to auditory & tactile spatial targets. Canadian Journal of Experimental Psychology 2009, 63:287-293.
23) Hotting K & Roder B; Auditory & auditory tactile processing in congenitally blind humans . Hearing Research 258, 165-174.
24) Pritesh Hariprasad Gandhi, Pradnya A Gokhale, HB Mehta; Indian Journal of Psychology Med 2013 July- September; 35 (3): 273-277
25) Bhavana Bhitud, Lalita Chandan; comparative study of simple auditory reaction time in blind & blindfolded sighted individuals. National Journal of Physiology, Pharmacy & Pharmaclology 2017, Vol &, issue 1, pages 64-67.