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Research Article

THE IMPACT OF CROSS-MODAL PERCEPTION ON AUDITORY DISCRIMINATION OF DOWN SYNDROME CHILREN

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ABSTRACT
Most children with Down syndrome suffer from auditory discrimination difficulties. In contrast, they have strength in visual learning. Cross-modal perception involves interactions between two or more different sensory modalities. Thus the use of gestures as visual stimulation can have great effects on their learning process and even auditory skills such as auditory discrimination. Included in the study were 64 children with Down syndrome, aged 7 to 11 years. Subjects were randomly designated into two groups of experimental and control. Visual stimulation in form of oral gestures was applied during 12 sessions after conducting Wepman Test of Auditory Discrimination (WTAD). No intervention was applied in control group. By comparing scores from conducted test before and after intervention, the significant differences were perceived between the results of experimental group. In contrast, the changes were not so significant in control group. The results of this study show that using visual stimulation in form of oral gestures has significant effect on improvement of auditory discrimination in children with Down syndrome.

Keywords: *Auditory Discrimination, Children with Down Syndrome, Oral Gestures, Visual Stimulation*

INTRODUCTION
At least 80-90% children with Down syndrome have auditory discrimination difficulties which will combine the phonological loop problems. Howsoever, the phonological loop problems are presumed to exist separately of any hearing impairment (Jarrold and Baddeley, 2001). To summarize the adaptations for their cognitive profile, children with Down syndrome should be thought of as visual learners, with strengths in visual processing and weaknesses in auditory processing. Learning from listening is particularly difficult for them and all teaching should be supported with visual materials (Buckley and Bird, 1994).
Cross-modal perception involves interactions between two or more different sensory modalities. Cross-modal investigation has displayed that visual adaptation can present auditory aftereffects (Kitagawa and Ichihara, 2002). Visual adaptation was more presumably to have an impact on auditory perception than contrariwise as evidence that the visual system is more accurate and influential in terms of spatial conception (Kitagawa and Ichihara, 2002). One description of this conclusion is that the internal presentations that were foremost suited to determination making were visual, so the visual system overcame. One of the causes that the deceptive flash result is so intriguing is that it contradicts the normal detection of visual dominance in cross-modal interaction (Shams *et al.*, 2000). Despite unequivocal visual information, the auditory stimulus is substituted the visual experience rather than contrariwise (Berger, 2002).
The integrated contest hypothesis lie downs on three general points. First, many brain systems, cortical and subcortical, sensory and motor, are started by visual input. Within many of these systems, activations from various objects challenge. A gain in activity for one object is coexisted with a loss in activity for others (Duncan *et al.*, 1997). Second, although competition happens in various brain systems, it is incorporated between systems. As a winning target appears in one system, it wills also to become predominant in others (Farah, 1990; Phaf *et al.*, 1990). For the sensorimotor net as a total, the orientation is to settle into a condition in which various brain systems have converged to function on the same predominant object, decomposing its multiple visual attributes and implications for operation. This is the condition that, at the behavioral level, is consonant with ‘focused attention’ on the elected object. At the

neural plane, there should be perfect maintenance of the elected object's presentation, went along by widespread detention of response to ignored objects (Duncan *et al.,* 1997). Third, competition can be lid on the basis of linked object properties. surely, there are bearing or bottom-up bigotries into objects that are bright, moving, large and so on (Jonides and Yantis, 1988; Treisman and Gormican, 1988), but, generally, it must be feasible to select any type of object for rein of behavior, depending upon the prevalent task demands.

Studies have accounted that primary auditory cortical areas are delicate to visual stimuli. For instance, variations in a speech signal in the visual state can be completed in the primary auditory cortex (Moettoenen *et al.,* 2002). This surface of the brain can also be initiated by a solely visual speech signal (Calvert *et al.,* 1997; Pekkola *et al.,* 2005). Lip reading, that is, the visual recognition of speech gestures from the moving face, modifies the intelligibility of speech in noise when audio-visual understanding is compared with audio-only understanding (Erber, 1975; Sumby and Pollack, 1954).

The aim of this research was to overview whether the use of gestures as visual stimulations have great effects on their learning process and even auditory skills such as auditory discrimination or not.

MATERIALS AND METHODS

In this RCT study, the effects of Cross-modal perception on auditory discrimination of Down syndrome children were studied. Included in the study were 64 children with Down syndrome, aged 7 to 11 years who were randomly selected from four rehabilitation centers. Subjects were randomly designated into two groups of experimental and control. Inclusion criteria were: (a) meeting diagnostic criteria for Down syndrome; (b) aged between 7 and 11 years at the start of intervention. Exclusion criteria were (1) having hearing less; (2) fulfilling criteria for diagnosis of clinically significant nervous disorders such as oral weakness or apraxia; (3) having oral structural deformities; (4) IQ <80 (based on an IQ test or the physician's clinical impression and rehabilitation history); and (5) medical illness requiring immediate treatment.

Measures

For assessing changes during the treatment, Wepman Test of Auditory Discrimination (WTAD) was used. WTAD assesses children's ability to recognize differences between phonemes used in speech. Forty pairs of words are read out, and the child indicates, verbally, whether the words in each pair are the same or different (Hirshoren and Ambrose, 1976). This test was validated based on Ghorbani's study (Ghorbani, 1997). The entire test can be administered and scored in just 5 minutes (Hirshoren and Ambrose, 1976). Pointing style was based on the number of wrong answers during the test.

Procedure

Visual stimulation in form of oral gestures was applied during 12 sessions after conducting Wepman Test of Auditory Discrimination (WTAD). No intervention was applied in control group. At first, for all subjects, the examiner explained the Procedure of test one by one:

"I read some words for you, and then you should recognize whether there are similar or not, for instance I say: Chin- Jin, and then I ask you are they similar?" After explanation, the examiner performed WTAD in both groups. For applying test, the examiner sat behind examinee with the distance of one meter to prevent child from looking at examiner's mouth. The examiner had to read word list with same loudness and speed for all participants. After reading each pair of word, the subject assessed similarity or non-similarity of the words.

After assessment and conducting WTAD, visual stimulation in form of oral gestures were presented to children in experimental group in which the therapist sat in front of children and moved her mouth and lips without saying anything. The oral movements of therapist were like gesture of oral structure during pronouncing letters but in exaggeration form. Visual stimulation was applied during 12 sessions. After that WTAD were conducted in both groups.

RESULTS AND DISCUSSION

Results

For assessing the relation between presenting oral visual stimulation and auditory discrimination, Student's t-test for independent samples was used. The mean error in experimental group in pretest was reduced in compare to posttest. The mean error in control group after posttest did not reduced significantly. After conducting WTAD for the experimental group, there were significant changes in independent and paired sample tests ($P < 0.05$). However, for the control group there were no significant changes ($P > 0.05$ for between and within comparison).

Table 1: Means, SDs, and t-values between two groups for the WTAD Scale

Measure	Group	pre M ± SD	post M ± SD	"t-test" (within group) pre to post t(p)	pre to pre t(p)	"t-test" (between group) post to post t(p)
WTAD	*E*	7.3333 ± 3.3266	3.6667 ± 2.4221	4.348 (.007)	.582 (.574)	-1.569 (.014)
	C	6.3333 ± 2.5819	6.1667 ± 3.0605	.277 (.793)		

df = 62, E = experimental group, C = control group

Discussion

By comparing scores of conducted tests before and after intervention, the significant differences were perceived between the results of experimental group. In contrast, the changes were not so significant in control group. The results of this study show that using visual stimulation in form of oral gestures has significant effect on improvement of auditory discrimination in children with Down syndrome. These results are in line with khalili kermani's study (Khalili *et al.,* 2012).

Neuroimaging studies have established audiovisual interactions in multimodal levels like the superior temporal sulcus and sensory-specific areas involving the visual and auditory cortices (Besle *et al.,* 2004; Callan *et al.,* 2004). It has been offered that the involving one mode inputs are at first integrated in superior temporal sulcus and that interaction in the elementary auditory and visual cortices reverberates feedback from superior temporal sulcus (Calvert *et al.,* 1999). On this way, interactions in the primary cortex are probably mediated by the superior temporal sulcus via backward plans (Besle *et al.,* 2004). Besides superior temporal sulcus, motor regions of execution and planning (premotor cortex, Broca's area, and anterior insula) could be required via the mirror neurons (MN) (Giard and Peronnet, 1999; Ojanen *et al.*, 2005). Broca's area is motioned to be in area F5 of inferior premotor cortex where MN are placed that discharge upon operation and understanding of goal-directed mouth or hand movements. The assumed function of these MN is to mediate imitation and assist understanding and action (Rizzolatti and Craighero, 2004). Broca's area is not only necessitated in the generation of speech, but is also become activated during passive listening to speech (Wilson, Saygin, Sereno, & Iacoboni, 2004) and silent lip-reading (Campbell *et al.,* 2001).

On this perspective, activation of MN in Broca's area may simplify a link between the corresponding motor presentations and visual and auditory speech inputs. In line with this implication, it has been accounted that recalibration of auditory by lip-read data happens only if the sine-wave tokens were understood as speech, but not if they were perceived as non-speech sounds (Vroomen and Baart, 2009) most presumably because in the latter case, there was no linkage to articulatory motor programs. Vision may thus affect auditory processing via articulatory motor programs of the perceived speech acts (Callan *et al.,* 2003), and as illustrated here, it is possible that this result is bi-directional in character. The integrated competition hypothesis relates general demands on an attentional system to information mattering single-neuron activity, spatial and non-spatial effects on extinction subsequent brain lesions, and integrative procedures in usual sensorimotor cognition.

According to hypothesis, there is no concentrated system accountable for visual attention: even functional ingredients (competition, priming and integration) have no distinguished localization. Instead, election of targets for the control of activity arises through competitive and cooperative activity across multifold brain systems. Meanwhile, the hypothesis inflicts severe extents on parallelism. In line with the limitations on parallel processing explicit in everyday behavior, accretion severely limits the ability of multifold brain systems to work at the same time on different tasks. Visual attention supplies a well worked-out instance of these general rules. It will be absorbing to see how widely they operate to other appearances of higher cognitive activity: for instance, to joint activity of various motor systems in action election or to combination of semantic and phonological systems in word generation (Patterson *et al.*, 1994). In many subjects, no simple mapping may exist between unitary neural systems and unitary cognitive events (Duncan *et al.*, 1997). In conclusion, the results of this study show that using visual stimulation in form of oral gestures has significant effect on improvement of auditory discrimination in children with Down syndrome.

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