Visual Perception in Hearing Impaired Children

Thesis

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Introduction

The incidence of permanent hearing loss in children ranges from 1.2 to 6 per 1,000 live births worldwide. Greater incidences have been found in developing countries **(Olusanya et al., 2006**). In a recent survey, the prevalence of hearing loss in Egypt was found to be 16% with no significant gender differences. However there were significant differences between the age groups and governorates: Marsa Matrouh had the highest prevalence of hearing loss 25.7% and North Sinai the lowest 13.5%. Those above or equal 65 years had the highest prevalence 49.3%, but it was also high in those aged 0-4 years 22.4%, Otitis media with effusion 30.8% was the commonest cause of hearing loss, followed by presbycusis 22.7% **(Khatib et al., 2007).**

Individuals with hearing impairment may be described as deaf or hard of hearing. Deafness is defined as a hearing disorder that limits an individual's oral communication performance to the extent that the primary sensory input for communication may be other than the auditory channel. Hard of hearing is defined as a hearing disorder, whether fluctuating or permanent, which adversely affects an individual's ability to communicate. The hard-of-hearing individual relies on the auditory channel as the primary sensory input for communication **(Cheryl et al., 1993).**

Hearing loss results from an interruption in the transmission of sound or subsequent nerve impulses in one or more areas of the ear and/ or the auditory pathway. Recognition and treatment of hearing loss is imperative; unrecognized or untreated hearing loss may result in severe psychosocial ramifications in both adults and children. In the elderly population, hearing loss may lead to social withdrawal and depression. In the pediatric population, hearing loss may cause speech or cognitive delays. Hearing loss also has significant safety implications when it interferes with awareness of warning sounds (e.g., car horns, sirens, fire alarms) **(Robert et al., 2011).**

Hearing loss can be classified according to which part of the auditory system is affected in to:

1. Conductive hearing loss (CHL) occurs when there is a failure of normal propagation of acoustic energy through the conducting portions of the ear, which include the external auditory canal and the middle ear.

2. Sensorineural hearing loss (SNHL) occurs from dysfunction of the inner ear.

3. Mixed hearing loss (MHL) occurs when hearing loss results from both CHL and SNHL.

4. Central hearing loss is a form of sensorineural hearing loss caused by damage to the auditory pathways which result from ischemic or traumatic brain injuries **(Robert et al., 2011).**

Communication in hearing impaired persons depends on the amount of residual hearing, type of deafness, language skills, age of onset, lip reading skills, and educational background. Some use speech only or a combination of sign language, finger spelling, writing, body language, and facial expression. Some are more easily understood than others **(Sheryl and donna, 2007).**

Finney and Dobkins (2000) proposed that sensory adaptation enables deaf individuals to develop a shift of perception to other sensory modalities. For example, visual perception may be improved to compensate for auditory deprivation. This phenomenon is denoted as cross-modal plasticity and was shown to involve structural remodeling of various sensory brain areas **(Bavelier and Neville, 2002).**

Visual perception is the process of acquiring knowledge about environmental objects and events by extracting information from the light they emit or reflect **(Palmer, 2002).** The term visual perception makes reference to the capacity that brain has to understand and to interpret what the eyes see **(Gardner, 1986; Scheiman, 1997).**

Humans can perceive speech under a wide variety of conditions, including the presence of various background noises, sloppy pronunciation, speakers with different dialects and accents, and the often chaotic give-and-take that routinely occurs when people talk with one another **(Sinha, 2002).** Multisensory integration provides a natural and important means for communication. The benefit of integrating auditory and visual AV cues in speech perception has been well documented, particularly in difficult listening situations and for hearing-impaired listeners **(Desai et al., 2006).**

Aim Of The Work

The aim of this work is to study the visual perception skills in hearing impaired children in comparison to normal children, in order to determine the impact of this sensory disability on their visual skills.

The Auditory System

The auditory system is divided into four anatomical regions (figure1): (1) the external ear, (2) the middle ear, (3) the inner ear, and (4) the central auditory pathway **(Marcia et al., 2009).**

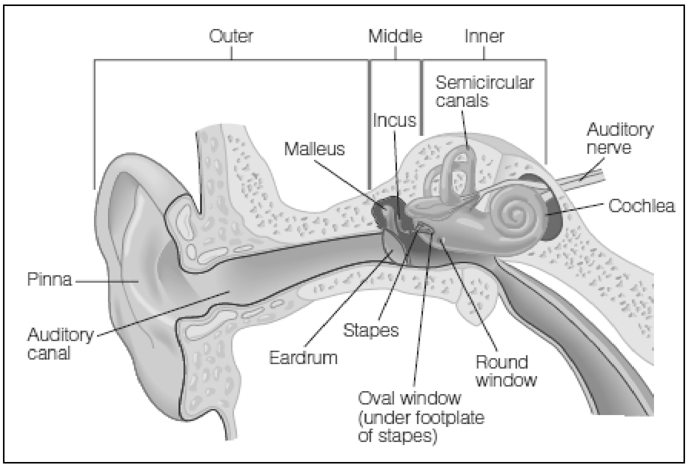

Figure 1: The ear, showing its three subdivisions outer, middle, and inner **(Lindsay and Norman, 1977)**.

The external ear, which consists of the pinna, concha, and auditory meatus, gathers the sounds arriving at the ear and directs these acoustic signals to the tympanic membrane. Because of the configuration of the external auditory meatus, which is much like a pipe or tube that is closed at one end and open at the other, it generates an ear canal resonance, which is important for the natural perception of sound. The loss or compromise of the normal ear canal response can result in the perception of speech and other acoustic signals as being unnatural. Such perceptions are often noted by patients who have their ears occluded by earmolds or hearing aids **(Musiek and Baran, 2007).**

A second important function of the pinna and concha is to selectively filter different sound frequencies in order to provide cues about the elevation of the sound source. The vertically asymmetrical convolutions of the pinna are shaped so that the external ear transmits more high-frequency components from an elevated source than from the same source at ear level **(Purves et al., 2004).**

The middle ear is an air-containing space with bony walls except for the tympanic membrane laterally. Anteriorly the Eustachian tube leads downward and medially to the nasopharynx. The medial border is the bony promontory that encloses the basal turn of the cochlea. The middle ear space opens posterosuperiorly through the aditus and antrum into the mastoid antrum, which is the largest of the mastoid air cells **(Biller, 2009).**

Attached to the tympanic membrane is the handle of the malleus. The malleus is bound to the incus by minute ligaments, so that whenever the malleus moves, the incus moves with it. The opposite end of the incus articulates with the stem of the stapes, and the faceplate of the stapes lies against the membranous labyrinth of the cochlea in the opening of the oval window **(Guyton and Hall, 2006).**

The tip end of the handle of the malleus is attached to the center of the tympanic membrane, and this point of attachment is constantly pulled by the tensor tympani muscle, which keeps the tympanic membrane tensed. This allows sound vibrations on any portion of the tympanic membrane to be transmitted to the ossicles, which would not be true if the membrane, were lax **(Guyton and Hall, 2006)**.

The ossicles of the middle ear are suspended by ligaments in such a way that the combined malleus and incus act as a single lever, having its fulcrum approximately at the border of the tympanic membrane. The articulation of the incus with the stapes causes the stapes to push forward on the oval window and on the cochlear fluid on the other side of window every time the tympanic membrane moves inward, and to pull backward on the fluid every time the malleus moves outward **(Guyton and Hall, 2006)**.

The major function of the middle ear is to match relatively low-impedance airborne sounds to the higher impedance fluid of the inner ear. The middle ear overcomes this problem and ensures transmission of the sound energy across the air–fluid boundary by boosting the pressure measured at the tympanic membrane almost 200-fold by the time it reaches the inner ear **(Purves et al., 2004).**

Two mechanical processes occur within the middle ear to achieve this large pressure gain. The first and major boost is achieved by focusing the force impinging on the relatively large-diameter tympanic membrane on to the much smaller-diameter oval window, the site where the bones of the middle ear contact the inner ear. A second and related process relies on the mechanical advantage gained by the lever action of the three small interconnected middle ear bones, or ossicles (i.e., the malleus, incus, and stapes, which connect the tympanic membrane to the oval window **(Purves et al., 2004).**