Brain and Cognition 76 (2011) 323–331

Contents lists available at ScienceDirect

Brain and Cognition

journal homepage: www.elsevier.com/locate/b&c

Use of the dichotic listening technique with learning disabilities

John E. Obrzut *, Emery B. Mahoney

Department of Disability and Psychoeducational Studies, College of Education, University of Arizona, Tucson, AZ 85721-0069, United States

ARTICLE INFO

Article history:
Available online 22 March 2011

Keywords:
Dichotic listening
Language disorders
Learning disabilities
Selective attention

ABSTRACT

Dichotic listening (DL) techniques have been used extensively as a non-invasive procedure to assess language lateralization among children with and without learning disabilities (LD), and with individuals who have other auditory system related brain disorders. Results of studies using DL have indicated that language is lateralized in children with LD and that the lateralized language asymmetries do not develop after age 6 nor are they affected by gender. Observed differences in lateralized language processes between control children and those with LD were found not due to delayed cerebral dominance, but rather to deficits in selective attention. In addition, attention factors have a greater influence on auditory processing of verbal than nonverbal stimuli for children with LD, and children with LD exhibit a general processing bias to the same hemisphere unlike control children. Furthermore, employing directed attention conditions in DL experiments has played an important role in explaining learning disabled children's performance on DL tasks. We conclude that auditory perceptual asymmetries as assessed by DL with children who experience LD are the result of the interaction of hemispheric capability and attention factors.
© 2011 Elsevier Inc. All rights reserved.

1. Introduction

Although many theories have been advanced over decades regarding the underlying etiology of learning disabilities (LD), evidence to date indicates that a developmental failure in neural integration may be responsible for this specific cognitive disability as suggested by Benton as far back as 1975. Specifically, poorly established cerebral dominance for language function has been implicated as a correlate of poor reading achievement (Orton, 1937; Zangwell, 1962). However, due to the fact that lateral hand preference seemed to be relatively stable by the time normal children began to read (Gesell & Ames, 1947), experimenters began to examine the associations between reading disorders and lateral preferences in hand, foot, eye, and ear processes.

The dichotic listening (DL) technique has been used extensively as a stable measure of cerebral processing and auditory reception as it relates to language functions (Hugdahl, Carlsson, Uvebrant, & Lundervold, 1997; Zatorre, 1989). According to Bryden (1982), DL techniques have provided us with some of the most robust effects available in contemporary neuropsychological research. This technique was originally conceived by Broadbent (1956) as an experimental paradigm to investigate a mechanical model of memory. The DL task consists of a series of paired stimuli presented simultaneously, one to each ear. The stimuli reported by the subject will usually be evidence of an "ear effect" such that a greater proportion of the dichotic stimuli are correctly reported favoring one ear. The dichotic stimuli may consist of digits, filtered speech or competing sentences, words, consonant–vowel (CV) syllables, or any combination of linguistic stimuli.

Working with both normal and brain damaged adult subjects, Kimura (1961a, 1961b) demonstrated that the majority of right-handed subjects correctly identified more stimuli presented to the right-ear when the stimuli were verbal and more stimuli presented to the left-ear when the stimuli were nonverbal. Based on studies of neurological patients in whom cerebral dominance had been established by the sodium amytal test (Wada & Rasmussen, 1960), the DL procedure appeared to be a reliable and stable measure of cerebral dominance for central auditory and language related functions. Those with known left hemisphere representation of language function displayed the normal right-ear advantage (REA) on verbal material, and those with known right hemisphere representation for language function displayed a left-ear advantage (LEA). This suggests that crossed or prepotent contralateral auditory pathways transmit information more quickly (or have an inhibitory effect on ipsilateral pathways) than ipsilateral pathways to the auditory cortex (Godfrey, 1974; Kimura, 1967). Therefore, the ear opposite the dominant cerebral hemisphere will perceive correctly a greater number of the dichotically presented stimuli. However, it must be acknowledged that most dichotic studies do not employ external validation measures in conjunction with their research, making it difficult to decipher whether results are reflective of the individual's different information processing strategies or different patterns of cerebral organization (Obrzut & Boliek, 1986). Some research has been performed in order to determine the level of agreement between

* Corresponding author. Fax: +1 520 621 382.
E-mail address: jobrzut@u.arizona.edu (J.E. Obrzut).

0278-2626/$ - see front matter © 2011 Elsevier Inc. All rights reserved.
doi:10.1016/j.bandc.2011.02.012

the Wada test and DL measures. Results suggest that a high-level of concordance exists between the measures (Hugdahl et al., 1997; Hung-Georgiadis, Lex, Friederici, & Yves von Cramon, 2002; Van Ettinger-Veenstra et al., 2010).

Following the work of Kimura, other investigators used the paradigm to study the normal development of dichotic ability in infancy and young children. In this regard, cerebral asymmetries have been found in infant auditory perception by Glanville, Best, and Levenson (1977), and an REA has been found as early as age three in Canadian (Ingram, 1975) and Japanese children (Nagafuchi, 1970) age four with a different sample of Canadian children (Kimura, 1963) and age five with American children Berlin, Hughes, Lowe-Bell, and Berlin (1973). Further, Hynd and Obrzut (1977) provided normative DL data obtained from kindergarten, second, fourth, and sixth grade children and found that the magnitude of the dichotic ear advantage did not increase as a function of age or sex.

However, one of the more significant applications of this clinical procedure has been in the assessment of school age children who experience specific LD. The learning disabled subjects in these studies were classified on the basis of an extensive evaluation in which each subject had to (1) possess average intellectual abilities on a standardized test of intelligence with a Full Scale IQ > 85; (2) show evidence of a processing deficit in reception, discrimination, association, organization/integration, retention or application of information; and (3) demonstrate a two-year achievement deficit in reading as defined by IQ/achievement discrepancies of more than one standard deviations corrected for regression scores across IQ levels. These criteria are legally recognized under the "Individuals with Disabilities Education Improvement Act".

In this regard, the laboratory at the University of Georgia under the direction of Hynd and the laboratories at the University of Northern Colorado and the University of Arizona under the direction of Obrzut have provided some of the most compelling data on the issues of whether LD can be attributed to incomplete or delayed language lateralization, and whether cerebral lateralization follows a developmental course as assessed by the DL paradigm. Although, these issues were prominent in DL assessment, other demographic variables such as gender and handedness were being investigated, and controlled for, in relation to cerebral lateralization for language. At the same time other studies using subtypes of learning-disabled children, studies employing bilingual children, and those individuals who experience other language related brain disorders (i.e. elderly, stutterers, aphasics, and those with early focal brain damage) were being assessed with the DL technique and seemingly provide information that can be used as a model for understanding LD.

For example, several studies have been performed to examine the language lateralization in individuals with aphasic disorders. Perhaps the most frequently discussed finding in these studies is that individuals with damage to only one hemisphere of their brain tend to exhibit a significantly poorer performance on conditions assessing the contralateral ear than on those assessing the ipsalateral ear in relation to the lesion site (Niccum, Rubens, & Selnes, 1983). As a group, individuals with aphasic disorders seem to exhibit a unique pattern of performance on DL assessments, namely, the demonstration of a left-ear effect that is contrary to the pattern exhibited by control participants. Additionally, some studies have shown that aphasic individuals often demonstrate an increase in the amount of engagement demonstrated by the right hemisphere during tasks, which require language processing (Gowers, 1893; Kinsbourne, 1971; Nielsen, 1936; Papanicolaou, Moore, Levin, & Eisenberg, 1984). Whether these patterns are due to a shift in cerebral dominance or due to a break down of messages received auditorally prior to being analyzed is a question that has been debated within the literature (Bavosi & Rupp, 1984; Johnson, Sommers, & Weidner, 1977; Johnson, Sommers, & Weidner, 1978; Niccum et al., 1983; Petit & Noll, 1979). Interestingly, research in this area has also indicated that the scores an individual earns on DL tasks that direct attention to the right ear will also provide information regarding the extent of damage present in central auditory processing structures (Niccum et al., 1983).

Dichotic listening procedures have also shed some light on the reorganization of language functions following early focal brain damage. Some research in this area has indicated that childrens' language processing shifts to the right hemisphere following congenital lesions to the left hemisphere (Brizzolara et al., 2002; Carlsson, Hugdahl, Uverbrant, Wiklund, & Von Wendt1992; Isaacs, Christie, Vargha-Khadem, & Mishkin, 1996). Other research has indicated that whether or not language is reorganized within the same hemisphere seems to depend largely on the child's age and the type of lesion (Brizzolara et al., 2002). Similarly, research by Chilosi et al. (2005) found that children with left-hemisphere damage showed a LEA, while children with right-hemisphere damage demonstrated a REA. This study also found that children with left hemisphere lesions experience a delay in language development.

While the free recall technique in DL studies primarily has been used to assess auditory perception, the directed attention paradigm (stimulus pre-cuing task) has been used to assess selective attention or, what some may call, auditory-executive function. Thus, differences between learning disabled individuals' performance versus their control counterparts in selective attention may be explained by the top-down and bottom-up processing model. In essence, the forced left task demands top-down processing, as performance on this task involves suppression of the automatic response (reduction in report of automatic right ear input), and an increase of the reporting of the redundant signal in the left ear (shift to a left-ear advantage) (see, Tallus, Hugdahl, Alho, Medvedev, & Hamalainen, 2007). It is thought that the forced left ear task is a more sensitive test for attention deficits that some learning-disabled children experience.

Directed attention tasks have also been used in an effort to gain a better understanding of developmental stuttering. One study by Foundas, Corey, Hurley, and Heilman (2004) examined 18 adults who were developmental stutters and 28 control participants. Participants were given three DL conditions, attend left, attend right, and free recall. The participants were grouped by sex and dominant hand. By so doing, the researchers were able to make several conclusions. While the control participants and right-handed male stutterers demonstrated a REA during free recall and a LEA under the directed left condition, a significantly different pattern was found for left-handed men with developmental stuttering and right-handed female developmental stutterers. These individuals demonstrated the inverse pattern. More specifically, they showed a REA in left-ear directed condition and a REA during free recall. In contrast, right-handed female developmental stutterers showed a tendency to report hearing sounds that had not been presented. Additionally, they also showed no ear effect under free recall and seemed to find shifting attention from one ear to another more challenging than the other participants.

Directed attention tasks have also been used to assess individuals with auditory processing disorders. Results have shown that the DL procedure is able to accurately detect a variety of auditory system related brain disorders (Jerger & Martin, 2006). In a study by Jerger and Martin (2006) a group of 172 elderly individuals with auditory processing disorders were assessed in order to determine the magnitude of difference in performance on a divided vs. directed attention dichotic listening task. The participants were simultaneously presented with a pair of sentences in each ear. After being presented with the sentences, they were to select their response from a list of six target sentences. In one condition, the participant was asked to report which sentences were heard, while in

متن کامل مقاله ← دریافت فوری

ISIArticles
مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات