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Differences in visual orienting between persons with Down or fragile X syndrome

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Abstract

The voluntary and reflexive orienting abilities of persons with Down syndrome and fragile X syndrome, at average MA levels of approximately 4 and 7 years, were compared with an RT task. Reflexive orienting abilities appeared to develop in accordance with MA for the participants with Down syndrome but not for those with fragile X syndrome. However, both groups showed delayed voluntary orienting. The group differences in reflexive orienting at the low MA level reinforce the practice of separating etiologies and highlight the contribution of rudimentary attentional processes in the study of individuals with mental retardation.

Keywords: Visual orienting; Attention; Down syndrome; Fragile X syndrome; Mental retardation

1. Introduction

The many differences in the behavioral and neurological profiles of genetically based syndromes associated with mental retardation (Burack, Hodapp, & Zigler, 1988; Dykens, Hodapp, & Finucane, 2000; Hodapp & Burack, 2006) challenge two related myths about attentional deficits among persons with mental retardation. One myth is that attention deficits are defining features, or even a cause, of mental retardation. The second myth is that the same attentional deficits are common across all persons with mental retardation regardless of etiology (for a review, see Burack, Evans, Klaiman, & Iarocci, 2001). However, no evidence of a deficit that is either inherent to mental retardation or common across etiologies is consistently found in studies that meet rigorous methodological and developmental criteria, such as matching groups on developmental level (Iarocci & Burack, 1998). This finding does not imply that attention deficits might not be found within specific etiological groups, but rather that attentional functioning, like all other aspects of cognitive function, needs to be assessed independently for each etiological group (Burack et al., 2001). This issue entails a more fine-tuned, even if more labor-intensive, approach in which the choice of the specific components of attention to be studied is determined by the unique cognitive and behavioral patterns that are characteristic of a specific etiological group.

In one example, the orienting aspect of attention, or the ability to shift attention in relation to cues in the environment, was studied among persons with Down syndrome because of the observation that infants with Down syndrome display difficulties in searching and shifting attention in free play contexts (Krakow & Kopp, 1983; Landry & Chapieski, 1989). These preliminary observations led to the hypothesis that orienting deficits would

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be evident later in development among persons with Down syndrome. However, this hypothesis was not supported in three studies in which versions of commonly used experimental tasks of orienting were administered to a group of persons with Down syndrome and a group of typically developing children carefully matched on mental age (Goldman, Flanagan, Shulman, Enns, & Burack, 2005; Randolph & Burack, 2000). The two groups showed similar patterns both in automatically orienting to target stimuli when flashes of light were presented as cues in the locations to the left or right of the center of the screen where the targets were eventually displayed (Randolph & Burack, 2000), and voluntarily utilizing a centrally located arrow (i.e., a symbolic cue) to predict the location of a target to the left or right of the screen (Goldman et al., 2005). Although discrepant from the initial observations of infants, these findings are convincing because the developmental levels of the participants were between 5 and 6 years, the age range in which orienting abilities approach adult-like levels of efficiency and, therefore,when group differences are most likely to be found (for a review of issues related to the development of participant groups, see Burack, Iarocci, Bowler, & Mottron, 2002; Burack, Iarocci, Flanagan, & Bowler, 2004).

In keeping with the notion that the efficiency of attentional processing may vary across etiological groups, the evidently intact orienting abilities of the persons with Down syndrome may serve as a metric for gauging the efficiency of persons with mental retardation of other etiologies. This comparison strategy serves to diminish the effects of potentially confounding factors such as IQ differences and the disparity between chronological age and mental age that would need to be considered if differences in orienting are found between persons with intellectual disabilities and typically developing persons (Burack et al., 2001; Zigler, 1967, 1969). Thus, the comparison of the orienting abilities of persons with Down syndrome to those with fragile X syndrome may be useful because attentional problems are often cited for the latter syndrome (e.g., Cornish, Sudhalter, & Turk, 2004; Hagerman, 1999; Munir, Cornish, & Wilding, 2000). Any orienting differences between etiologically homogeneous groupings might be considered within the context of the disparate profiles of cognitive and social skills displayed by the two groups to allow for more fine-tuned mapping of the relation between orienting and other aspects of functioning (see Burack et al., 2002; Cicchetti & Pogge-Hesse, 1982; Hodapp, Burack, & Zigler, 1990).

1.1. Visual orienting and the experimental task

Visual orienting entails shifting attention from one stimulus to another based on information in the environment (Posner, 1980). Overt attentional shifts are accomplished by eye movements that are directed toward a particular location in space, whereas covert shifts occur independent of eye fixation (Posner, 1980; Turatto et al., 2000). These events are typically measured with tasks that involve visual cues that are processed either deliberately or automatically (Logan & Compton, 1998). A central cue indicates where attention should be focused and serves to initiate a voluntary attention shift to a specific location (Parasuraman & Greenwood, 1998). In contrast, a peripheral cue, in the form of, for example, an abrupt flash of light, initiates an automatic shift of attention to the location and does not require higher-order intentional processes for interpretation (Klein, 1993).

Visual orienting is often studied with reaction time (RT) tasks similar to a task developed by Posner (1980) in which a cue is presented just prior to the appearance of a target stimulus. In this methodology, the validity of the cue can be manipulated such that the location of the target is correctly cued on most trials (valid trials) and incorrectly cued on other trials (invalid trials). This procedure typically results in enhanced performance for conditions with the valid cue (relative to baseline), but impaired performance for conditions with invalid cues (relative to baseline) because attention must be redirected from the incorrectly cued location to the target location in the latter condition. The primary index of attention in this task is the ''orienting effect,'' which is derived by subtracting the RT on valid trials from the RT on invalid trials (e.g., Akhtar & Enns, 1989; Randolph & Burack, 2000). Shorter RTs on valid trials than on invalid trials are evidence that processing was influenced by the location of the cue in relation to the target.

In order to examine reflexive and voluntary visual orienting and the relations between the two, among children and adolescents with Down syndrome than to MA-matched children and adolescents with fragile X syndrome, we developed a simple detection task based on the location of the target stimulus with two cue types (peripheral or central) that were valid or invalid. The cue validity was based on the direction of an arrow or the location of a flash cue that either correctly or incorrectly predicted target location. The relations between the two forms of orienting were measured during trials on which both cue types were presented. Based on evidence of intact orienting abilities among persons with Down syndrome, we expected the participants with fragile X syndrome to show a less effective pattern of orienting in relation to those with Down syndrome. Further, in order to examine the developmental changes in orienting within groups, we assessed each component in high and low mental age (MA) groups and expected more effective performance among the high MA group.

2. Method

2.1. Participants

The participants with fragile X syndrome ($N = 20$) were recruited across the United States, although the largest number resided in Wisconsin and surrounding states. The