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Vision-for-perception and vision-for-action in typical development, autism, and Parkinson's disease

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Background

According to the two-visual-system hypothesis (Milner and Goodale, 1995), after V1 the visual system splits into vision-for-action and vision-for-perception modules. Support for the two-visual-systems hypothesis has come from monkey and human studies using a variety of techniques, including neuroimaging, neuropsychological, neurophysical, psychophysical, and behavioral methods (for a recent review, see Goodale & Westwood, 2004). In particular, four commonly accepted criteria for the modularity of cognitve systems are broadly tested in the literature: association with fixed neural architecture, obligatory output, information encapsulation, and specific breakdown patterns after damage (Fodor, 1983). Essentially no studies have tested other criteria for modularity, such as, for instance, the idea that independent modules may exhibit characteristic pace and sequencing in their development.

Method

We investigated two spatial tasks in typically developing school children, autistic children, adults, and patients with Parkinson disease (PD). Thus, we collected data on the development of vision-for-perception and vision-for-

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A. Granà I.M.F.R. Ospedale Gervasutta, Udine, Italy action along the life span and in specific kinds of patient, such as autistic children and adults affected by PD, who could show alterations of visual processing (for a review, see Mitchell & Ropar, 2004; Bondi & Tröster, 1997). The tasks consisted in blindwalking with no delay to a near target and in matching the frontal extent to the sagittal extent of an L-pattern formed by ropes on the ground. The blindwalking task was assumed to tap into the action module, whereas the L-pattern matching task was assumed to tap into the perception module.

Results

In the blindwalking task, typically developing children and adults were accurate whereas autistic children and PD patients exhibited an underestimation bias. Conversely, in the L-pattern matching task adults and PD patients showed comparable underestimation biases, typically developing children showed even greater underestimation, and autistic children were accurate. Control experiments ruled out alternative interpretations based on differences in eye-height and testing rooms.

Conclusions

These studies are consistent with independent vision-foraction and vision-for-perception subsystems that develop at different paces and speeds and are affected in different ways by different pathologies. At least for locomotion, vision-for-action appears to develop more quickly and to be essentially mature at six - seven years of age. As a consequence, childrens' representation of distance when they program a short walk is comparable to that of adults, and both are accurate. Vision-for-perception, conversely, appears to develop more slowly. Moreover, PD participants systematically underestimate distance in blindwalking, but show performances comparable to



control in the L-pattern matching task. This pattern of results may evidence a specific difficulty in processing visual information to guide action, while visual perception is not affected. On the other hand, the surprising performance of autistic children in the L-task suggest that autism may involve anomalies in the use of spatial reference frames in visual cognition.

