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Low-Vision Aids for Young Visually-Impaired Children: Learning to Use a Magnifier

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In principle, tools are used to improve an actor's action radius in terms of her/his geometrical, dynamical or perceptual capabilities (Smitsman, 1997; Smitsman, Cox & Bongers, 2005). When learning to use such a tool, the actor has to be sensitive to the way this bodily attachment alters her/his perception-action capabilities. At first, the tool might not enhance the possibilities for action or perception, because of this changed relation with the environment. Before being able to benefit from the tool, the actor has to learn how it has changed, and how the actions should be adjusted accordingly.

The actor-environment relation certainly changes when using a visual aid, like a hand-held magnifier. Such a magnifier is meant to increase the quantity and quality of visual-information flow for its users, which are mostly visually-impaired people. For a visual aid to be truly beneficial in, for example, reading, the actor has to learn to adequately use the device, as well as learn to interpreted and use the enhanced flow of visual information.

Arguably, this is particular challenging for young visually-impaired children. Studies have shown (e.g., Reimer, Boonstra, Cox & Smits-Engelsman, 2007) that young visually-impaired children not only have a lower level of vision, but generally show an overall impediment in their motor development as well, as compared to their age-matched peers. This poses an interesting issue from a social and a research point of view. On the one hand, because of their lower level of vision, they might benefit from the use of a magnifier. On the other hand, their poorer motor skills might render the actual use of the device difficult.

The research presented in this paper addresses the following main questions: What can we say about the perception-action dynamics of a child + mag-

nifier system in a goal-directed task? What are the relevant behavioural variables that the children need to be controlled for? Does training at an early age improve the skills, strategies and willingness of visually-impaired children to use such a magnifier?

Method

We devised a goal-directed task. Young visually-impaired children (age 3.5 to 6 years) had to use a magnifier (see Figure 1) to be able to perform this task effectively and efficiently. In the task, they had to follow a path of small symbols (LEA symbols: house, apple, square, and circle), somewhat like an 'ant trail', connecting a definite start location with an unknown end location. Children could find the correct end location by carefully following the trail with the magnifier. Each path consisted of one type of symbols, which were scaled to each individual child's near vision.

* * * FIGURE 1 (MAGNIFIER) * * *

The materials used in the experiment were eight different A3 patterns. Each pattern consisted of four paths, and varied in orientation and complexity. An example of an A3 pattern with two paths is shown in Figure 2. Three patterns required the children to make a horizontal movement (i.e., from the top of the page to the bottom or vice versa), three patterns required a vertical movement (i.e., from left to right of vice versa), and two pattern required a circular movement over the entire page. Complexity varied between paths in the number of curves, and the number and type of crossings. There were two types of crossings of one path with another. A crossing might be a simple continuation of the trail through the other path or an interruption of the trail by the symbol of the other trail (see Figure 2). Arguably, the latter type is more complex.

* * * FIGURE 2 (PATTERN) * * *

The design of the study was as follows: Children performed a Pre-Test, in which they had to complete as much paths as they could. The patterns were presented in a random order. After the pre-test, all children received a training of 12 half-hour sessions, twice a week during six weeks. One group of children (N=16) trained with the magnifier, another group (N=16) trained without the magnifier. After the training, children performed the task once more in a Post-Test. This post-test had the same set up as the pre-test. Both groups used the magnifier during the pre-test and post-test. During the training, the same material was used as in the pre-test and post-test.

Two cameras were used to digitally record both tests. One camera was positioned laterally and provided us with a view of children's movements and magnifier handling during task performance. Another camera was mounted to the magnifier and provided us with a clear indicator of magnifier use during the task. That is, whether children actually looked through the magnifier (as op-

posed to next to it). We assessed several behavioural variables from children's behaviour. These variables were posture, and hand, eye, and magnifier use. The latter variable was measured twice, from both the lateral and magnifier cameras. All variables were categorically scored by using video-scoring software (The Observer 5.1; Noldus b.v.).

Results and Discussion

In terms of successfulness on the task, we found an increase in both groups, although a difference was found in the amount and type of increase. First, quantitatively, in both groups children managed to follow more trails (irrespective of finding the correct end location or not). The increase was a factor 1.8 in both groups. Second, in terms of the quality of performance, however, a difference was found between the two groups. With quality of performance we refer to the number of correct end location that children found. On average, the without-magnifier training group performed 2.1 times as good, while the with-magnifier training group performed 4.3 times as good. In order to successfully find the end location, using the magnifier is necessary. Therefore, this result gives us a clear indication that children that had trained with the magnifier actually performed better in the task.

Video analyses of the behavioural variables revealed an additional and more detailed view on children's task performance. The difference in qualitative task performance can (partially) be explained by the increase in the amount of time looking trough the magnifier, in the with-magnifier training group. Also, we found an increase in the flexibility of coordinating posture, and hand and magnifier movements in this group. Interestingly, both groups showed a decrease in the eye-to-magnifier distance during the task, which indicates an increased willingness to use the magnifier and more interest in 'detail'.

References

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Figure 1.

Figure 2.