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Viewing and attention in children

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The study of Cooper, Uller, Pettifer and Stole (1) showed that 4-year-old children's visual attention was supported by watching an experimentally designed television clip, which had many different views onto a 'teacher' reading from a picture book. However, 6- to 7-year olds' attentional system appeared to be more supported by fewer changes and longer durations of views on the reading-aloud teacher.

This is not only of interest to paediatricians and parents as well as children's television programme directors, but also a new and exciting research paradigma where two traditions within developmental psychology have been linked, i.e. viewing and attention. In my commentary, I am describing the background to children's viewing of multiple visual scenes with regard to attentional load. I begin with a brief review of the earliest systematic research on view processing in children, the Three Mountains task, and continue with the possible cognitive and neuropsychological background behind view processing.

Children's viewing of visual scenes was part of the Swiss psychologists Piaget's and Inhelder's research on the development of spatial reasoning (2). Their Three Mountains Task had become a well-researched paradigm in the 1980s and is part of nearly every developmental psychology textbook. Children were asked to decide from the four views of the Three Mountains array, which would be the one of the

Invited commentary for Cooper NR et al. Conditioning attentional skills: examining the effects of the pace of television editing on children's attention.

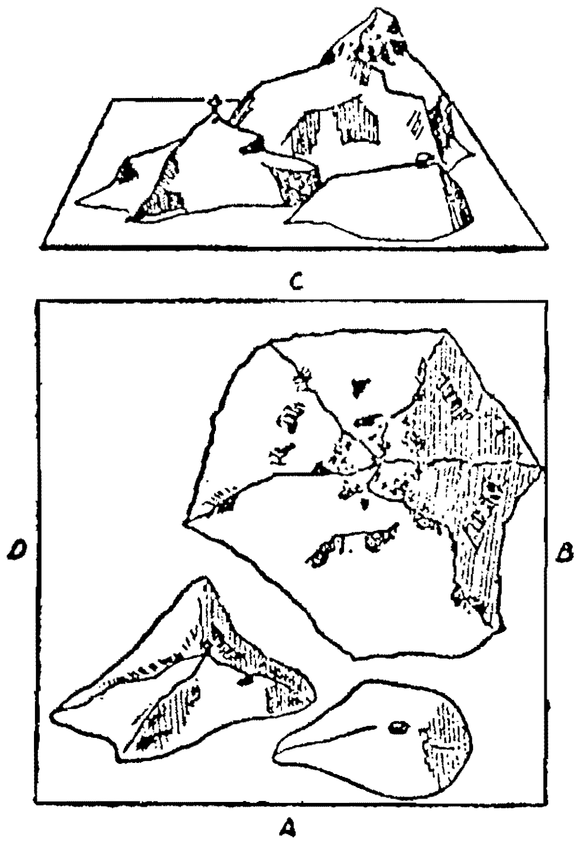

Figure 1 Three Mountains Task.

experimenter, i.e. they were tested whether they could identify the perspective of somebody else (Fig. 1).

Most children could do this only at about age nine, with the advent of operational thought (executive skills). Before, they would often select their own perspective instead. Nowadays, we could call this perseveration, but then it was called egocentrism. Only at about age eleven did children show the same performance level as undergraduate students (3).

Earlier age thresholds could be found when geometrically regular blocks, rather natural objects like mountains with an irregular contour were used and it was revealed that also the overlap of the mountains was posing a difficult problem (4). An information processing perspective was proposed very early by Rosser (5) who sorted the task demands such as number of views and recognition vs. reproduction as response into some sort of a logical sequence. She stated with great foresight that 'when the task is beyond the representational and conceptual abilities of the young child, they behave egocentrically either because the internal relationships are most salient, or because they do not know what to do' (Rosser, 1983, p. 666). In other words, the own-view perspective is just the most familiar, so they may fall back on what they know. Perseverative responses in the most difficult task, requiring children to reconstruct the view from ready-made object shapes, occurred in 56 % of the 4-year olds, 48 % of the 6-year olds and still in 39 % of the 8-year olds, i.e. all these children were constructing their own view instead of the other's view.

A recent study of myself (6) used a series of four views of spatial systems into which children had to draw figures playing a ball game. Children initially do not draw views at all, but only single objects without a spatial context. Hence, the ready-made views presupplemented their objects with a surrounding. Most 7-year-old children were drawing a habitual figure size and did not reduce size in perspective systems, but some benefited from the perceptual pull created by gradually emerging depth in one of the series without actually being aware of it. However, a random sequence of these views where depth would not gradually unfold did not have the same effect until 2 years later. Hence, the experience of multiple views could have an impact on 7-year olds when their sequence corresponded to the perceptual flow. This underpins the finding of Cooper et al. that the experience of a higher amount of views had a beneficial effect on children's attentional skills.

So if the experience of multiple views is beneficial, why would children return to their own view when their information processing capacity was challenged in the Three Mountains Task? Response perseveration is an important problem, and could be demonstrated already in infancy in another well-researched Piagetian spatial task, the A-not-B search task (7–10). Perseveration consists of a dysfunctional 'inhibition of return' which normally favours new locations and inhibits orienting towards visual locations that have been previously attended (11,12). Lange-Küttner (9) suggested that this is a return to the familiar object still bound to its original place, a relation which would have needed dissociation before an object-new-place unit could be constructed. However, individual object-place units lose their power as soon as multiple objects are bound into larger, common regions (13,14). Perseverative responses in spatial tasks are also a problem in children with attention deficit hyperactivity disorder (ADHD) (15,16).

Perserveration because of limited attentional resources can also occur in adult stroke patients with right hemisphere brain injury (17). They may show perserverative errors in tasks such as line cancellation, where in an array of lines, they have a tendency to return to and re-mark targets that they had already cancelled (18,19). This perseveration is often coupled with a visual neglect, where items on the left can become entirely ignored, yet simultaneously their presence leads to increased perseveration in the right visual field, especially when these objects were similar to the targets (20). The more stimuli (competing choices), the higher the attentional load, the stronger the visual neglect (21,22). Furthermore, normal children when under pressure (23), and children with ADHD show similar behaviour (24). This suggests that real or perceived attentional load activates an innate bias to the right side in visual attention (25). The attentional task which Cooper et al. used for testing (26) did in fact test just this, orientation to the left or right spatial field, i.e. is the fish looking to the left or right side, and do I have to press the left or right button respectively to feed it?

Unlike in earlier Posner paradigms (27,28), where the spatial cues were left and right to the target, in the Attention Network Test (ANT) the different sorts of spatial cues were not really giving any hints about the left-right 'feeding' direction, as they were above and below cues along a vertical axis. Hence, they were just warning cues about the upcoming of the next trial to test alertness, not tapping into the innate right-side bias, which emerges under pressure. Yet, the most pronounced result in the Cooper et al. study pertained to the variable 'orienting' which involved picking up a helpful spatial cue on where-to-look-next, with 4-year olds in the fast-changing views condition and the 6-year olds in the slow-changing views condition benefiting most in terms of faster reaction times [i.e. negative values indicating a gain; (1)]. In contrast, 'alerting' which involved widening the visual field of the children by attracting their attention to the entire up-down expanse (double cue) was most helpful for 4-year olds who showed a gain in the fewer-views condition. The effect of congruent vs. incongruent fish spatial context did not vary in the two conditions.

In the Cooper et al. study, in the condition with more views, a new view appeared relatively regularly after two complete sentences of the speaker. Hence, if one supposes that children exerted more focused attention in this condition while at the same time experiencing more spatial information about the same object, this would correspond to the Three Mountains task with one object, but multiple views, a relatively optimal condition. Hence, the beneficial effect on cue pick-up in the youngest age group and increase of accuracy across age groups in the visual attention test thereafter is very plausible. In contrast, in the fewer-views condition, children experienced long passages of read-aloud text, which would have drawn their attention and imagination to the actual storyline, while the fewer views would have provided relatively less incentive to increase the alertness of the visual attention system. That 6-year olds benefited of where-to-look cues more in this condition was probably due to the effect that they would have had the ambition to do both, lining up the story and actively exploring the spatial context during the film, which would have been more conducive to do in the 'slow' condition as the language flow of the picture book story appeared more continuous. A short memory test at the end of the session would make it possible to test this idea in an easy way.

In short, the Cooper et al. study surely needs further research, the most urgent being that children would need to be assessed on the ANT before and after the film intervention, so that an attention baseline would be available. Children usually come into school with large individual differences in terms of reaction times, but standard deviations become smaller with age. However, given the many trials (24 practice trials and 48 experimental trials), we can be reasonably confident that individual differences in baseline speed may have dissipated during learning, while the viewing experience was a valid and reliable treatment in the current study.

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