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Developmental components of large-scale search: evidence from children and individuals with partial genetic deletions

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Background

We examined cognitive factors that support the development of efficient search behaviour in large-scale space. It has been suggested that physical effort may account for the deployment of memory during search, and this was manipulated in a study involving typically developing children. It has also been claimed that the LIMK1 gene is involved in the development of spatial cognition. Most support for this has come from studies of individuals with Williams Syndrome (WS), a disorder associated with hemizygosity for certain genes on chromosome 7 (including LIMK1) and typified by spatial impairments. We tested the role of LIMK1 by comparing adult individuals with Williams Syndrome, and participants with an isolated LIMK1 deletion (without full-blown WS).

Method

The experiments were conducted using an automated search apparatus, situated in a square room with a large raised platform floor. Participants searched for a hidden target amongst a randomised display of lights by activating a switch at each potential location. In the child study, the motor difficulty of the task was manipulated by requiring children to search with either their dominant or their non-dominant hand. 20 children aged 5-8 years performed a block of 14 trials for each hand and also completed a small battery of standardised tests of cognitive function. In the WS/ LIMK1 study, 2 adults with WS and 2 adults with LIMK1 deletion performed 28 trials of a similar search task, without the manipulation of responding hand. In this case, display size was varied between 5, 10, 15, 20 potential target locations. Individuals were also compared to 24 adult controls.

Results

In the child study, participants made significantly more revisits to locations that they had already inspected when using their non-dominant hand. Overall individual differences in children's performance were related to their spatial working memory ability: children with a longer Corsi span completed trials in less time and with fewer visits than children with a shorter span. However, their search performance was unrelated to general fluid intelligence (measured using RCPM). In the WS/ LIMK1 study, individuals with WS made significantly more revisits than those with LIMK1 deletions and unimpaired adult controls.

Conclusions

In children, increased motor effort was associated with poorer memory for locations that had already been searched. This might be due to costs associated with inhibiting a response with the preferred hand. Search efficiency was highly correlated with spatial working memory but not intelligence, suggesting that the development of spatial memory is associated with the success of children's search behaviour, rather than more general cognitive factors. In the WS/ LIMK1 study, individuals with WS made more erroneous revisits than other participants, and this occurred for all display sizes. In comparison, LIMK1 participants made no revisits at all. This finding rules out the hemizygotic deletion of LIMK1 as the main cause of spatial deficits in WS. Furthermore it also demonstrates that individuals with WS show impairments in large-scale space, a component of their cognitive profile that requires further study.

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