Abstract: 8998

Clustering of external representations in young people with autism spectrum disorder

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Introduction

•To inform design criteria for effective and efficient user interfaces for young people with autism spectrum disorder (ASD), we were interested in exploring how the differences in cognitive abilities in individuals with ASD impact the usability of external representations (ERs).

•Research has shown that ASD is related to an imbalance in cognitive abilities. For example, Minshew and Goldstein (2001) have shown that individuals with ASD have relatively weaker language skills, while other studies have shown that spatial cognition might be enhanced (Caron et al., 2004).

•A reduced declarative function in individuals with ASD might be compensated by a 'visual module' (Matessa, 2008), where for example, mental imagery processing is used for sentence comprehension (Kana et al., 2006). Also, Kunda and Goel (2008) describe a bias towards visual processing in individuals with ASD, which might explain differences in cognition.

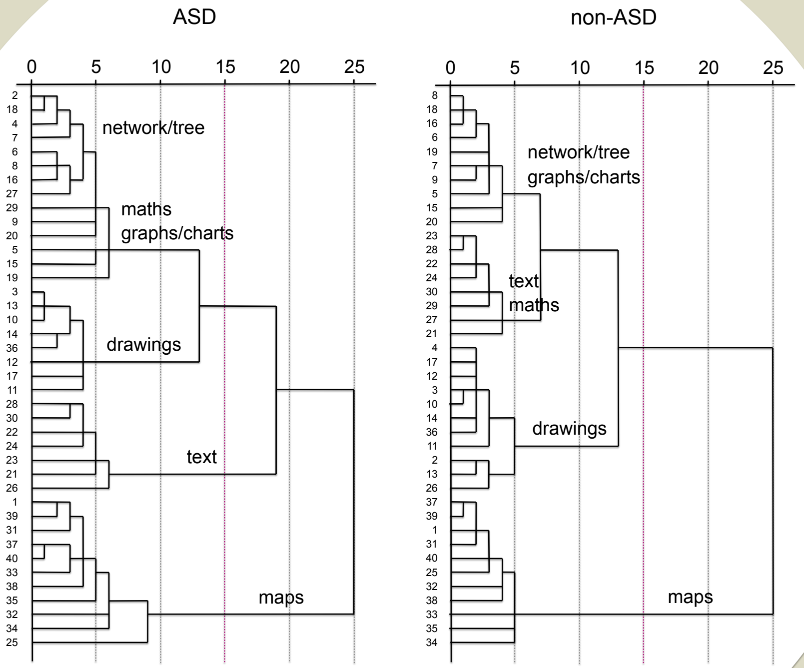
•User interfaces should accommodate the difference in information processing. In particular, ERs need to be developed that support and enhance visual processing.

Methodology

•28 high-functioning young people with ASD (24 male; 4 female) aged between 11-15; and 28 young people without ASD (18 male; 10 female) aged between 11-14. The groups were matched on age, maths ability, and verbal ability. Each group was enrolled, respectively, in specialist and non-specialist schools, in years 7, 8, and 9 of the UK curriculum.

•We ran an open ER card sort that investigated the clustering of ERs by young people with and without ASD. The ER stimuli were based on a card sort task developed by Cox and Grawemeyer (2003), who examined ER clustering by typical adults, For this study, the original ER stimuli were adapted in view of participants younger age range (stimuli were based on ERs used in educational software and the amount of cards was reduced to 40).

•Participants were asked to sort the representations into different piles, each pile representing a cluster. It was possible to swap cards between piles as clusters evolved. After the clustering had been completed participants were asked to label each cluster (using 'post-it' notes).



Results

•From participants' card sorts a similarity matrix for each group was created, which was then input to the SPSS CLUSTER procedure to produce a hierarchical cluster analysis.

•The resulting dendrograms from the analysis (`Rescaled Distance Cluster Combined') showed overall similar clusters for both groups: maps, drawings, text, graphs and charts, and network and tree diagrams.

•However, looking at the clusters at the scaled distance of 15, different major clusters occurred. For the ASD group these clusters were: 1. maps; 2. text; 3. drawings, graphs, charts, network and tree diagrams. In contrast, the non-ASD clusters were: 1. maps; 2. drawings, text, graphs, charts, network and tree diagrams.

•Also, the ASD group clustered mathematical notation together with graphs and charts, while the non-ASD group clustered maths with textual representations.

•In both groups drawings and non-drawing clusters were between 10 and 15 units apart, whereas the remainder of the clusters (network and tree diagrams, as well as graphs and charts) showed in both groups a scaled distance close to 5 units or lower.

Discussion and Conclusion

•The clearest top level distinction for both groups were maps. Maps can be seen as the most spatial type of ER and have been identified as a 'basic level' ER category by Cox and Grawemeyer (2003).

•For the ASD group, textual representations – after maps – form a distinct cluster at the high level branching factor, whereas the non-ASD group showed a less clear distinction between textual and non textual representations (some of the textual ERs referred to the main visual ER stimuli categories).

•A different organisation of certain brain regions within ASD may imply that individuals with ASD perceive textual information (including maths) as a distinctive visual category rather than a linguistic category. This might underpin a bias towards visual processing in individuals with ASD (Kunda and Goel, 2008).

•The results will help us to design user interfaces that are tailored to young people with ASD. The next step is to investigate how user interfaces can be adapted to the special needs of the ASD population, based upon the differences in information processing.

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