Associations between visuospatial working memory and enumeration impairments

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Introduction

- Chromosome 22q11.2 Deletion Syndrome (DS22q11.2) results from a microdeletion on the 22nd chromosome and is estimated to occur in 1 out of every 4000 live births.
- Typical manifestations include heart defects, facial dysmorphism, cleft palate, and anomalous cognitive and brain development.
- Common cognitive phenotype includes mild to moderate reductions in IQ and impairments in numerical and visual spatial abilities.
- Neuronal substrate changes include overall reductions in brain volume (both gray and white matter) which appear particularly concentrated in posterior regions.
- Previous research in both typically developing children and children with neurodevelopmental disorders has suggested that visual-spatial working memory is related to enumeration (counting) abilities.
- Thus, we hypothesized that the numerical impairments characteristic of 22q are the cascaded effects of alterations in the frontoparietal neural network and consequent dysfunction in spatial, attentional, and executive processing (Simon et al., 2005).
- To examine this hypothesis, we examined both visual-spatial and enumeration performance in 7- to 14-year-old children with DS22q11.2 and typically developing controls.

Participants

68 children between 7 & 14 years of age
(Mean = 10 years, 3 months, SD = 2 years, 2 months)
42 children with DS22q11.2 (25 female, 17 male)
26 typically developing children (12 female, 14 male)

Method

- 8 conditions:
  - Number of items (1,2,3,4,5,6,7,or 8 items)
  - Reaction Time (ms)
  - Percent Correct (%)
  - Errors
- Dependent Variables
  - Reaction Time & Percent Error
  - Number of Items
  - Percent Correct
  - Errors

Results

- Reaction Time & Percent Error
  - Although both groups' reaction time was comparable across conditions, DS22q11.2 group made more errors (i.e., indicated the wrong number of dots were present) when counting trials with more than 2 items.
  - Consistent with previous finding, DS22q11.2 group had more difficulty determining the correct number of items in the display.

- Visual Spatial Working Memory Task
  - Percent Correct
    - All participants' performance decreased as a function of longer delays and more items.
    - DS22q11.2 group performed similarly to the control group on 2-item trials at the short (500ms) delay, but below the control group at longer delays (5000ms).

- Error Types:
  - DS22q11.2 group had more difficulty producing an effective search among items in the display.

- Enumeration Task on a Touchscreen Computer
  - Percent Correct
    - “Too many” Kermits
    - “Too few” Kermits
    - “Wrong Arabic Numerals or Counting Mistakes

Discussion

- Performance on the Enumeration Task, varied between the two groups:
  - Although there was no difference in reaction time, the DS22q11.2 group made significantly more errors than the control group on items
  - This difference in performance was due to poor control of the search process in the DS22q11.2 group, likely the result of frontoparietal network impairments.
  - Performance on the Visual Spatial Working Memory Task differed between the two groups:
    - There was no group difference in performance on 2-item trials at the short delay.
    - However, there was a group difference in performance on 2-item trials at the long delay.

References


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