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Everyday Spatial Behaviors: A Comparison between Individuals with Down Syndrome and Typically Developing Children

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Introduction

Spatial abilities assist in manipulating, constructing, and navigating the physical world and are employed in a number of everyday activities (Newcombe & Shipley, 2014; Montello, 2001). Research suggests that individuals with Down syndrome (DS) perform either at or below the level of their mental-age matched typically developing (TD) controls on visio-spatial tasks, suggesting that this is an area of weakness in individuals with DS (Yang, Conners, & Merrill, 2014). Much of the research examining spatial abilities in people with DS has focused on their performance on laboratory measures of spatial abilities. Yet spatial abilities measured in a laboratory setting are different from everyday spatial behaviors which consist of what one actually does on a daily basis. In this study, we sought to examine everyday spatial behaviors in individuals with DS compared to mental-age matched TD children as indicated by caregiver self-report.

Methods

Participants were individuals aged 12-25 years with DS (N =10, Mage = 14.90, Range = 12:0-19:4, Male = 4 Female = 6), TD children aged 4-9 years (N = 10, Mage = 5.12, Range = 4:2-5:10, Male = 3 Female = 7), and their primary caregivers. The sample of TD children was larger than the sample size used in this analysis, however, we selected participants that were matched on mental age for comparing groups. To conduct group matching, DS and ID participants completed the Raven's Progressive Matrices 2 and were matched by Ability Score.

Participant's caregivers completed a modified version of the Everyday Spatial Behavior Questionnaire (ESBQ; Eliot & Czarnolewski, 2007). It consisted of 25 high-loading items in various spatial categories from the original ESBQ (Lawton, Czarnolewski & John Eliot, 2016). Additional items deemed more appropriate for children were added based on consensus by the researchers. Questions were categorized into Newcombe and Shipley's (2014) four categories of spatial behavior: intrinsic-static, intrinsic-dynamic, extrinsic-static, and extrinsic-dynamic. Caregivers also completed the Santa Barbara Sense of Direction Scale (SBSOD; Hegarty, Richardson, Montello, Lovelace, & Subbiah, 2002) which is a 15-item self-report measure that assesses environmental spatial abilities. The items were modified from self-report to caregiver report.

Table 1. Spatial categories and item examples from questionnaire

Spatial Category	Example Item (Rated on a Likert scale of Always Difficult to Never Difficult or Strongly Agree to Strongly Disagree)
Intrinsic-Static	Finding a pen on a crowded surface (e.g., desk or table)
Intrinsic-Dynamic	Folding a piece of paper into equal halves
Extrinsic-Static	Identifying landmarks that lead to home (i.e., a street sign or tree indicating that they are close to home)
Extrinsic Dynamic	Correctly running toward a spot where they anticipate a ball will land after it has been thrown from a distance
Sense of Direction	They are very good at judging distances

Results

- Items across the questionnaire were indexed to create a total scale measuring everyday spatial abilities.
- Indexes were also created that included items measuring spatial abilities across the four spatial categories and sense of direction.
- Five one-way ANCOVAs were conducted to compare caregiver reports between the DS and TD groups on the four spatial categories on the ESBQ, and the SBSOD questionnaire while controlling for mental age.
    - There were no significant differences between DS and TD participants on the total scale, $F(1,17) = 2.68$, $p = .120$.
    - Caregiver reports for the DS and ID participants did not significantly differ on the intrinsic static [$F(1,17)= 3.18$, $p = .092$], intrinsic dynamic[$F(1,17) = .03$, $p = .864$], extrinsic static [$F(1,17)= 3.35$, $p = .085$], or extrinsic dynamic [$F(1,17)= .06$, $p = .810$] spatial dimensions.
    - There was a significant difference in caregiver reports on the Sense of Direction questionnaire [$F(1,17)= 4.92$, $p = .041$] between the DS ($M = 72.71$)and TD groups ($M = 56.79$).

Discussion

Overall, caregiver reports did not significantly differ in terms of the difficulty their child experienced with tasks related to intrinsic static, intrinsic dynamic, extrinsic static, or extrinsic dynamic spatial abilities. However, caregiver reports indicated that individuals with DS have greater difficulty with sense of direction compared to their TD counterparts. Hence, people with DS may have more problems conducting complex and large-scale spatial activities, compared with relatively easy small-scale spatial activities (Yang, Faught, & Merrill, 2018). Difficulties related to sense of direction may pose limitations in independent living skills (e.g., navigation) among individuals with DS. It is important to note that our current analysis is limited due to the small sample size as data collection is ongoing. Future research should continue to explore difficulties in navigation in individuals with DS to inform the development of programs to improve navigational abilities in individuals with DS.