



Research Paper

Mental rotation ability and everyday-life spatial activities in individuals with Down syndrome[☆]Chiara Meneghetti^{a,*}, Enrico Toffalini^a, Barbara Carretti^a, Silvia Lanfranchi^b^a Department of General Psychology, University of Padova, Italy^b Department of Developmental and Social Psychology, University of Padova, Italy

ARTICLE INFO

Number of reviews completed is 2

Keywords:

Down syndrome

Mental rotation

Everyday-life spatial activities

ABSTRACT

Although certain visuospatial abilities, such as mental rotation, are crucially important in everyday activities, they have been little explored in individuals with Down syndrome (DS). This study investigates: i) mental rotation ability in individuals with DS; and ii) its relation to cognitive abilities and to everyday spatial activities. Forty-eight individuals with DS and 48 typically-developing (TD) children, matched on measures of vocabulary and fluid intelligence, were compared on their performance in a rotation task that involved detecting which of two figures would fit into a hole if rotated (five angles of rotation were considered: 0°, 45°, 90°, 135°, 180°). Participants were also assessed on their visuospatial and verbal cognitive abilities, and on their parents and/or educators reports regarding their everyday spatial activities. Results showed that: (i) individuals with DS were less accurate in mental rotation than TD children, with larger differences between the groups for smaller angles of rotation; individuals with DS could not mentally rotate through 180°, while TD children could; (ii) mental rotation ability was related to fluid intelligence and to spatial activities (though other cognitive abilities are also involved in the latter) to a similar degree in the DS group and the matched TD children. These results are discussed with regard to the atypical development domain and spatial cognition models.

What this paper adds?

This paper adds new knowledge on the mental rotation ability of individuals with Down syndrome (DS) and its relation to cognitive ability and everyday spatial activities. Visuospatial skills are usually judged to be weak in individuals with DS, but a variegated profile has emerged in this condition due to the complexity of the construct (Yang, Conners, & Merrill, 2014). Given the paucity of knowledge on mental rotation ability in individuals with DS, and its effect on their environment learning ability, this study newly explored: (i) mental rotation ability in individuals with DS; and (ii) its relation to visuospatial and verbal cognitive abilities, and performance in everyday spatial activities (based on parents and/or educators reports). Individuals with DS were compared with typically-developing (TD) children matched for mental age on a rotation task that involved mentally rotating figures through 0°–180° (Frick, Hansen, & Newcombe, 2013). The results showed a different angular orientation effect in the two groups, where larger differences coincided with smaller angles of rotation. For rotations at 180° the DS group's performance was at chance level. Our findings also showed a relation between visuospatial (rotation) ability and fluid intelligence. Rotation and other cognitive abilities (receptive vocabulary, fluid intelligence) were related to a hetero-assessed performance in every day spatial activities too, and this relation was similar in the DS and TD groups. Overall, these results contribute to what is known about visuospatial (rotation) ability in individuals with DS, and how it relates to other cognitive skills and everyday spatial activities.

[☆] This research was supported by a grant (CPDA140302/14) awarded to the first author.

* Corresponding author at: Department of General Psychology, University of Padova, Via Venezia 8, 35131 Padova, Italy.

E-mail address: chiara.meneghetti@unipd.it (C. Meneghetti).

1. Introduction

Down syndrome (DS) is a genetic condition caused by trisomy of chromosome 21 (Kittler, Krinsky-McHale, & Devenny, 2008). It is the most common genetic cause of intellectual disability. The majority of individuals affected reach a mental age of up to 5–6 years (Dykens, Hodapp, & Finucane, 2000). As is usually the case in developmental disorders, however, DS is associated with a variegated profile of cognitive abilities, with particular strengths and weaknesses. There is much research to suggest that the verbal domain is an area of relative weakness in the intellectual profile of individuals with DS, while their visuospatial abilities are relatively well preserved (see Davis, 2008; Silverman, 2007, for reviews). This view has been questioned, however, because there is evidence of impairments in certain visuospatial tasks too (e.g. Lanfranchi, Cornoldi, & Vianello, 2004; Pennington, Moon, Edgin, Stedron, & Nadel, 2003). The point to bear in mind is that visuospatial abilities are not a single construct, but a complex set of several sub-factors (Hegarty & Waller, 2005; Uttal et al., 2013), and the relative strengths and weaknesses of individuals with DS may depend on which specific aspect is considered (Yang et al., 2014). The present study focused on mental rotation, i.e. the ability to imagine how a two- or three-dimensional object would look if it were rotated in space. This is considered one of the fundamental visuospatial abilities and part of general intelligence (Carroll, 1993; Lohman, 1996).

Studies on typical development (TD) have shown that children are capable of mental rotation beyond the chance level by the age of 5 years (Kosslyn, Margolis, Barrett, Goldknopf, & Daly, 1990), which corresponds to the mental age reached by most individuals with DS in adulthood. There have also been some reports of mental rotation ability even in infants and toddlers, however (Lauer & Laurenc, 2016; Möhring & Frick, 2013; Moore & Johnson, 2011). By 3 years of age, mental rotation ability can be assessed by using forced-choice tasks, presenting pairs of figures that may be either the same but seen from different angles, or mirror images (i.e. different figures). There is evidence of mental rotation ability developing steadily between 3 and 6 years of age (Frick, Hansen et al., 2013; Krüger, Kaiser, Mahler, Bartels, & Krist, 2014). A linear effect of angular disparity has usually been reported, with longer response times (Krüger et al., 2014) or lower degrees of accuracy (Frick, Ferrara, & Newcombe; 2013; Frick, Hansen et al., 2013) with increasing angles of rotation of the object being compared. An example of a mental rotation task appropriate for TD children was proposed by Frick, Hansen et al. (2013), called the Ghost figures task. Participants were shown a pair of two-dimensional ghost figures, only one of which could fit, if rotated, inside a given hole (the other figure is a mirror image). The images could be rotated through different angles from 0° to 180°. Children from 4 to 5 years of age were asked to turn the ghost figures in their mind and choose the one that would fit into the hole. The results showed the typical orientation effect (i.e. a decreasing accuracy with increasing angular disparities between the images being compared), and an improvement in performance from 4 to 5 years old. More of the 4-year-olds' than of the 5-year-olds' responses would be at chance level (as shown by previous studies, Estes, 1998; Noda, 2010).

The question of rotation ability in individuals with DS has received little attention. It seems important to examine mental rotation ability in DS in order to clarify to what extent it may be a strength or weakness in the domain of this population's visuospatial competences. In the review conducted by Yang et al. (2014), only two studies reportedly investigated mental rotation in individuals with DS (Hinnell & Virji-Babul, 2004; Vicari, Bellucci, & Carlesimo, 2006) and, to our knowledge, they are the only two such studies available in the literature. In both cases, individuals with DS were compared with TD children matched for mental age. Hinnell and Virji-Babul (2004) tested adults with DS of around 30 years of age, comparing them with TD children around 7–8 years old who were matched for a measure of receptive vocabulary. They used a forced-choice paradigm, asking participants to indicate whether an upper case "F" was reversed ("Ɔ") or not ("F"); the letter was presented with eight different angles of rotation (0°, 45°, 90°, 135°, 180°, rotated to both left and right). The authors found that the DS and the TD groups did not differ significantly in response times, but they did differ in accuracy, which neared the ceiling in the TD group, but not in the DS group (the two groups reached an accuracy of around 96% and 76%, respectively). The DS group's performance dropped to chance level for the maximum degree of rotation, i.e. 180° (the main effect of the angle of rotation was not reported). No significant group by angle of rotation interaction was reported. In the other study, Vicari et al. (2006) tested individuals with DS and a mean chronological age of 15–16 years, matched on mental age (measured using the Stanford-Binet Intelligence scale, which covers both verbal and visuospatial aspects) with a group of TD children who had a mean chronological and mental age of around 5 years. The tasks used to assess their mental rotation ability involved presenting: (i) L- or S-shaped sticks with full or empty circles at the two ends, rotated through 45°–270°; and (ii) geometrical drawings created *ad hoc*. In both cases, participants were shown several options and asked to choose which one matched the target stimulus. The authors found no effect of group on total accuracy, but the mean scores they reported revealed a floor effect in both groups (performance was below chance level in the first task, and very close to it in the second). No information was provided on performance for different angles of rotation.

It is therefore still not clear whether individuals with DS would present the same effect of the angle of rotation on their mental rotation accuracy as already seen in TD children of similar mental age (e.g. Frick, Hansen et al., 2013). It is worth noting that previous results could be influenced by methodological issues, however. Both the above-mentioned studies were conducted on relatively small samples (only 7 participants with DS were tested in Hinnell & Virji-Babul, 2004; and 18 in Vicari et al., 2006), and this may have limited the statistical power of the analyses. Different tasks were used (one based on a "yes"/"no" judgement, the other on multiple-choice questions) and generated different results, with differences between the groups in favor of the TD children in Hinnell and Virji-Babul (2004), but not in Vicari et al. (2006). A more thorough analysis of mental rotation ability in individuals with DS is therefore needed to clarify their profile by comparison with the TD population of similar mental age.

Another research question concerns the extent to which mental rotation is related to other abilities. Studies on TD populations found rotation ability related to general cognitive abilities such as fluid intelligence (Jansen & Heil 2010; Lehmann, Quaiser-Pohl, & Jansen, 2014). For instance, Jansen and Heil (2010) found that performance in the Picture Mental Rotation Test (Quaiser-Pohl, 2003) – which involves choosing one of three objects that is the same as the target object, but in a rotated position – was related

Download English Version:

<https://daneshyari.com/en/article/6848275>

Download Persian Version:

<https://daneshyari.com/article/6848275>

[Daneshyari.com](https://daneshyari.com)