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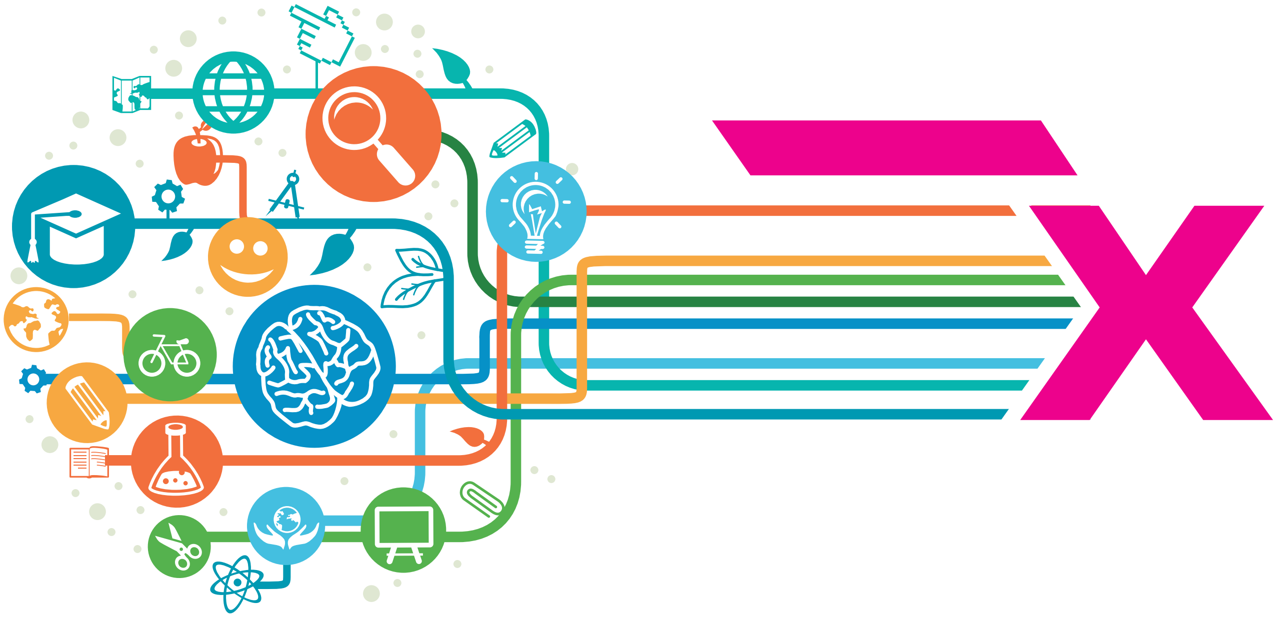
Spatial Intelligence



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Spatial Intelligence

INTRODUCTION

Spatial ability is the over-arching concept that generally refers to skill in representing, transforming, generating, and recalling symbolic, nonlinguistic information. Although traditional IQ tests may be a valid measure of linguistic or sequential reasoning, they are not a valid measure of spatial intelligence.

Spatial ability consists of mental rotation of objects or spaces, spatial perception, and spatial visualization. Mental rotation involves the ability to rapidly and accurately rotate two- or three dimensional figures while spatial perception is a person's ability to determine spatial relationships with respect to the orientation of his or her own body (perspective taking), in spite of distracting information. Spatial visualization involves complicated, multi-step manipulations of spatially presented information. These tasks require analysis of the relationship between different spatial representations, rather than a matching of those representations.

Spatial thinking is what is done when shapes and spaces are visualized in the "minds" eye. The mental feat architects and engineers (Sutton and Williams 2010) have to perform when designing buildings, a chemist trying to visualize the three dimensional molecule and its pattern of folding, a surgeon navigating the body with a minute camera (Hegarty et al 2013) or a radiologist performing scans and X-rays. Sculptures are often visualized by the sculptor within the matrix of the stone. Developing spatial skills hence is of great significance in a whole variety of careers (Johnson S; Scott, L)

TRAINING

People often assume that spatial skills are biologically determined and either you have it or you don't. This may arise from several studies which have shown that males have greater spatial skills than females.

However, experience with spatial tasks leads to notable improvements among both men and women (Terleki.MS et.al 2008). Studies on undergraduates done by Rebecca Wright et al (2008) revealed that although at baseline males were better at spatial skills, with training ranging from few hours to few weeks both sexes improved and the gender gap closed.
A review of more than 200 publications on the educational intervention to improve spatial skills by Prof Uttal and co-authors (2012) confirms that spatial skills can be improved, are malleable and transfers to other fields and the gender gap is reduced.

Maxxbrain Holdings Pte. Ltd.
19 Orchid Drive
Adelphi Park Estate
Singapore 576174

neil.thamotheram@maxxbrain.com
T +65 9666 1257 (SGP)
T +66 87 831 1252 (THA)
F +65 6491 6568

These skills are not the only aspect of a person's overall intelligence but the research suggests that spatial skills and thinking is an important predictor of achievement in Science, Technology, Engineering and Mathematics (STEM) (Wai et al 2009).

Psychology researchers Kell, Lubinski and co workers (2013) followed up 563 students aged 13 who scored exceptionally well at SATs (TOP 0.5%).The researchers also examined their spatial ability as measured by the differential aptitude test. Although SAT's score at 13 predicted their scholarly publications and patents 30yrs later, their spatial ability at 13yrs predicted uniquely creative and scholarly outcomes particularly in the STEM domains, above and beyond more traditional measures of mathematical and verbal skills. Cultivating spatial skills is likely to play a major role in future scientific innovation.

SPATIAL SKILLS /ABILITY IN CHILDREN

Mental spatial transformation abilities are present in precursor form in infants, toddlers, and preschool children. This ability is thought to develop when children explore their respective environments and gain experiences with how objects look from different perspectives. They show important individual differences, which are malleable (Newcombe and Frick 2010; Diezman CM and Watters JJ 2000)

Preschoolers

Toddlers were given a spatial task of choosing a correct piece from among four alternatives which could be added to the others to make a square shape. Those with the strongest spatial knowledge had the best understanding of numbers (Gunderson et al 2012).

Psychologist Susan Levine and colleagues (2012) recently conducted a study that found 2-4 year-old children, who play with puzzles, have better spatial skills when assessed at 4 1/2 years of age. The researchers followed 53 child-parent pairs from diverse socioeconomic backgrounds for a two-year period. They recorded parent-child interactions on video during 90-minute sessions that occurred every four months between 26 and 46 months of age.

The researchers asked the parents to interact with their children as they normally would and about half of the children in the sample played with puzzles at least one time. Higher income parents tended to engage children with puzzles more frequently. Both boys and girls who played with puzzles had better spatial skills important in maths but boys played with more complicated puzzles than girls, and the parents of boys provided more spatial language during puzzle play and were more engaged in the play than the parents of girls.

Primary school

Cheng, Mix and colleagues (2012) trained 6- to 8-year-olds in mental rotation, a spatial ability, and found their scores on addition and subtraction problems improved significantly. The mental rotation training involved imagining how two halves of an object would come together to make a whole, when the halves have been turned at an angle. Previous research has shown a link between spatial training and math and the current study suggests that training primes the brain to better deal with calculation problems. Improved math performance was observed with 20mts training. Understanding this connection and early intervention with longer training periods in elementary grades can close the achievement gaps in math.

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Tzuriel,D and Egozi,G (2010) tested the mental rotation abilities of 116 Israeli first graders (average age, 6.5 years), and randomly assigned about half of them to a training program designed to help kids observe, transform, and keep track of geometric shapes in their "mind's eye." The other kids were assigned to an alternative, non-spatial training program. At the beginning of the study, boys outperformed girls. But after only 8 weekly sessions, the girls in the spatial skills training program had caught up. The gender difference was gone.

Disadvantaged kids from poor homes high poverty preschools and kindergartens were rarely exposed to activities like puzzle play handicraft and other projects linked to spatial skills. David Grissmer (2013) and his team in an attempt to understand the achievement gaps in these children worked with afterschool programmes in 3 high poverty high minority elementary schools.

For 45 minutes a day, 4 days a week for 7 months 1st graders played with games that required them to copy designs and shapes. At the start of each class pupils took part in "calirobics" –hand writing and line tracing set to music. Other activities included copying pattern or picture in various materials, cut and paste construction paper to make chains, built clay models or lego blocks, stencil pattern blocks or fusible beads. The children were not taught math and the teachers did not draw any link between art projects to math. At the start of the programme the students tested at the 30th percentile nation wide in numeracy and applied problems. At the end of the programme they had moved to the 47th percentile. Similarly large improvements were observed in looking, listening, attention and executive function skills. David Grissmer says that you cannot teach maths and reading skills to get higher maths and reading skills unless the students have the foundational skills of fine motor coordination and executive skills.

These findings provide the basis for considering how to promote spatial thinking in pre and primary schools, at home, and in children's play.

CONCLUSION

Integrating spatial content into formal and informal instruction could not only improve spatial functioning in general but also reduce differences related to gender and socioeconomic status that may impede full participation in a technological society.(Wei,J 2012)

Like all skills creative skills can be developed or enhanced by training. Testing for these skills and looking at neurological processes associated with spatial skills, mapping these processes in the brain by MRI imaging etc (Jung R et al 2013) may provide important clues for more specifically designed games, puzzles and toys geared to individual need. Educational toys can contribute significantly to the cultivation of spatial intelligence at a young age.

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