Center for Open Access in Science ▪ Belgrade - SERBIA
8th International e-Conference on Studies in Humanities and Social Sciences
http://centerprode.com/conferences/8IeCSHSS.html
ISBN (Online) 978-86-81294-09-3 ▪ 2022: 143-148

Examining the Effect of Gender on the Landmark Task Judgment in Preschool Children

Maria Lagonikaki & Ivanka Asenova

South – West University "Neofit Rilski", Blagoevgrad, BULGARIA
Faculty of Philosophy

Received: 20 May 2022 ▪ Revised: 18 June 2022 ▪ Accepted: 24 June 2022

Abstract

With the aim to examine gender-related differences in visual spatial perception/attention in preschool age, 84 boys and 94 girls (range 3,4 – 6,7 years old) were studied with a Landmark task which require whether 17 pre-marked horizontal lines are correctly bisected in two equal halves. Between-group comparisons were based on the differences in mean scores three variables: Percentage of correct answers, Quotient of error, and Type of perceptual error. The results revealed a slight effect of gender on the Landmark task judgment in preschool children, with the male group exhibiting higher magnitude of leftward bias in comparison to the female group.

Keywords: Landmark task, preschool age, gender, spatial perception/attention, lateralization.

1. Introduction

Attention is a central component of cognitive functioning and "lies at the crossroads between perception and cognition" (Carrasco, 2018: 77). Visual spatial attention is essential for visual spatial perception and spatial ability (Carrasco, 2018; White, Boynton, & Yeatman, 2019), which in turn are vital for human survival and development, because we are living in a multidimensional space all the time (Yuan et al., 2019).

Numerous studies have provided evidence for gender-related differences both in spatial abilities and lateralization of spatial perception and attention, and although contradictions exist, most of the studies have found better spatial abilities (Halpern, Straight, & Stephenson, 2011; Kerns, & Berenbaum, 1991; Kimura, 2000; Reilly, Neumann, & Andrews, 2017; Voyer, Voyer, & Saint-Aubin, 2017; Yuan et al., 2019) and more pronounced functional cerebral asymmetries for visuospatial processing in males than in females (Clements et al., 2006; Hausmann et al., 2002; for a meta-analysis – Voyer, Voyer, & Bryden, 1995).

Line-bisection and Landmark task are the most commonly used behavioral methods for studying brain asymmetry in visual spatial attention. Line-bisection task consists in the subjective determination of the center of visually presented horizontal lines with different lengths, by marking a sign with a pencil, as usually the task is done once with each hand. It is well documented that healthy adults (especially right-handed people) systematically tend to bisect or judge lines left of the real center (Asenova, 2014; Çiçek et al., 2009; Failla, Sheppard & Bradshaw, 2003; for a review and meta-analysis see Jewell & McCourt, 2000). This phenomenon is called

Correspondence: Ivanka Asenova, South – West University "Neofit Rilski", Faculty of Philosophy, Blagoevgrad, BULGARIA. E-mail: asenova_iva@swu.bg.

"right pseudoneglect" (Bowers, & Heilman, 1980) and is considered to be related to right hemispheric dominance for spatial attention (Jewell & McCourt, 2000).

- Children aged 3-6 years showed a group-level slight leftward error in Landmark task performance, indicating the presence of pseudoneglect during preschool age.
- There are slight gender-related differences in the performance of Landmark task in 3-6 years old children.
- There are no gender-related differences in the abilities for visual spatial perception in preschool age.
- Gender has slight and insignificant effect on the pattern of asymmetry of visual spatial attention in 3-6 years old children.

Unlike adults, when perform line-bisection task pre-pubescent children tend to bisect lines to the left of the true midline with the left hand and to the right with the right hand. This phenomenon is called "symmetrical neglect" (Bradshaw et al., 1988; Dobler et al., 2001; Failla, Sheppard & Bradshaw, 2003; for a meta-analysis – Kaul, Papadatou-Pastou & Learmonth, 2021) and is considered as a result of inability of the right hemisphere to consistently exert dominance over the left hemisphere via callosal inhibition, due to immaturity of the corpus callosum in childhood (Yazgan et al., 1995).

Landmark task is the perceptual form of the line-bisection, or its non-motor adaptation, and requires the subject to assess whether pre-marked lines are correctly bisected in two equal halves or alternatively, whether the bisection mark is closer to the left or to the right end of the line (Fink et al., 2000; Çiçek, Deouell, & Knight, 2009; Learmonth & Papadatou-Pastou, 2021).

Therefore, Landmark task and not line-bisection is a pure visuospatial task, since line bisection also includes a motor component requiring translation of the perceived visual-spatial information into an appropriate motor program (Hausmann et al., 2002). Moreover, the motor confounds introduced by using a paper-and-pencil version of a line bisection task are considered one of the factors leading to inconsistencies of the results of behavioral studies on the development of spatial biases that have used this version of the line bisection task (Hoyos et al., 2021).

Despite the above-mentioned considerations, three studies only have used a landmark task to investigate asymmetry of visual spatial attention among children till now (Kaul et al., 2021). These studies belong to Dellatolas et al. (1996), Liu et al. (2012) and Hoyos et al. (2021). There results showed a group-level leftward attentional bias indicating right spatial inattention.

Scarce results from research on the development of spatial attentional lateralization among population of children that have used a landmark task and lack of a relevant study among children in preschool age, motivated the present study. Its main purpose was to examine the effect of gender on the development of asymmetry in visual spatial attention in early childhood, and in particular, in the period from 3 to 6 years of age.

2. Method

A total of 178 children (84 boys and 94 girls, ranged 3,4 – 6,7 years old) participated voluntarily in the study and with their parents' consent. They were studied with a Landmark task requiring a subject's judgment, whether pre-marked horizontal lines are correctly bisected in two equal halves.

The Landmark task used in the present study includes 17 pre-bisected horizontal black lines on a white sheet of paper (21×30cm). Line length ranges from 100 to 260mm. Seven lines

are presented in the middle of the sheet, five are aligned to the left side and five lines are aligned to the right of the sheet. Six lines are pre-bisected 0.5mm closer to the left end of the lines, six lines are pre-bisected 0.5mm closer to the right end of the lines, and the rest five lines are exactly bisected.

3. Procedure

Each child was instructed by the experimenter that he/she is required to judge for each line separately whether it is divided into two equal halves or the left side of the line is longer or the right side of the line is longer. Then the experimenter placed the sheet in front of the child and started the testing by asking the question: "Are the two parts of this line equal or not?" If the answer is "No", the experimenter asked: "Which part is shorter – the left or the right?"

The experimenter covered each commented line with a white sheet, to ensure that the child is not biased by his/her previous choices. The experimenter did not provide feedback for the correctness of the answers.

No time limitation existed to complete the task.

The two possible errors were scored in the following way: an overestimation of the right segment of a line (leftward bias – L) was scored as -1, and an overestimation of the left segment of a line (rightward bias – R) was scored as +1.

A Mean percentage of correct answers and a Quotient of error were calculated individually of each child.

The Quotient of error was calculated, using the formula: $[(R - L) / (R + L)] \times 100$, where R is the number of overestimations of the right segment and L is the number of overestimations of the left segment. The negative value of the Quotient of error indicates a tendency of leftward bias, and the positive value of the Quotient of error indicates a tendency of rightward bias.

4. Results

Results of the Independent Samples T-test, performed on the Mean percentage of correct answers of the Landmark task (Mean; SD; SE) of the two gender groups, are presented in Table 1.

Table 1. Mean percentage of correct answers of the gender groups

	N	Mean percentage of correct answers	Std. Deviation	Std. Error
Boys	84	62.25	17.78	1.940
Girls	94	57.75	18.71	1.930
t *(p)*	$t_{/176/}$=1.637; p=.103			

As seen, at the group level, the Mean percentage of correct answers for the Landmark task of the group of boys was slightly higher in comparison to the Mean percentage of correct answers of the group of girls. The between-group differences did not reach statistical significance ($t_{/176/}$ =1.637; p=.103).

As regards the between-group comparison of the Quotients of error, which inform us about the magnitude and direction of bias (leftward or rightward bias) associated with spatial perception at the group level, the results are presented in next Table 2.

Table 2. Mean Quotient of error of the gender groups

	N	*Mean Quotient of error*	*Std. Deviation*	*Std. Error*
Boys	84	-10.94%	52.72	5.752
Girls	94	-1.02%	43.43	4.479
t *(p)*	$t_{/176/}$=-1.375; p=.171			

As seen, at the group level, the two gender groups showed the same direction of perceptual bias, namely, to the left of the real center, but different magnitude of the bias, with the male group exhibiting more pronounced leftward bias in comparison to the female group, without between-group differences reaching statistical significance ($t_{/176/}$=-1.375; p=.171).

The performed Chi-square comparisons of the frequency of left, right or no perceptual error on the Landmark task performance in gender groups (Table 3) revealed that the highest percentage of both groups showed leftward bias, i.e., the typical right pseudoneglect for spatial perception. The percentage of the participants exhibiting leftward bias was slightly higher in the group of boys than in the group of girls, but the difference did not reach statistical significance ($\chi^2_{|2|}$=1.387, p=.500; Cramer's V=.088).

Table 3. Distribution of participants in gender groups according to the type of perceptual error in spatial perception (Landmark test)

	Leftward bias		Rightward bias		No bias	
	n	%	n	%	n	%
Boys	44	52.4	27	32.1	13	15.5
Girls	41	43.6	35	37.2	18	19.1
Pearson Chi-Square	$\chi^2_{\|2\|}$=1.387, p=.500					
Cramer's V	.088					

5. Discusion

Overall, we found that children aged 3,4 – 6,7 years showed a group-level slight leftward error in Landmark task performance, indicating that pseudoneglect is present in typically developing children even in preschool age. This pattern of results agrees with the results of the two previous relevant studies (Dellatolas, Coutin, & De Agostini,1996; Hoyos et al., 2021; Liu et al., 2012).

The observed slight gender differences in the performance of Landmark task in current study suggests no significant modulating effect of gender on the pattern of asymmetry of visual spatial attention in children aged 3,4 to 6,7 years. In addition, lack of differences in the Mean percentage of correct judgments between the groups of boys and girls we identified, suggests no significant gender-related differences in the abilities for visual spatial perception in this age period. These findings are in agreement with the results of previous studies aiming to examine the effect of gender on lateralization of visual spatial attention (Andonova, 2014; Asenova & Andonova-Tsvetanova, 2019; Jewell & McCourt, 2000; Kaul, Papadatou-Pastou & Learmonth, 2021).

Nevertheless, the tendency of higher incidence and higher magnitude of the leftward error in spatial perception in boys than in girls we revealed, is a finding to some extent consistent with the Roig and Cicero's report (1994) that males tend to made bigger leftward bias than females, and could be seen as supporting the suggestion for greater right-hemisphere lateralization of the attention in males than in females. More precisely, this finding provides some support for the assumption that the earliest signs of gender-related differences in hemispheric asymmetries of visual spatial attention may emerge in preschool age.

The main limitations of this study are the relatively small size of the studied sample and non-matched size of male and female groups. Replications with larger and gender-matched sample are needed to assure the validity of the current findings.

6. Conclusions

In conclusion, we identified a slight leftward bias of visuospatial attention in children aged 3,4 to 6,7 years old, as indexed by the Landmark task performance. There was evidence of a slight and insignificant effect of gender on the pattern of asymmetry of visual spatial attention in this age period.

The overall pattern of results supports a dominant role of the right hemisphere in spatial attention in both sexes, slightly more pronounced in males than females, which may be identified as early as preschool age.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public commercial, or not-for-profit sectors.

The authors thank the children and families who participated in this study.

The authors declare no competing interests.

References

Asenova, I. (2014). Lateralization of visual spatial attention in right-handers, left-handers and converted left-handers: A comparative investigation with line-bisection task. *MEDIMOND-Monduzzi Editore International Proceedings* (pp. 5-8): (16th ECDP, Lausanne, Switzerland, sept. 3-7, 2013).

Bowers, D., & Heilman, K. M. (1980). Pseudoneglect: Effects of hemispace on a tactile line bisection task. *Neuropsychologia, 18*(4-5), 491-498. https://doi.org/10.1016/0028-3932(80)90151-7

Bradshaw, J. L., Spataro, J. A., Harris, M., Nettleton, N. C., & Bradshaw, J. (1988). Crossing the midline by four to eight year old children. *Neuropsychologia*, *26*(2), 221-235. https://doi.org/10.1016/0028-3932(88)90076-0

Carrasco, M. (2018). How visual spatial attention alters perception. *Cogn Process, 19*(Suppl 1), 77-88. https://doi.org/10.1007/s10339-018-0883-4

Çiçek, M., Deouell, L. Y., & Knight, R. T. (2009). Brain activity during landmark and line bisection tasks. *Front. Hum. Neurosci.*, Vol. 3, article 7. https://doi.org/10.3389/neuro.09.007.2009

Clements, A. M., Rimrodt, S. L., Abel, J. R., Blankner, J. G., Mostofsky, S.H., Pekar, J. J., Denckla, M. B., & Cutting, L. E. (2006). Sex differences in cerebral laterality of language and visuospatial processing. *Brain Lang.*, *98,* 150-158.

Dellatolas, G., Coutin, T., & De Agostini, M. (1996). Bisection and perception of horizontal lines in normal children. *Cortex: A Journal Devoted to the Study of the Nervous System and Behavior*, *32*(4), 705-715. https://doi.org/10.1016/S0010-9452(96)80040-2

Dobler, V., Manly, T., Atkinson, J., Wilson, B. A., Ioannou, K., & Robertson, I. H. (2001). Interaction of hand use and spatial selective attention in children. *Neuropsychologia*, *39*(10), 1055-1064.

Failla, C., Sheppard, D., & Bradshaw, J. (2003). Age and responding-hand related changes in performance of neurologically normal subjects on the line-bisection and chimeric-faces tasks. *Brain and Cognition, 52*(3), 353-363.

Feng, Q., Zheng, Y., Zhanga, X., Song, Y., Luo, Y-J., Li, Y., & Talhelm, T. (2011). Gender differences in visual reflexive attention shifting: Evidence from an ERP study. *Brain Research*, 1401(15), 59-65.

Halpern, D. F., Straight, C. A., & Stephenson, C. L. (2011). Beliefs about cognitive gender differences: Accurate for direction, underestimated for size. *Sex Roles*, *64*(5-6), 336-347. https://doi.org/10.1007/s11199-010-9891-2

Hausmann M, Ergun G, Yazgan Y, Güntürkün O. (2002). Sex differences in line bisection as a function of hand. *Neuropsychologia 40*, 235-240.

Hoyos, P. M., Kim, N. Y., Cheng, D., Finkelston, A., & Kastner, S. (2021). Development of spatial biases in school-aged children. *Developmental Science*, n/a(n/a), e13053. https://doi.org/https://doi.org/10.1111/desc.13053

Jewell, G., & McCourt, M. E. (2000). Pseudoneglect: a review and meta-analysis of performance factors in line bisection task. *Neuropsychologia*, *38*, 93-110. https://doi.org/10.1016/S0028-3932(99)00045-7

Kerns, K. A., & Berenbaum, S. A. (1991). Sex differences in spatial ability in children. *Behavior Genetics, 21*(4), 383-396. https://doi.org/10.1007/BF01065974

Kimura, D. (2000). *Sex and cognition*. Cambridge, MA: MIT Press.

Liu, L., Qian, Q.-J., Li, H.-M., Li, Z.-H., Huang, F., Yang, L., & Wang, Y.-F. (2012). Atypical brain laterality for spatial attention in children with attention-deficit/hyperactivity disorder. *Chinese Mental Health Journal*, 13-16.

Reilly, D., Neumann, D. L., & Andrews, G. (2017). Gender differences in spatial ability: Implications for STEM education and approaches to reducing the gender gap for parents and educators. In M. S. Khine (Ed.), *Visual-Spatial Ability: Transforming Research into Practice* (pp. 195-224). Switzerland: Springer International. https://doi.org/10.1007/978-3-319-44385-0_10

Voyer, D., Voyer, S., & Saint-Aubin, J. (2017). Sex differences in visual-spatial working memory: A meta-analysis. *Psychonomic Bulletin & Review*, *24*, 307-334.

Voyer, D., Voyer, S., & Bryden, M. P. (1995). Magnitude of sex differences in spatial abilities: A meta-analysis and consideration of critical variables. *Psychological Bulletin, 117*(2), 250-270. https://doi.org/10.1037//0033-2909.117.2.250

White, A. L., Boynton, G. M., & Yeatman, J. D. (2019). The link between reading ability and visual spatial attention across development. *Cortex, 121*, 44-59. https://doi.org/10.1016/j.cortex.2019.08.011

Yazgan, M. Y., Wexler, B. E., Kinsbourne, M., Peterson, B., & Leckman, J. F. (1995). Functional significance of individual variations in callosal area. *Neuropsychologia*, *33*(6), 769-779. https://doi.org/https://doi.org/10.1016/0028-3932(95)00018-x

Yuan, L., Kong, F., Luo, Y., Zeng, S., Lan, J., and You, X. (2019). Gender Differences in Large-Scale and Small-Scale Spatial Ability: A Systematic Review Based on Behavioral and Neuroimaging Research. *Front. Behav. Neurosci.* https://doi.org/10.3389/fnbeh.2019.00128