Science Arena Publications
International Journal of Philosophy and Social-Psychological Sciences
ISSN: 2414-5343
Available online at www.sciarena.com
2018, Vol, 4 (4): 1-5

Direction of Human Profile Facing in Drawings is Associated to the Quality of Reading in School Second Graders

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Abstract: *Elementary school G-2 and G-5 were requested to draw human profile by memory. Teachers scored the quality of the reading skill of G-2 and G-5. Tendency to draw RF vs LF was found associated to lower vs higher scores respectively in G-2. No difference in the reading scores between the participants, drawing RF vs LF was found in G-5. Tendency to draw LF vs RF is suggested to stem from visual attention bias to the left vs right half of the visual space, due to the predominant involvement of the right vs left brain hemisphere in visuo-spatial attention. Left hemispheric activity and spatial bias to the right visual space is suggested to prevent G-2 from fast adaptation to the reading in L-R direction.*

Keywords: *Elementary School, Reading Direction, Reading Skill, Visuo-Spatial Attention, Hemispheric Lateralization.*

INTRODUCTION

Out of the 1474 human portraits painted by Western European masters, 60% were shown to represent the LF and 40% - the RF from the viewer's perspective (MacManus, Humphrey, 1973). Predomination of the LF over the RF was demonstrated in the survey of 4180 drawings, paintings and photographs produced by the Western artists (Conesa et al., 1995). The preference to portray the LF is observed in artifacts of early Greek culture (Hufschmidt, 1980). The tendency of the right-handed nonartists to draw the LF was mentioned in 19th century (see for review Meshcheryakov, Moshkina, 2016). We reported on the 76% prevalence of the LF over the RF in the drawings of adult nonartist Georgians (Makashvili et al., 1997).

Various factors are suggested to account for the tendency of human subjects to draw the LF vs RF. Social interaction between the model and the artist and the visual preference to the left half of the model's face, as well as predominance of the left visual field over the right in face recognition is suggested to account for the prevalence of the LF in artistic production (MacManus, Humphrey, 1973).

Another explanation refers to the "Biomechanical factor" such as handedness. In particular, right vs left-handedness of the painter is suggested to influence the direction of profile drawing in artists (MacManus, Humphrey, 1973) as well as in nonartist adults and children (Crovitz, 1962; Taguchi, Noma, 2005; Picard, 2011; Tosun, Vaid, 2014). According to authors, preference to draw the LF or RF is related to the ease of execution of different types of limb movements and for right-handers it is easier to draw LF.

Direction (L-R vs R-L) of reading in the native script is considered one more factor, responsible for the tendency to produce the LF vs RF. Depend on the reading direction subjects may be predisposed to predominantly operate in the left vs right visual space and to produce the LF vs RF respectively.

Therefore, tendency to predominantly operate in the left vs right visual space may be ascribed to cultural influence of reading habit (Tosun, Vaid, 2014; Kebbe, Winter 2012; Vaid, 1995; Hufschmidt, 1985).
In sum, it is still not clear why people differ in tendency to draw RF vs LF.
Prevalence of the LF over the RF in the drawings as well as association between the profile direction and the quality of reading skill was found in the small sample of elementary school pupils in our pilot study. Current study was designed to replicate these results in the larger sample and to decide, which of the above-mentioned explanations are applicable to the data obtained.

Materials and Methods

A total of 109 G-2 and 115 G-5, mean age 7,1 and 10.8 respectively, of both sexes were recruited in the study after approval from the school officials and informed consent of parents. All participants were healthy, with the normal or corrected to normal vision and without signs of cognitive or motor impairment. Experiment was conducted in the last 2 months (May and June) of the school year. Handedness questionnaire (Oldfield, 1971) translated into Georgian and adapted to children was used to assess the handedness of the study participants. Participants were asked to demonstrate how to use a hammer, scissors to cut a paper, a knife to cut a piece of clay, a broom and a toothbrush. Safety scissors and knives with plastic blades, as well as safety plastic hammer were used. In addition participant was asked to write some letters, to draw a house, to throw a ball, to open the box and to open the door. In sum, each participant was required to perform a total of 10 manipulations. The preference to use either the right or the left hand in the each task performance was registered. The handedness index R-L/10 was calculated to assess the handedness. The R and the L denote the hand (the right and the left hand respectively), preferred for task performance while 10 stands for the sum total of the tasks listed above. Exclusion criterion was the score bellow +0.8, i.e. preference to the use of the right hand in less than 9 tasks. Another exclusion criterion was the use of the left hand either in writing or in drawing. Selected participants were asked to draw a human profile. The instruction was as following: "Here you have a pencil and paper. Please use a pencil to draw a human profile. Do you know what is it? profile is a half-face, it looks like when somebody turns his/her head to look aside". Participants have not been specially taught neither at home, nor in the school how to draw a human profile. Teachers of G-2 and G-5 were asked to score the reading ability of each study participant by the use of scoring system with the range between 0 and 20, where 0 denotes absence of reading ability and 20 denotes excellence in reading. The data were analyzed by the use of SPSS 20.0. The Pearson $\chi 2$ test of the independence of frequency distribution, the Student's *t*-test for independent samples as well as the nonparametric Mann-Whitney U test and the Univariate Analysis of Variance were used for the data analysis.

Results and Discussion

Out of the 109 G-2, 36 (33%) produced the RF and 73 (67%) – the LF. The mean score in reading for the G-2 producing LF vs RF was 18,33 (*SD*=2,095) and 17,56 (*SD*=2,741) respectively. The difference between the mean scores was insignificant (t (55,831) = -1,491, p=0,141 ns). The mean rank of the scores in the G-2 producing the LF vs RF was 56,75 and 51,46 respectively and the difference in the reading performance was insignificant: U=1186,5, exact p<,383 ns. The frequency distribution of the scores in the G-2 is presented in the Chart 1.

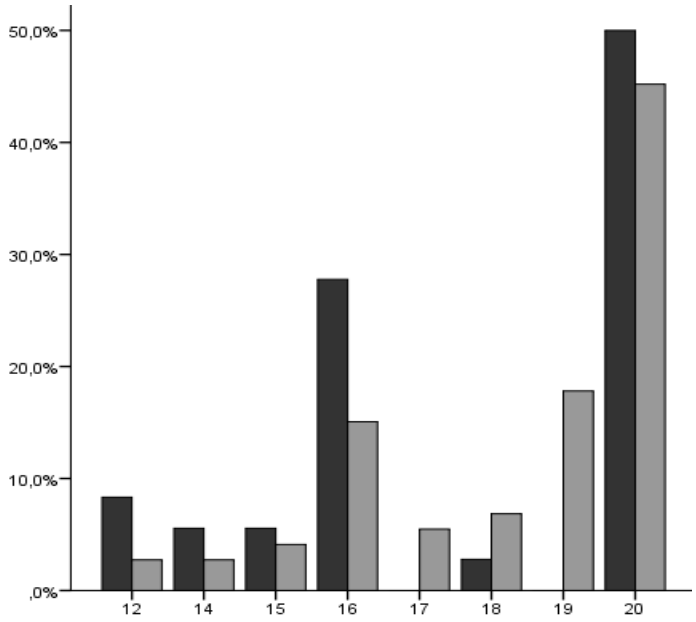

Chart 1. The frequency distribution of the scores in reading in the G-2

Vertical axis: Percentage of the G-2. Horizontal axis: Scores in reading. Dark column: The G-2 producing the RF, gray column: The G-2 producing the LF. The difference in the frequency distributions of the scores between the G-2 producing the RF vs LF was significant at one tail ($\chi 2$=13,525, df=7 p<.06). Thus, G-2 producing RF display the tendency to get lower scores in reading as compared to G-2 producing LF.

Out of the 115 G-5, 35 (30,4%) produced the RF and 80 (69,6%) – the LF. No significant difference in the number of the RF between the G-2 and the G-5 was found. The mean score in reading for the G-5 producing the LF vs RF was 17,33 (*SD*=2,773) and 17,29 (*SD*=2,696) respectively. There was no significant difference in mean scores between the G-5 producing the LF vs RF (t (113) = -,070, p=,944 ns.). The mean rank of the scores for the G-5 producing the LF vs RF was 58,33 and 57,24 respectively. No significant difference in the mean ranks of reading performance between the G-5 producing the LF vs RF was revealed: U=1373,5, exact p<,867 ns. The difference in the frequency distributions of scores between the G-5 producing the RF vs LF was found insignificant ($\chi 2$=10.663, df=9 p<.299 ns.).

As it was mentioned above, authors (MacManus, Humphrey, 1973) proposed several social, biological and psychological factors to account for the prevalence of the LF in artistic productions. Participants in the current study were nonartist school pupils, having no experience in profile drawing. At the same time, factors such as the interaction between the model and the artist and the visual preference to the left half of the model's face do not come into play in the current case, as long as study participants produced profiles from imagination. For the same reason, predominance of the left visual field over the right in face recognition, as a factor determining the direction of profile drawing (MacManus, Humphrey, 1973) is not accountable for the prevalence of LF, obtained in the current study.

Biomechanical factor such as handedness is suggested responsible for producing the LF with the right hand in right-handers (Crovitz, 1962; Taguchi, Noma, 2005; Picard, 2011; Tosun, Vaid, 2014). However, producing RF with the right hand does not fit into biomechanical explanation. Therefore, RF in the current study can not be ascribed to the right-handedness of study participants. Several authors (Tosun, Vaid, 2014; Kebbe, Winter 2012; Vaid, 1995; Hufschmidt, 1985) ascribe the tendency to produce the LF vs. RF to the direction of reading in the native script. However, if script direction had an influence on the direction of profile drawing, stronger tendency to draw LF in G-5 as compared to G-2 would be expected in the current study. Since the school second graders are beginners in reading while the fifth graders are relatively skilled readers, development of the L-R reading habit in G-5 should strengthen the tendency to draw the LF in the G-5. However, there was no difference in the number of the RF and LF between the G-2 and the G-5 and we suggest, that the tendency to draw the LF vs RF is not determined by script direction and reading habit.

In our opinion, the tendency to operate predominantly in the left vs right visual space is biological rather then cultural by the origin. We suggest asymmetric involvement of brain hemispheres in spatial processing responsible for the lateral bias in profile drawing. According to the "Activation-orienting hypothesis" (Reuter-Lorenz et al., 1990) visual attention bias to the left vs right half of the space depends on which brain hemisphere is predominantly activated during the visuo-spatial task performance. Involvement of the left vs right hemisphere in the rightward vs leftward spatial bias is confirmed in clinical studies demonstrating association between the left-sided spatial neglect and the right-hemispheric lesion and vise versa (see for review Heilman et al., 1997; Bisiach, 1999; Karnath, Zihl, 2003). Although the right hemisphere of right-handers is commonly considered superior to the left hemisphere in organizing visual attention, recent studies demonstrate, that in some right-handers, the left hemisphere may dominate in the control of spatial attention (Floel et al., 2005). We suggest individual differences in hemispheric lateralization of visuo-spatial attention to account for the attention bias to the left vs right half of the space and as a result, to determine the individual tendency to draw LF vs RF.

The question to be answered is, why G-2 producing RF display the tendency to get lower scores in reading as compared to G-2 producing LF. To our knowledge, this is a first report on the association between the direction of profile drawing and reading skill in elementary school children.

According to the "Sequential attention shift" model, the process of reading depends on the shift of attention from one word (letter) to the next (Morrison, 1984). Since in the L-R script order the first word is placed on the left of the sentence, as well as the first letter is placed in the left part of the word, attention of the reader should be primarily focused on the left side of the space.

We suggest the interplay between the natural right vs left bias of visual attention and sequential shift of attention in the process of reading to influence the ability to read in school beginners.

On the one hand, predominant right-hemispheric activity determines the left bias of visual attention and on the other hand, this helps L-R reader to concentrate attention on the first word in the sentence and the first letter in the word, therefore promoting the process of reading from the first word (letter) to the next one. Predominant left-hemispheric activity directs the visual attention to the right half of visual space, preventing L-R reader from the fast concentration on the first word and the first letter. This may explain the lower scores in reading in the study participants, producing the RF as compared to the participants, producing the LF.

With age, some brain adaptive mechanisms should help pupils to deal with the L-R reading and the predomination of the left hemisphere in visuo-spatial attention no longer interferes with the process of reading. That is why G-5 producing RF vs LF did not differ in reading ability.

Conclusion:

Elementary school pupils are shown to display the tendency to draw human profiles, directed to the left vs right. We suggest this tendency to stem from the predominant involvement of the left vs right brain hemispheres in visual-spatial attention, determining attention bias to the right vs left part of visual space. At the same time, tendency to draw profiles, facing to the right, may cause problem in reading in school second graders – beginners in reading. These pupils may experience problem in focusing attention to the left part of the written sentence (word) and therefore, fail to read fluently from left to the right.

The limitation of the current study is that teachers scored overall reading skill of their pupils and further examination is necessary to find, which component of reading (mainly reading fluency or word comprehension) was affected in G-2, who produced the RF and at the same time, got lower scores in reading. The same participants should be tested on cancelation task. Prevalence of the omissions on the left part of the cancelation sample would confirm the rightward visual bias in these participants. Not all the G-2 producing RF demonstrated worth reading skills, and only tendency to have worth reading ability in this group of participants have been revealed. Therefore, the data obtained need further replication in the larger sample of participants.

Abbreviations: LF – Left-facing profiles; RF – Right-facing profiles; L-R – left-to-right; R-L – right-to-left, G-2 – second graders, G-5 – fifth graders.

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