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Effects of hand clasping and arm folding on academic performance*

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Abstract

BACKGROUND: Similar to handedness, hand clasping and arm folding are also lateral preferences. Previous studies showed a variation frequency for hand clasping and arm folding among different populations.

OBJECTIVE: To investigate the relationship between patterns of lateral preferences (hand clasping or arm folding) and academic performance of middle school students.

DESIGN, TIME AND SETTINGS: Cross-sectional investigation. The data were collected in the Beijing Zhongguancun High School in Beijing in May 2007. Data analysis was performed in the State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University during June to July 2007.

PARTICIPANTS: A total of 102 senior-grade students from Beijing Zhongguancun High School, including 58 males and 44 females, were selected for this study.

METHODS: Different forms of hand clasping and arm folding were recorded. More specifically, hand clasping was either right-thumb-top or left-thumb-top, and arm folding was either right-arm-top or left-arm-top. Students with congruent preference used right-thumb-top-right-arm-top or left-thumb-top-left-arm-top, and incongruent preference was displayed by right-thumb-top-left-arm-top or left-thumb-top-right-arm-top. Academic performances were collected from mid-term exams in six subjects (Chinese, Mathematics, English, Physics, Chemistry, and Biology), with a total points = 100 for each. A three-way (hand clasping, arm folding, and sex) ANOVA was performed to determine the effect on academic performances.

MAIN OUTCOME MEASURES: The relationship between hand clasping, arm folding, sex, and academic performance of students.

RESULTS: (1) There was no significant difference in distribution frequency between right-thumb-top and left-thumb-top ($P > 0.05$), or between right-arm-top and left-arm-top ($P > 0.05$). The distribution frequency difference between boys and girls was not significant for any subtype ($P > 0.05$). (2) hand clasping had no significant main effect on any of the six subjects ($P > 0.05$). The right-arm-top students received significantly higher points in Chinese, Physics, Chemistry, and Biology, compared with the left-arm-top students ($P < 0.05$). A significant sexual difference was detected in academic performance in Chinese and English; girls had higher scores than the boys ($P < 0.05$). The students with congruent preference scored higher in English, compared with those with incongruent preference ($P < 0.05$).

CONCLUSION: The arm folding form of lateral preference had a significant effect on academic performance of middle school students, implying that this human laterality index is of great functional importance.

Key Words: academic performance; arm folding; hand clasping; middle school students

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INTRODUCTION

Studies on various aspects of handedness have been performed, including genetics, behavior, and academic performance, as well as brain structure and function^[1-4]. Similar to handedness, hand clasping (hand clasping) and arm folding are also forms of lateral preferences^[3,5]. Previous studies on hand clasping and arm folding addressed the frequency among populations (e.g., sex and race)^[3,6-9]. Some studies failed to determine a relationship between these laterality preferences (hand clasping or arm folding) and sex^[9]. However, several studies found significant distribution differences between nationalities^[6,10]. Results from genetic studies have not been very consistent, with some studies suggesting that postural laterality preference (arm folding and hand clasping) may have a genetic basis^[11-12], although genetic background was not confirmed in an Hungarian twin study^[13]. The aforementioned studies do not provide direct information about the function of hand clasping or arm folding. Several studies have addressed the relationship between handedness and brain structure or function, and some studies even demonstrated a higher frequency of diseases among left-handers, compared with right-handers^[14]. In addition, right-handed children scored higher in academic performance, compared with left-handed children^[2]. To the best of our knowledge, no study has addressed the relationship between academic performance and arm folding or hand clasping. The purpose of the present study was to investigate whether patterns of lateral preference, such as hand clasping and arm folding, relate to academic performance of middle school students.

SUBJECTS AND METHODS

Design

A cross-sectional investigation.

Time and setting

Data were collected in the Zhongguancun High School of Beijing in May 2007. Data analysis was performed in the State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University during June to July 2007.

Subjects

102 students, including 58 males and 44 females, from three classes of grade-two seniors in the Beijing Zhongguancun High School in Beijing, were selected for this study.

Inclusion criteria

Right-handedness and Han Chinese. Informed consent was obtained from each participant.

Exclusion criteria

Students with neurological or psychiatric disorders. This study was approved by the Key Laboratory of

Cognitive Neuroscience and Learning, Beijing Normal University.

Methods

The forms of hand clasping and arm folding are described as follows^[15]: each participant was requested to interlace the fingers of both hands, *i.e.*, hand clasping. If the right thumb was on top, this was termed right-thumb-top and *vice versa* left-thumb-top.

For arm folding, each participant was requested to fold his or her arms. If the right forearm was on top, this form was termed right-arm-top (right-arm-top) and *vice versa* left-arm-top (left-arm-top).

The students with congruent preference were defined as right-thumb-top-right-arm-top or left-thumb-top-left-arm-top, and incongruent preferences were termed right-thumb-top-left-arm-top or left-thumb-top-right-arm-top.

Academic performance grades from a mid-term exam of six subjects (Chinese, Math, English, Physics, Chemistry and Biology, total points = 100 for each) were collected. All 6 subjects were included in the Chinese College Entrance Exam.

Main outcome measures

The relationship between hand clasping, arm folding, sex, and academic performance of the students.

Design, enforcement, and evaluation

All authors participated in the design of the current study. Author Zhenxiang Zang collected the data in the middle school by using a simple questionnaire.

Statistical analysis

All authors participated in data analysis. We used SPSS 14.0 (SPSS Inc., Chicago, USA) to perform a chi-square test (on the distribution frequency of hand clasping and arm folding among populations) and a three-way ANOVA with three independent variables (arm folding, hand clasping, and sex) and 6 dependent variables, *i.e.*, mid-term exam score of each of six subjects (Chinese, Math, English, Physics, Chemistry and Biology).

RESULTS

Quantitative analysis of the experimental participants

All 102 students were included in the final analysis.

Forms of hand clasping and arm folding distribution

Among the 102 students, there was no significant difference in distribution frequency between right-thumb-top (47%) and left-thumb-top (53%) ($P > 0.05$), or between right-arm-top (56%) and left-arm-top (44%) ($P > 0.05$).

There was also no significant difference in distribution frequency between boys and girls for any subtypes: boys vs. girls = 47% vs. 48% for right-thumb-top ($P > 0.05$), boys vs. girls = 50% vs. 64% for right-arm-top ($P > 0.05$).

The relationship between forms of hand clasping, arm folding, and sex with academic performance (Table 1)

Table 1 Results of three-way ANOVA

Effect	Subject		Mean \pm SD	F1,94	P
AF	Chinese	R _{AF}	73.1 \pm 0.770	4.90	0.029
		L _{AF}	70.4 \pm 0.898		
Physics	R _{AF}	R _{AF}	76.3 \pm 1.319	9.07	0.003
		L _{AF}	70.2 \pm 1.539		
Chemistry	R _{AF}	R _{AF}	82.6 \pm 1.087	4.30	0.041
		L _{AF}	79.1 \pm 1.269		
Biology	R _{AF}	R _{AF}	88.1 \pm 0.905	6.13	0.015
		L _{AF}	84.7 \pm 1.056		
Sex	Chinese	F	73.3 \pm 0.907	6.73	0.011
		M	70.2 \pm 0.759		
English	F	F	81.8 \pm 1.083	5.66	0.019
		M	78.4 \pm 0.907		
AF*HC	English	R _{HC} -R _{AF}	81.9 \pm 1.399	3.99	0.049
		L _{HC} -L _{AF}	81.1 \pm 1.586		
		L _{HC} -R _{AF}	79.9 \pm 1.194		
		R _{HC} -L _{AF}	77.5 \pm 1.445		

AF: arm folding; HC: hand clasping; R_{AF}: right-arm-top; L_{AF}: left-arm-top; R_{HC}: right-thumb-top; L_{HC}: left-thumb-top; M: male; F: female

Hand clasping exhibited no significant main effect on any of the six subjects ($P > 0.05$). right-arm-top students received significantly higher grades in Chinese, Physics, Chemistry, and Biology, compared with the left-arm-top students ($P < 0.05$). A significant sexual difference occurred between academic performance of boys and girls in the subjects of Chinese and English, where girls received higher grades than boys ($P < 0.05$).

Hand clasping and arm folding displayed a significant interaction effect with English; congruent preference students scored higher than students with incongruent preference ($P < 0.05$). There were no significant interaction effects with other combinations.

DISCUSSION

To the best of our knowledge, this is the first study to investigate the correlation of hand clasping and arm folding on academic performance. We determined that middle school students displaying right-arm-top scored better than students with left-arm-top in the subjects of Chinese, Physics, Chemistry, and Biology. There was also a significant interaction effect of hand clasping and arm folding on English. Students who were congruent scored higher than incongruent students, and the right-thumb-top-right-arm-top form received the highest scores. These results demonstrated that the two postural lateral preferences (hand clasping and arm folding) might affect academic performance. Only one study has analyzed the potential function of the two postural lateral preferences. Mohr and colleagues found that incongruent subjects received higher points in a psychotic-like thinking style, namely magical ideation, compared with congruent subjects^[15]. Together with previous results^[15], the current findings suggest that hand clasping and arm folding may be of great

functional importance. However, the underlying mechanism of the interrelationship remains unclear. Scientific proof for the relationship between the two postural lateral preferences, and brain structures and functions, as well as brain diseases, require further studies.

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Background: This work was supported by the Chinese-Finnish NEURO program from NSFC (30621130074). The current study, for the first time, investigated the functional importance of hand clasping and arm folding (*i.e.*, the relationship between lateral preferences and academic performance). Future studies will utilize neuroimaging techniques to explore the neural correlates of hand clasping and arm folding, as well as academic performance. This may help in understanding the brain mechanisms of learning disabilities in children.

Key laboratory: State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University focuses mainly on the neural mechanisms of basic cognitive processes, cognitive development, cognitive disorders, *etc.* This laboratory has a 3T Siemens MRI scanner and has a leading position in the above research fields in China.

Bias or limitations: A few limitations should be addressed. Firstly, the current study investigated only academic performance. The relationship between hand clasping or arm folding and other functions, *e.g.*, IQ and personality, remains to be elucidated in future studies. Secondly, the sample size was relatively small and less representative, because it was only from middle school students. Future studies could enroll larger samples from more schools.

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NRR data for publication and articles indexed by CA and EM in 2007

Issues	Total papers (n)	Research and reports (n)	Doctoral dissertations (n)	Master's theses (n)	Fund (n)	International cooperative research (n)	Written by academicians (n)	Papers from Hong Kong, Macao and Taiwan (n)	Self-citation (n)	References (n)	Indexed by CA (n)	Indexed by EM (n)
1	14	5	3	6	8		1			519		
2	14	6	3	8	8	1				318		
3	14	7	3	9	8	2				401		
4	15	8	2	6	6			1		307		
5	14	8	6	2	4					286		
6	14	12	5	4	9					286		
7	16	7	5	7	7					283		
8	14	7	2	10	13			1		245		
9	15	6	7	5	11	1			1	264		
10	15	8	3	7	12					296		
11	14	2	5	7	5	1				240		
12	14	4	6	4	9	2				228		
Total	173	80	50	75	100	7	1	2	1	3 673	95	173