

## Interference in Geometrical Stroop like Task among Different Handed Persons

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### ABSTRACT

The Geometrical Stroop like task was administered to study the amount of interference in different handed persons in naming geometrical word and their shape when stimuli were presented in two different conditions congruent and incongruent in two visual fields (RVF & LVF). It was hypothesized that, the ability of visual perception can be differing of a person in terms of their handedness. 149 subjects were voluntary participated in this study in which 80 subjects were predominantly Right handed and rest of them were non-right handed, between 17 and 21 years old. Each pair of stimulus was presented for 180msec preceded by a fixation dot for 2000msec. Subjects were asked to respond as fast and as accurately as they could either the geometrical words or the shape or both, depending upon the conditions. Reaction times of correct responses were analyzed. As expected, the results of this study on the basis of Stroop-like experiment give us enough findings in support of hypothesis. The findings of current study indicate that congruency effect in both of the groups. A significantly higher accuracy rates were obtained in non right handed person under the Stroop interference condition. Under this same condition, reaction time analysis yielded also significant differences between two groups.

**Keywords:** *Geometrical Stroop Task, Interference, Handedness, Lateralization, Visual Information*

Functional lateralization research from the last more than 25 years has clearly demonstrated that the two hemispheres of human brain differ in their functions in which they process different kind of emotion and cognitive information (Sperry, 1974). Hemispheric processing differences are often categorized in various researches and documented that, the left hemisphere as an analytical processor while right hemisphere as a holistic processor (Bogen, 1996, Gazzaniga, 1970 and Ornstein, 1972). This difference can be explained functionally as dominance performance of serial operations by the left hemisphere as like processing of stimulus element one-at-a-time, before beginning the next, first completing last one, and dominance performance by right hemisphere for parallel operations like processing stimulus

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element simultaneously, individual element can be completed at different times (Moscovitch, 1979 and Townsend, 1974).

One of the most obvious lateralized functions in humans is handedness. At least 90% of humans are right-handed and that hand is controlled largely by motor areas in the left frontal lobe. Thus, right-handedness is generally believed to be a consequence of “dominance” of the left hemisphere. Left-handedness is a universal phenomenon (Perelle & Ehrman, 1994), with a world population of around 10-12% (Halpern, Haviland, & Killian, 1998; Oldfield, 1971). A central concern about lateralisation is that differences in handedness indicate different patterns of cerebral organisation (Anstey et al., 2004; Buchel et al., 2004; Geschwind, Miller, DeCarli, & Carmelli, 2002), with a possible effect on general mental performance. As a result there is a large body of research that has focused on studying handedness in both verbal and visual-spatial tasks (Gordon & Kravetz, 1991; Halpern et al., 1998; Kopiez, Galley, & Lee, 2006; Porac & Searleman, 2002).

Although different findings have been noted (e.g., Gibson, Dimond, & Gazzaniga, 1972; Klatzky & Atkinson, 1971), right visual field (RVF) superiority for the recognition of tachistoscopically presented verbal materials in right-handed subjects is a well documented phenomenon (Springer, 1977; White, 1969, 1973; McKeever, 1974; Moscovitch, 1973). These results have generally been interpreted as manifestations of a left hemisphere (LH) specialization for language processing in right-handed English speakers. A similar pattern of results has also been found in Chinese speakers using two-character Chinese materials (Feustel & Tsao, 1978).

It would be interesting to observe how this left hemisphere specialization for processing verbal materials and right hemisphere specialization would affect the perception of images of emotional face and emotional words responses in the Stroop phenomenon (Stroop, 1935). It would also be seen how much this specialization affect on amounts of Stroop interference in the two hemispheres among different handed persons.

A classic procedure to display the Stroop phenomenon involves the arrangement of color names printed in incongruent colors (e.g., the word “green” printed in red). Subjects are asked to name the colors of the inks and to ignore the printed color names. These irrelevant printed color names result in noticeably slower color-naming responses: This phenomenon is called Stroop Color-Naming Interference. Due to the findings of LH/RVF superiority in processing linguistic materials, it was articulated in this study that the irrelevant color name would be more difficult to ignore when presented in the RVF than it would in the LVF. Consequently, more Stroop interference was expected when the stimuli were projected briefly in the RVF than in the LVF. Dyer and Harker (Dyer, 1973) attempted to test this hypothesis.

In the present study experiment was designed with the some changes on traditional Stroop task procedure. Firstly emotion faces and emotional words stimuli used in place of colour patches and colour name. Secondly, stimuli were presented in two different visual fields i.e.

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right visual field (RVF) and left visual field (LVF) and in addition reaction times and, accuracy was recorded.

The measure purpose of this study was to investigate possible difference between right and non-right handed person in reaction time and accuracy to congruent and incongruent emotional faces and emotional words due to interference of hemispheric dominance or due to different processing style of hemispheres.

### EXPERIMENT

Experiment has been designed on the base of Weekes and Zaidel's (1996) Stroop-like task. This study was examined with the help of self developed JAVA based program for Stroop like task in which five different geometrical shape and five geometrical words used in the form of stimuli. Stimuli were presented in the pair of geometrical shape and geometrical words. Total forty pairs of stimuli were shown to subject in two different conditions; congruent and incongruent further stimuli were displayed in two different categories of each condition i.e. LVF-word and shape and RVF-word and shape. Every pair of stimuli presented only for 180msec after the presentation of fixation point in the centre of the display for 2000msec. All subjects had to perform in the response of all forty trials by using key A, S, D and W for words and 1, 2, 3, and 4 keys for shapes of the computer keyboard. There was 10 sec time interval between the subject's responses and next fixation point in each trial. If the subject didn't response within stipulated time frame program automatically proceed to next trails. Reaction time (in milliseconds) and accuracy of all possible forty responses were recorded by the program.

### METHODS

#### *Participants*

One hundred forty nine subjects were voluntary participated in this study in which eighty three were predominantly Right handed and rest of them were non-right handed. Predominantly left and mixed handed participant were included in non right handed subjects. All participants were undergraduate students of engineering stream between 17-21 years of the age ( $M=18.24$ ,  $SD=0.72$ ) had a basic knowledge of computer operating and their eye sight was also normal. Subjects were comfortable with English language and they knew all English words and their meanings of stimuli.

#### *Materials*

We presented stimuli with the help of JAVA based program and recorded Reaction time and Accuracy. Stimuli were displayed on 39.62 cm diagonal screen and response recorded in milliseconds. Subject's handedness was defined with help of 10-item self-report questionnaire. In this questionnaire ten items measure hand preference (using a knife, combing hair, picking up a book, writing on paper etc.). These item have appeared in earlier studies (Coren, 1989; Mandal et.al. 2001; Porac, Coren, & Duncan, 1980; Suar et. Al., 2007).

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### *Stimuli*

Five different kind of geometrical shape and their names were used as stimuli. In the stimuli four geometrical shapes were used like Circle, triangle, square, rectangle and pentagon. All stimuli were displayed in proper size so that subject can easily perceive it. There was a fixation point presented in the centre of screen prior to every stimulus and it was in the form of circle with the radius of 1 cm. Stimuli presented in two different visual field i.e. Right visual field (RVF) and Left visual field (LVF) were shown 10 cm from fixation point.

### *Procedure*

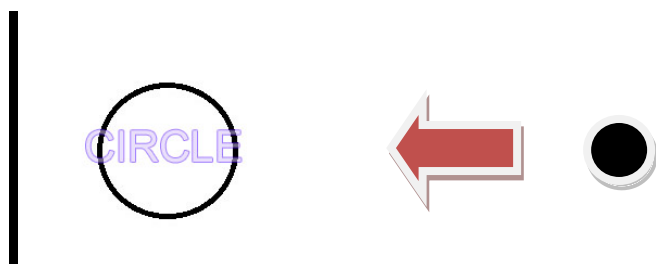
After taking consents from subjects, self report 10-items questionnaire were administered to determined handedness level. After defining their handedness level subject's eye sight were verified by performing some visual task by using one eye and both. We allowed participant to use their spectacles if needed. All procedure of experiment was explained to participants and answered their doubts. Five trials had given to every subject in the beginning of the experiment.

These were the instruction given to subject: In this experiment pair of stimuli (one image and one word) will be display in two different visual fields i.e. in left visual field and in right visual field followed by a fixation point for 2000msec. Stimuli will be present on screen only for 180msec preceded by four alternative response separately for each image and word. You have to respond one out of four alternatives for each stimulus (shapes and word) with the help of keyboard on the basis of your perception as soon as possible with accuracy. You can stop only after the END screen appears on your monitor. It will take five to ten minutes for completion.

Experiment (Part-I) with incongruent condition



Experiment (Part-II) with congruent condition



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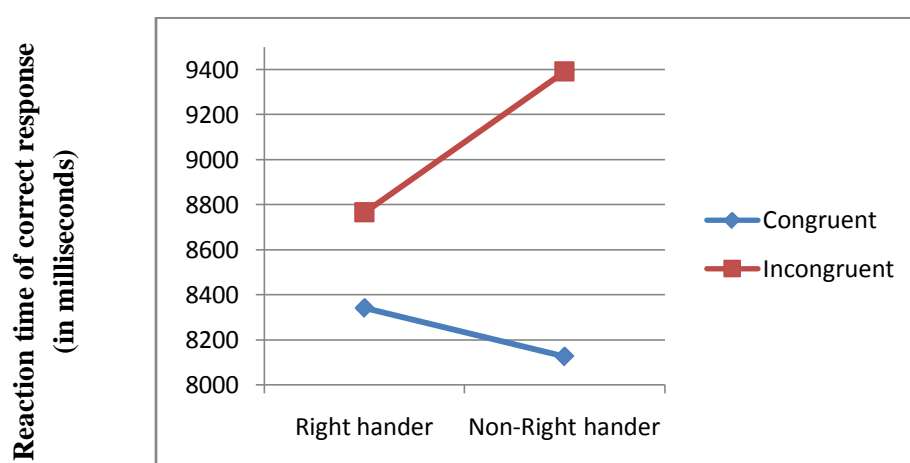
Experiment was run in noise free environment and subject sited in the level of monitor and two fit far from display. Subject responded to all 40 trails with help of key board by using key A, S, D and W for word and 1, 2, 3, and 4 for image. Reaction times (in milliseconds) of all forty trials were recorded with accuracy by the program in MS-excell and further data were used for analysis.

### RESULTS

Data were analysed in responses to geometrical shapes and geometrical words using 2x2 within group and 2 between groups mixed (Split-plot) designs repeated measures ANOVA used. Independent variables were visual field (LVF, RVF), congruency (Congruent and Incongruent) and Handedness (Right handed and Non-right handed). The dependent variable was Reaction time. Result was found significant main effect of visual field,  $F(1, 147) = 65.259, p < .01$  as well as there was significant main effect of congruency,  $F(1, 147) = 10.861, p < .01$ . In the continuation of the analysis, there was significant effect found in between subjects group,  $F(1, 147) = 4.062, p < .01$ . Interaction effects were also analysed as Handedness x Congruency  $F(1, 147) = 181.151, p < .01$  and for Handedness x Visual Field  $F(1, 147) = 56.001, p < .01$  found significant.

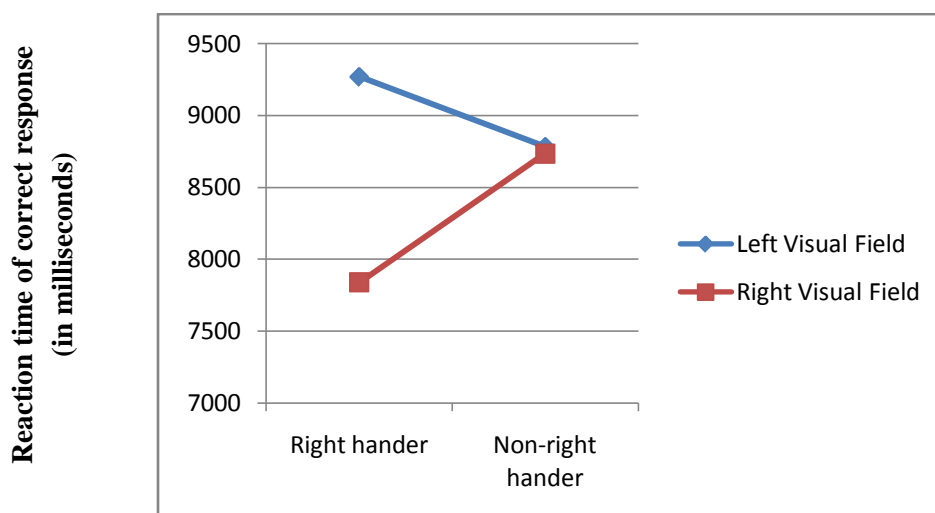
**Table 1: Descriptive Statistics of Reaction Time of Shape and Name of shape recognition**

Experiment	Handedness	Mean	Std. Deviation	N
Shape recognition	Right Hander	6307.181	1227.702	80
	Non Right Hander	6056.209	1830.989	69
Name of Shape recognition	Right Hander	7118.535	1547.243	80
	Non Right Hander	7374.401	1516.74	69



**Fig1 Interaction of Handedness x Congruency with Reaction for Correct Response as the Dependent Measure**

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**Fig 2 Interaction of Handedness x Visual Field with Reaction for Correct Response as the Dependent Measure**

Results for responding to geometrical words were also analysed. Analysis was done by using 2x2 (Congruent, Incongruent x Left visual field, right visual field) within group and 2(Right-handed, Non-right handed) between groups mixed repeated ANOVA. In which independent and dependent variables were same as like geometrical shape. The result was found significant main effect of congruency  $F(1, 147) = 128.179, p < .01$  and Visual field as  $F(1, 147) = 422.838, p < .01$  and interaction effect of Handedness x Visual field and Handedness x Congruency were found significant as  $F(1, 147) = 36.169, p < .01$  and  $F(1, 147) = 13.801, p < .01$  respectively. Further between group analysis was also done and it was found significant as  $F(1, 147) = 35.325, p < .01$ .

## DISCUSSION

The result of this study on the basis of Stroop-like experiment give us enough findings in support of hypothesis that, the ability of visual perception can be differ of a person in terms of their handedness. The findings of current study indicate that congruency effect in both of the groups. Right handed and non right handed individuals have faced difficulties to respond stimuli in the incongruent conditions for all types of stimuli like geometrical shape and names. The findings of this study related to congruency in line with the study of Simon, Paullin, Overmyer and Berbaum (1985). They found among different handed individuals reactions to incongruent stimuli were slower than to congruent stimuli in Stroop task. But in this study stimuli were not used as classical experiment of Stroop task. So we can say that interference can be occur with different kind of stimuli like with geometrical shape instead of color patches.

The findings of the current study that Non-right handed individuals perform better as compare to right handed individuals in terms of their reaction times on non verbal task. So the Non-right handed subjects were perceived the stimuli in a lesser amount of time as compare to right handed subjects, and our finds are agreement with Benbow (1986, 1988),

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Beratis et al.(2010) and O'Boyle et al. (1995). They found that Left-handers outperform right-handers in the visual perception of Stroop task.

There was no result found in the favour of right hemisphere advantage for geometrical shape stimuli but left hemisphere advantage was found for geometrical words. However, Right hemisphere advantage documented by Barnett (2008), Beratis et al.(2010) and numerous of previous studies. It should be noted that, in this study stimuli were taken in the form of geometrical shape not different colours as we generally take in traditional Stroop task. In addition to the findings of current research supports left hemisphere advantage for verbal task as we can see in the various previous results like Goldenberg & Arnet (1991) and others.

### CONCLUSION

The light of the fact that the study was focused on a sample of different handed young adults. The results provide enough support to hypothesis, different findings and theories that discussing a interaction of handedness and perception or cognitive functions. Further this study also gives different insight to understand the effect of handedness on Stroop like task as well as visual dominance on perception of verbal and non verbal materials. Apart from handedness, visual field is also a factor that effects visual perception that was also explained in this study. Suggestion would be to consider ambidextrous in the sample to see the effect of different form of Stroop like experiment.

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### Conflict of Interest

There is no conflict of interest of the authors with anyone regarding financial matters.

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