CHALMERS

Testing theories of premotor and perceptual neglect with mental rotation

By

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Abstract

Unilateral neglect is a neuropsychological condition in which, after damage to one hemisphere of the brain - most commonly the right one - patients have difficulties in reporting sensory events occurring in contralateral side of lesion. Moreover, studies on neglect patients have revealed that they may fail to explore with ocular and reaching movement the controlesional portion of space. Recent studies with neglect patients provided evidence for the 'failure to perceive' but also for the 'failure to reach for'. It has therefore been proposed the there exist two main components that when damaged give rise to two different types of neglect: 'perceptual' (mainly attentional/space representation deficits) and 'premotor' (failure to action into contralesional side of space).

Mental Rotation is the process of imagining an object (two-dimensional or three-dimensional) rotating in space. It has been proposed that different operations can be distinguished according to the type of stimulus involved, the reference frame or the strategies used. Neuropsychological observations suggest that what ultimately matters in mental rotation tasks is the type of strategy adopted to solve them. In particular, when subjects use a motor strategy, the solve the mental rotation by imagining a stimulus rotating as a consequence of their own action, while when they use a visual strategy they observe the stimulus rotating in the visual space.

In the present project we intend to test the premotor and perceptual theories of neglect by having patients perform a mental rotation task using a motor strategy and a visual strategy. The predictions are the following: if the theory of premotor neglect is correct, patients should be impaired in performing the mental rotation task using the motor strategy but should succeed in performing the mental rotation task using the visual strategy. In contrast, if the theory of perceptual neglect is correct, patients should be impaired in performing the mental rotation task using the visual strategy but should succeed in performing the mental rotation task using the motor strategy.

Keywords: Cognitive Neuroscience, Neuropsychology, Mental Rotation, Unilateral neglect, Brain damage.

"To see is one thing; to picture or visualize is another. A person can see things only when his eyes are open and when his surroundings are illuminated; but he can have pictures in his mind's eye, when his eyes are shut and when the world is dark ...[1]" (Concept of Mind, p. 246.).

Mental Rotation Background

Human brain possesses the capability to manipulate spatial information of two-dimensional and three-dimensional of objects; this facility has been considered as one of the imperative characteristic of cognitive performance. The mental rotation task is a well-founded study which helps us to investigate the cognitive process of mentally rotating objects. In the classical Mental Rotation Test (MRT) (Shepard and Metzler 1971) a number of similar three-dimensional objects, rotated in dissimilar dimensions from the original position, are presented to test subjects. The subject is asked to compare the presented objects and state if they are the same Image or they are not linearly proportional to each other. In order to come to a decision that if two figures are alike or not, the test subject has to mentally rotate the figures. Studies of mental rotation have shown that the more an object rotate from its original position, the longer it takes an individual to make judgment if the two images are of the same object [2,3,4]. This result that mentally rotating objects with greater orientation involve more time and probably more effort is exactly like rotating an object physically, which takes more time over a greater distance. Accordingly, the inner mental images seem to represent the matching physical objects. Mental Rotation Test can be differentiated with regard to the type of stimulus used [5], the reference frame [6], or the strategies used [7]. For designing a Mental Rotation Test different types of stimuli could be used, as an example three-dimensional figures [8], and alpha-numeric characters utilized as stimuli [9] and body segments with the same experimental rules as objects [10].

Psychophysical studies demonstrate that dissimilar mechanisms may be used in Mental Rotation as regards to the frame of reference hired for the rotation task[11]; as a consequence, Mental Rotation can be achieved as “Allocentric view” (reference frame of the object itself) or “Egocentric view” (the frame of reference of viewer’s)[12]. It has been revealed that the allocentric and egocentric transformations cause to different Response Time patterns [13]. It has been consistently demonstrated that when subjects mentally rotating the stimuli using the reference frame of the object itself (Allocentric view) the correlation between the Rotational

angle and Response Time (RT) is strong14. When transformations are based on Egocentric view, the Response Times display the biomechanical limitations that reflect real physical movements [15,16].

Regarding to stimulus type, unlike procedure may be engaged in Mental Rotation according to whether the stimulus used in the experiment is a body part or a two or three-dimensional object [17]. Neuropsychological studies have been specifying that these two kinds of transformations can be selectively impaired. For example, Left Hemisphere brain damaged patient was reported as being disable when deciding whether a hand stimuli , on the other hand the same patient was able to mentally rotate Shepard and Metzler's stimuli [18]. It seems when subjects performing the Mental Rotation of body parts, they carry out the test as subsequent of their own action and this procedure seems to be done by the real movement of the identical body part [19].These ability in human cognition could be constructive for movement planning and prediction [20].The significant responsibility of the parietal cortex in the mental rotation task has been highlighted by lesion studies in patients [21,22,23]. The functional separation involving visual and motor imagery has been demonstrated by studying two brain damaged patients with lesions suited in different brain regions. The study showed that patient that had tumor in a left parietal lobe was impaired in performing the tasks involving mental motor imagery; the opposite result obtained by patient with bilateral inferotemporal damage, he was impaired in performing mental rotation task using visual imagery [24]. The capability to carry out mental rotation of body parts is stringently associated with the notion of "body schema", that refer to the composite of feelings, thoughts of one's own and others' anatomy and subsequently perceiving them [25].

Mental rotation of body parts is spatial transformations of the human body instead of spatial transformation of unfamiliar objects [26]; therefore, by using this strategy the subjects would imagine rotating stimulus as a consequence of their own action (motor strategy), instead of observing the stimulus rotating in the visual space (visual strategy). In our experiment we applied both of these strategies. When performing a Mental Rotation task using Motor Strategy, participants impulsively compare the displayed hand with their own, that is, they carry out a motor imagery task using the egocentric perspective. Therefore, the time participants take to response to stimuli intimately corresponds to the time they would take to carry out an analogous movement [27].Alternatively when subjects performing a Mental Rotation task using Visual

Strategy, they are instructed to use an external strategy, imagining the stimulus rotating in visual space. As a result, mental rotation using the Visual strategy is a mental transformation based on the reference frame of object in the visual space (i.e., allocentric prospective) [28].

To apply these strategies, in our experiment as stimuli we used realistic photos of Right and Left hands (Hand stimulus side) rotated in different orientation (45, 90, 135, 225, 270, and 315). 1/3 of hand Stimuli presented centrally, 1/3 in the right visual field and the rest in the in the left visual field. For the motor strategy, subjects were required to decide whether a hand stimulus presented on the screen is left or right and response with their right hand by using a custom-made button box consist of two pads located one above the other corresponding to “left” and “right”. In the visual strategy, we used the same stimuli but with a red spot on the Thumb finger of the hand. They had to first mentally turn the rotated stimuli to reach the upright position and then decide whether a red spot is on the left or on the right side of the hand stimulus (Hand stimulus side) and consequently respond with their right hand by using a custom-made button box consist of two pads located one above the other corresponding to “left” and “right”.

Methods:

Subjects and neuropsychological screening

Twenty normal volunteers (13 female), with no history of previous neurological or psychiatric disease (mean age 68.4 years; range 65–74) participated in the experiment. All subjects were right-handed according to Edinburgh standard handedness inventory.

Experiment

Each subject performed two tasks, one involving a motor strategy the other involving a visual strategy. In the motor strategy, subjects were required to decide whether a hand stimulus presented on the screen is left or right. In the visual strategy they had to decide whether a red spot is on the left or on the right of the hand stimulus. Subjects sat in front of the PC screen, at a distance of approximately 30 cm and were told to press a previously assigned response key. All

subjects responded with their right hand by using a custom-made button box consist of two pads located one above the other corresponding to “left” and “right . The accuracy of button box was 1 millisecond. For all subjects, two dependent variables collected: RTs and accuracy. During the experiments participants placed their left hands on the table with the palm facing downwards. Half of the subjects first performed the task of Motor strategy before Visual strategy. The opposite sequence was used with the other half. After performing a first experiment (Motor/Visual) the participants had a pause (5 minutes); followed by the second experiment (Visual/Motor). The total duration of the experiment (including both experiments (Motor/Visual) and 5 minutes pause) was about 20-25 minutes. The Experiment performed at SISSA and all the subjects informed in accordance with the related laws and institutional guiding principle and were approved by the S.I.S.S.A. Ethical Committee. We paid 10 Euros to each subject for performing the experiment.

Stimuli and procedure

The experiment was programmed using Presentation, which is experimental control software dedicated to stimulus delivery for neuroscience, ran on Windows and uses standard PC hardware. In both experiments stimuli consisted of realistic photos of hands, illustrated in Fig. 1 in their canonical orientations; each image was produced from the rotations and reflections of basic figures (either dorsal or palm). Each hand (Right/Left) stimulus presented in 6 different rotational Orientations (45, 90, 135, 225, 270, 315) and two views (dorsal and palm) in total we had 24 different stimulus. Each paradigm was displayed 6 times; 1/3 Stimuli presented centrally, 1/3 in the right visual field and the rest in the in the left visual field. Each cell of the experimental design comprised 72 trials (2hand×2 views×3positions×6 Orientations). Since we designed the experiment for testing two strategies (Motor and Visual), hence each subject responded for a total of 144 trials overall. Each trial started with a central fixation cross (500ms ISI duration), followed by the presentation of a stimuli (4000ms ISI). The trial was timed-out immediately when the subjects responded. Subjects did not obtained any feedback about their response (reaction time or correctness), and they were required to make the laterality judgment as fast as possible. The stimuli were in a random order except that the same stimulus could not appear twice within three successive trials.

Figure 1: experiments stimuli

Schematic representation of the experimental hand-Stimulus used in the mental rotation task both In the Motor strategy and Visual strategy. Each hand (Right, Left) stimulus presented in 6 different rotational Orientations (45°, 90°, 135°, 225°, 270°, 315°) and two views (dorsal and palm) in total we had 24 different stimulus. In the motor strategy, subjects were required to decide whether a hand stimulus presented on the screen is left or right, whereas in the visual strategy they had to decide whether a red spot is on the left or on the right of the hand stimulus.

Graphs and Tables:

Graphs and tables drawn using Microsoft excel 2007 and SPSS 11.5 software.

Statistical analysis

We were mainly interested in the reaction times and accuracy as a function of rotation Orientation of the hand (45, 90, 135, 225, 270, and 315), hand (Right, Left), Strategy (Motor, Visual) and Position of the stimuli: Right Visual Field (RVF), Central Visual Field (C) and Left

Visual Field (LVF). Reaction times across 20 subjects were analyzed by means of a repeated measures analysis of variance (ANOVA) with four within factors (Strategy, Hand, Orientations and Position). The results of the linear polynomial contrasts are reported. The percentage of errors was analyzed by using an ANOVA with the same design.

Result

In Experiment with Normal subjects I analyzed subject's RTs and accuracy by means of analyses of variance (ANOVAs) with repeated measures. Each ANOVA had four within-subjects factors, rotation Orientation of the hand (45, 90, 135, 225, 270, and 315), hand (Right, Left), Strategy (Motor, Visual) and Position of the stimuli: Right Visual Field (RVF), Central Visual Field (C) and Left Visual Field (LVF). After I did the repeated measure ANOVA with four within-subjects factors, I ran future ANOVA and post hoc test for significant interactions all over again.

Response Time

I analyzed subjects' RTs by means of different analyses of variance (ANOVAs) with repeated measures.

Strategy

Results showed significant main effects of the type of STRATEGY [(F1, 19) =7.96, p =.011, with significantly longer RTs for the motor (mean and Std. Error: 2273.1±89.6) than the visual strategy (1936.4±158.3)]. Mean Reaction Time (ms) and standard errors for both strategies are reported in detail in Table 1 and represented in Fig. 2

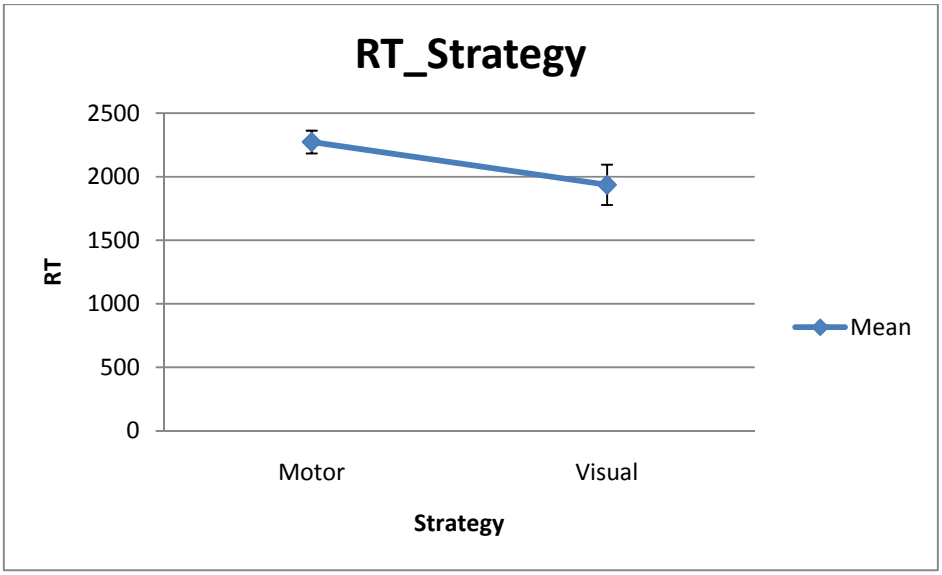

Figure 2: Mean Reaction Time (RT) and standard errors for strategies.

strategy	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Motor	2273.129	89.682	2085.422	2460.836
Visual	1936.418	158.387	1604.911	2267.926

Table 1: Mean Reaction Time (RT) and standard errors for strategies.

The Strategy effect was accounted for by the slowest performance at Visual Strategy compared to Motor Strategy and the difference is significant (p=0.01). The detail reported in Table 2.

(I) strategy	(J) strategy	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Motor	Visual	336.711(*)	119.330	.011	86.950	586.472
Visual	Motor	-336.711(*)	119.330	.011	-586.472	-86.950

Table 2: Pairwise Comparisons for strategies

Hand Stimulus side

The factor Hand Stimulus side was not significant (F (1, 19) = 0.841; p = 0.371). This effect was due to fact that subjects were not much faster in mentally rotating the right Hand stimuli (2091.4ms) than the left Hand stimuli (2118ms). Mean Reaction Time (ms) and standard errors for both strategies are reported in detail in Table 3 and represented in Fig. 3

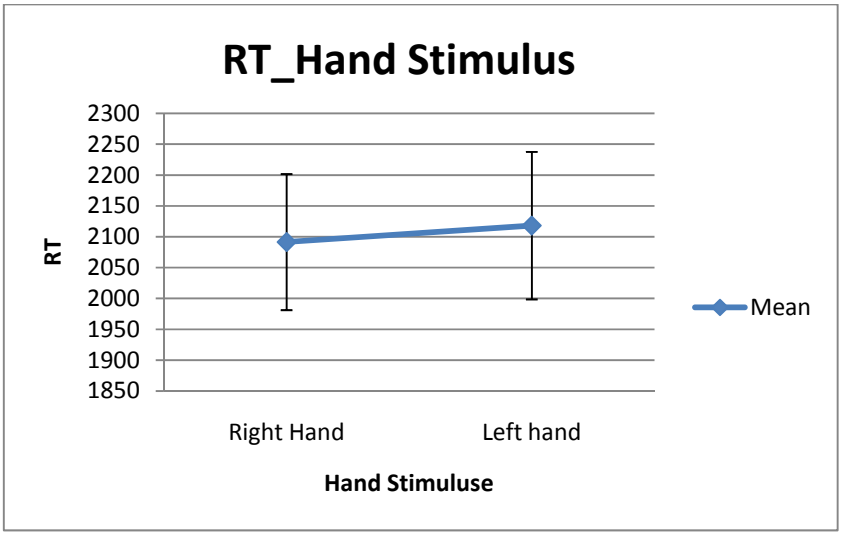

Figure 3: Mean Reaction Time (RT) and standard errors for each for each Hand stimulus side.

			95% Confidence Interval	
hand	Mean	Std. Error	Lower Bound	Upper Bound
Right	2091.457	110.238	1860.725	2322.188
Left	2118.091	119.493	1867.988	2368.193

Table 3: Mean Reaction Time (ms) and standard errors for each Hand stimulus side.

The insignificance of the Stimulus Hand side (P = 0.371) indicates that the time requested for mentally rotating hands without considering other Stimulus factors (Position, Strategy, orientation) was comparable. The detail reported in Table 4.

(I) hand	(J) hand	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	-26.634	29.040	.371	-87.415	34.147
Left	Right	26.634	29.040	.371	-34.147	87.415

Table 4: Pairwise Comparisons for Hand stimuli

Stimulus orientation

The factor Stimulus orientation was significant [F (5,95)=28,75,p=.000], insofar as RTs were higher when stimuli had an orientation of 315°(1940±108.4 ms) than in other five orientations (45°=1875,2±102,8 ms; 90° = 2069,4±115,4 ms; 225°= 2295.9±127.7 ms; 270° = 2050.2±140.6 ms ; 315° = 1940±108.4 ms) Mean Reaction Time(ms) and standard errors for each stimulus Orientation are reported in detail in Table 5.

Mean Reaction Times and Standard Errors are represented in Fig. 4 (135 ° > 225° > 90° > 270° > 315° > 45°).

Rotation	RT Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1875.254	102.851	1659.985	2090.524
90°	2069.410	115.406	1827.863	2310.957
135°	2397.679	115.981	2154.929	2640.429
225°	2295.980	127.786	2028.522	2563.438
270°	2050.278	140.633	1755.929	2344.626
315°	1940.041	108.400	1713.158	2166.923

Table 5: Mean Reaction Time (ms) and standard errors for each stimulus Orientation.

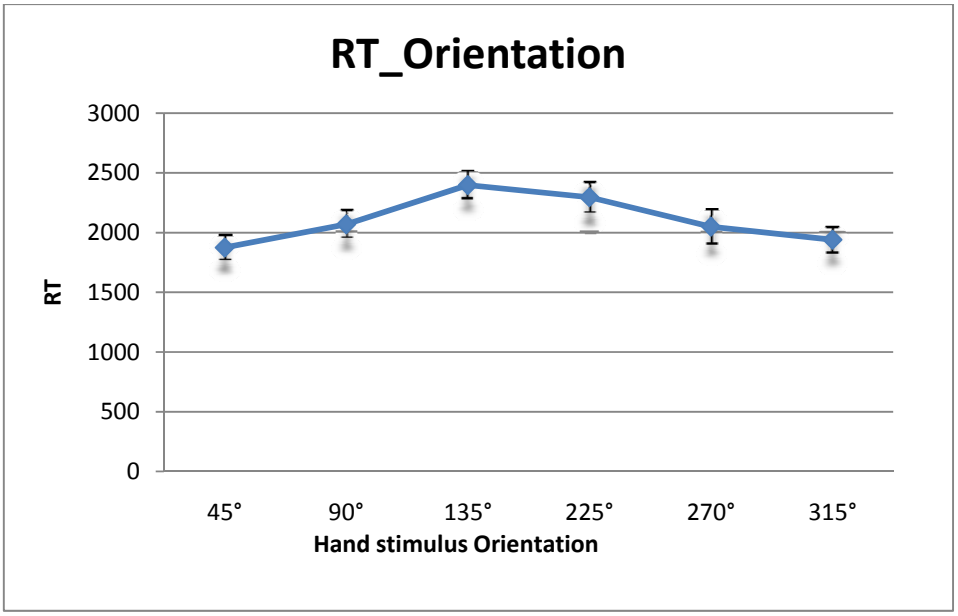

Figure 4: Mean Reaction Time (RT) and standard errors for each stimulus Orientation.

The stimulus orientation effect was accounted for by the slowest performance at 45° compared to all other orientations and differed significantly from all orientations except 270° and 315° [(90°: p=0.01) (135° and 225°: p=0.0)]. For 90° the calculated mean was significantly different from all orientations except 270° and 315° [(45°: p=0.01) (45° and 225°: p=0.01)]. The stimulus orientation at 135° had a higher response time and the calculated mean was significantly different from all orientations except 225° [(45°, 90° and 315°: p = 0.0), (270°: p = 0.01)].The stimulus orientation at 225° had a second highest response time and the calculated mean was significantly different from all orientations except 135° [(45°and 315°: p = 0.0), (90°: p = 0.01) and (270°: p = 0.03)]. For rotational Orientation of 270° the calculated mean was significantly different only from 135° and 225°,respectively (p = 0.01 ,p = 0.03).And finally RTs when stimuli had an orientation of 315 was significantly different 135° and 225° (p = 0.0).

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Higher bound
45°	90°	-194.156(*)	39.253	.001	-325.812	-62.500
	135°	-522.425(*)	59.239	.000	-721.113	-323.736
	225°	-420.726(*)	51.602	.000	-593.800	-247.651
	270°	-175.024	69.246	.308	-407.277	57.230
	315°	-64.786	43.064	1.000	-209.223	79.651
90°	45°	194.156(*)	39.253	.001	62.500	325.812
	135°	-328.269(*)	52.352	.000	-503.861	-152.677
	225°	-226.570(*)	42.696	.001	-369.775	-83.364
	270°	19.132	52.374	1.000	-156.532	194.797
	315°	129.370	45.166	.149	-22.118	280.857
135°	45°	522.425(*)	59.239	.000	323.736	721.113
	90°	328.269(*)	52.352	.000	152.677	503.861
	225°	101.699	52.383	1.000	-73.994	277.392
	270°	347.401(*)	69.136	.001	115.518	579.284
	315°	457.638(*)	54.196	.000	275.862	639.414
225°	45°	420.726(*)	51.602	.000	247.651	593.800
	90°	226.570(*)	42.696	.001	83.364	369.775
	135°	-101.699	52.383	1.000	-277.392	73.994
	270°	245.702(*)	53.321	.003	66.860	424.544
	315°	355.939(*)	56.675	.000	165.848	546.031
270°	45°	175.024	69.246	.308	-57.230	407.277
	90°	-19.132	52.374	1.000	-194.797	156.532
	135°	-347.401(*)	69.136	.001	-579.284	-115.518
	225°	-245.702(*)	53.321	.003	-424.544	-66.860
	315°	110.237	53.272	.786	-68.440	288.914
315°	45°	64.786	43.064	1.000	-79.651	209.223
	90°	-129.370	45.166	.149	-280.857	22.118
	135°	-457.638(*)	54.196	.000	-639.414	-275.862
	225°	-355.939(*)	56.675	.000	-546.031	-165.848
	270°	-110.237	53.272	.786	-288.914	68.440

Table 6: Pairwise Comparisons for each Orientation.

Hand Stimulus *Orientation Interactions:

We found a significant two-way Hand x Orientation interaction (F (5, 95) = 10.92, p=.000.).Post hoc analysis showed that the main effect of ORIENTATION was significant both for the Right hand (F (5, 95) =22.719, p =0.000) and for the Left hand (F (5, 95) =8.394, p = 0.000) meaning that subjects performed mental rotation of both the left and the right hand.

Right hand

In the result that we obtained for the interaction of Right hand with Stimulus orientation, RTs were higher when stimuli Right hand had an orientation of 135° (2548.6±117.3 ms) than in other five orientations (45°=1904.2±105.7 ms; 90° = 2123.7±117.7 ms; 225°= 2153.5±137.2 ms; 270° = 1939.9 ±133.9 ms; 315° = 1878.6 ±106.1 ms) Mean Reaction Time (ms) and standard errors for each stimulus Orientation are reported in detail in Table 6.Mean Reaction Times and Standard Errors are represented in Fig. 5 (135 ° > 225° > 90° > 270° > 45° > 315°).

The Right Hand*Orientation effect was accounted for by the slowest performance at 45° compared to all other orientations and differed significantly from all orientations except 270° and 315° [(90°: p=0.034); (135°: p= 0.000) 225°: p=0.008)]. For 90° the calculated mean was significantly different merely from 45° and 135° ,respectively (p = 0.034 ,p = 0.000). The stimulus orientation at 135° had a higher response time and the calculated mean was significantly different from all orientations [(45°, 90°, 270 and 315°: p = 0.000), (225°: p = 0.015)].The stimulus orientation at 225° had a second highest response time and the calculated mean was significantly different from all orientations except 90° [(45°: p = 0.008), (135°: p = 0.015) (270°: p = 0.03) and (315°: p=0.032]. For rotational Orientation of 270° the calculated mean was significantly different only from 135° and 225°,respectively (p = 0.000 ,p = 0.03).And finally RTs when stimuli had an orientation of 315 was significantly different 135° and 225° ,respectively (p = 0.000, p=0.032). See details in table 7.

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1904.256	105.710	1683.003	2125.509
90°	2123.716	117.788	1877.183	2370.248
135°	2548.644	117.393	2302.939	2794.350
225°	2153.537	137.274	1866.219	2440.854
270°	1939.972	133.900	1659.717	2220.227
315°	1878.616	106.182	1656.374	2100.858

Table 7: Mean Reaction Time (RT) and standard errors for Right Hand*Orientation.

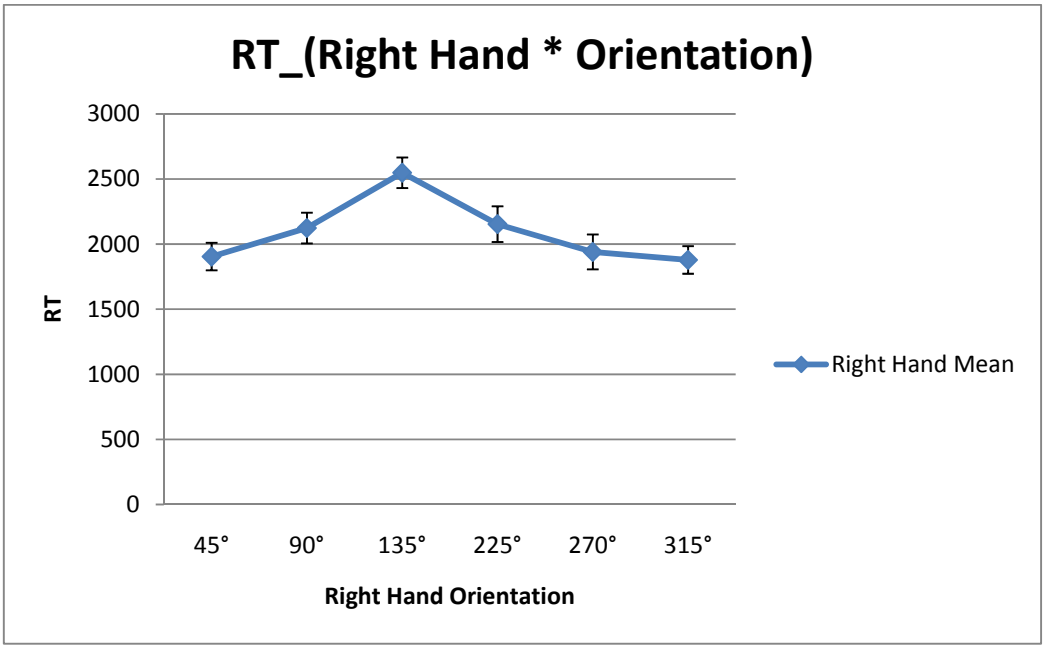

Figure 5: Mean Reaction Time (RT) and standard errors for Right Hand * Orientation

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-219.460(*)	62.304	.034	-428.428	-10.491
	135°	-644.388(*)	84.553	.000	-927.982	-360.794
	225°	-249.281(*)	59.958	.008	-450.382	-48.179
	270°	-35.716	68.066	1.000	-264.012	192.580
	315°	25.640	61.239	1.000	-179.757	231.036
90°	45°	219.460(*)	62.304	.034	10.491	428.428
	135°	-424.928(*)	77.487	.000	-684.824	-165.033
	225°	-29.821	76.745	1.000	-287.225	227.583
	270°	183.743	65.802	.174	-36.958	404.444
	315°	245.099	81.380	.108	-27.853	518.052
135°	45°	644.388(*)	84.553	.000	360.794	927.982
	90°	424.928(*)	77.487	.000	165.033	684.824
	225°	395.107(*)	101.521	.015	54.602	735.613
	270°	608.672(*)	80.143	.000	339.870	877.474
	315°	670.028(*)	90.155	.000	367.646	972.409
225°	45°	249.281(*)	59.958	.008	48.179	450.382
	90°	29.821	76.745	1.000	-227.583	287.225
	135°	-395.107(*)	101.521	.015	-735.613	-54.602
	270°	213.564(*)	59.700	.030	13.329	413.800
	315°	274.920(*)	77.412	.032	15.276	534.564
270°	45°	35.716	68.066	1.000	-192.580	264.012
	90°	-183.743	65.802	.174	-404.444	36.958
	135°	-608.672(*)	80.143	.000	-877.474	-339.870
	225°	-213.564(*)	59.700	.030	-413.800	-13.329
	315°	61.356	59.202	1.000	-137.209	259.921
315°	45°	-25.640	61.239	1.000	-231.036	179.757
	90°	-245.099	81.380	.108	-518.052	27.853
	135°	-670.028(*)	90.155	.000	-972.409	-367.646
	225°	-274.920(*)	77.412	.032	-534.564	-15.276
	270°	-61.356	59.202	1.000	-259.921	137.209

Table 8: Pairwise Comparisons for Right Hand*Orientation.

Left hand

In the same vain we obtained the for the interaction of Left hand with Stimulus orientation, once more RTs were elevated when stimuli Right hand comprised an orientation of 135° (2246.7 ±124.7 ms) than in other five orientations. See details in Table 9.Mean Reaction Times and Standard Errors are represented in Fig. 6 (135 ° > 225° > 90° > 315° > 270° > 45°).

The Left Hand*Orientation effect gave a report for the slowest performance at 45° compared to all other orientations and differed significantly from all orientations except 225° and 270° [(90°: p=0.028); (135°: p= 0.000) 315°: p=0.019)]. For 90° the calculated RTs mean was significantly different merely from 45° and 135° ,respectively (p = 0.028 ,p = 0.001). The stimulus orientation at 135° had a higher response time and the calculated mean was significantly different from all orientations except 225° [(45: p = 0.000), (90° and 315°: p = 0.001), (270° :p = 0.03].The stimulus orientation at 225° had a second highest response time and the calculated mean was solitary significantly different from 270° (p = 0.003). For rotational Orientation of 270° the calculated mean was significantly different only from 135° and 225°,respectively (p = 0.003 ,p = 0.009).As a final point RTs was significantly different when stimuli had an orientation of 315° 45° and 135° ,respectively (p = 0.019, p=0.001). See details in table 10.

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1846.253	102.781	1631.128	2061.377
90°	2015.105	123.625	1756.356	2273.855
135°	2246.714	124.737	1985.635	2507.792
225°	2074.898	175.416	1707.749	2442.047
270°	1871.562	186.226	1481.787	2261.337
315°	2001.465	120.463	1749.333	2253.597

Table 9: Mean Reaction Time (RT) and standard errors for Left Hand*Orientation

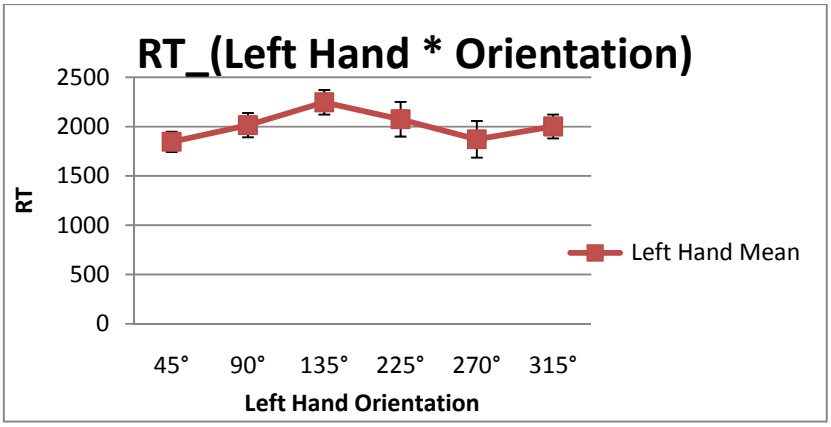

Figure 6: Mean Reaction Time (RT) and standard errors for Left Hand * Orientation

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-168.852(*)	46.849	.028	-325.986	-11.719
	135°	-400.461(*)	52.293	.000	-575.852	-225.070
	225°	-228.646	89.317	.287	-528.218	70.927
	270°	-25.309	107.943	1.000	-387.353	336.734
	315°	-155.212(*)	41.182	.019	-293.337	-17.088
90°	45°	168.852(*)	46.849	.028	11.719	325.986
	135°	-231.609(*)	42.950	.001	-375.664	-87.553
	225°	-59.793	75.134	1.000	-311.795	192.209
	270°	143.543	91.966	1.000	-164.915	452.001
	315°	13.640	47.713	1.000	-146.392	173.672
135°	45°	400.461(*)	52.293	.000	225.070	575.852
	90°	231.609(*)	42.950	.001	87.553	375.664
	225°	171.816	72.711	.434	-72.058	415.689
	270°	375.152(*)	81.667	.003	101.237	649.067
	315°	245.249(*)	48.358	.001	83.053	407.445
225°	45°	228.646	89.317	.287	-70.927	528.218
	90°	59.793	75.134	1.000	-192.209	311.795
	135°	-171.816	72.711	.434	-415.689	72.058
	270°	203.336(*)	49.650	.009	36.808	369.865
	315°	73.433	78.579	1.000	-190.123	336.990
270°	45°	25.309	107.943	1.000	-336.734	387.353
	90°	-143.543	91.966	1.000	-452.001	164.915
	135°	-375.152(*)	81.667	.003	-649.067	-101.237
	225°	-203.336(*)	49.650	.009	-369.865	-36.808
	315°	-129.903	92.650	1.000	-440.653	180.847
315°	45°	155.212(*)	41.182	.019	17.088	293.337
	90°	-13.640	47.713	1.000	-173.672	146.392
	135°	-245.249(*)	48.358	.001	-407.445	-83.053
	225°	-73.433	78.579	1.000	-336.990	190.123
	270°	129.903	92.650	1.000	-180.847	440.653

Table 10: Pairwise Comparisons for Left Hand*Orientation.

Right Hand vs. Left Hand

The Hand*Orientation effect was accounted for both hand by the slowest performance at 45° compared to all other orientations. For the Right hand (45°=1904.2 ± 105.7 ms) we found significantly shorter RTs than all orientations except 270° and 315° [(90°: p=0.034); (135°: p= 0.000) 225°: p=0.008)]. For the Left hand (45°= 1846.25 ±102.78 ms) the effect gave a report for significantly shorter RTs than all orientations except 225° and 270° [(90°: p=0.028); (135°: p= 0.000) 315°: p=0.019)].

For both the Right and Left hand we found significantly longer RTs for 90° (2123.7 ±117.7 , 2015.1± 123.6 for the R and for the L hand respectively) than for 45° [(1904.2±105.7, p =0.034) ; (1846.2 ±102.7 ,P=0.028) for the Right and Left hand respectively .on the other hand for both hands at the orientation of 90° we found significantly shorter RTs than for 135° [(2548.6 ±117.3 ms, p = 0.000);(2246.7 ±124.7 ms, p = 0.001)].

For both The Right and Left hand the stimulus orientation at 135° had a higher response time compare to other stimulus orientation. For the Right hand stimulus (135° =2548.6 ±117.3 ms) the calculated RTs mean was significantly longer than all other orientations (45°=1904.2±105.7 ms; 90° = 2123.7±117.7 ms; 225°= 2153.5±137.2ms; 270° = 1939.9±133.9 ms; 315° = 1878.6 ±106.1 ms) [(45°, 90°, 270 and 315°: p = 0.000), (225°: p = 0.015)].For the Left hand stimulus(135° = 2246.7 ±124.7 ms), indeed, We found significantly longer response time than all orientations except 225° (45°= 1846.2 ±102.7; 90°=2015.1± 123.6; 225°= 2074.8 ±175.4; 270°=1871.5± 186.2; 315° =2001.4±120.4)[(45: p = 0.000), (90° and 315°: p = 0.001), (270°: p = 0.03].

The effect of Orientation differed for the R and the L hand at 225°. For the R hand only, indeed, we found significantly shorter RTs for 225° (2153.5±137.2 ms) than for 135° (2548.6 ±117.3 ms, p = 0.015), whereas for the L hand [(225= 2074.8 ±175.4) the difference was not significantly shorter than (135° = 2246.7±124.7 ms)].

In addition, for the R hand only, RTs were also significantly longer for 225° (2153.5±137.2ms) than for 45° (1904.2±105.7 ms, p =0.008), whereas for the L hand the difference was not significant [(225= 2074.8 ±175.4) is not significantly longer than (45°= 1846.2 ±102.7)], and were significantly longer for 225° (2153.5±137.2ms) than for 315° (1878.6±106.1 ms , p =0.032) whereas for the L hand the difference was not significant ([(225= 2074.8 ±175.4) is not significantly longer than (315 = 2001.4±120.4)].

Lastly, the effect of Orientation differed for the L and the R hand at 315°for the L hand only, we found significantly longer RTs for 315° (2001.4±120.4) than for 45° (1846.2±102.7, p =0.019), whereas for the R hand the difference was not significant (315° = 1878.6±106.1 ms) longer than (45° = 1904.2±105.7ms)

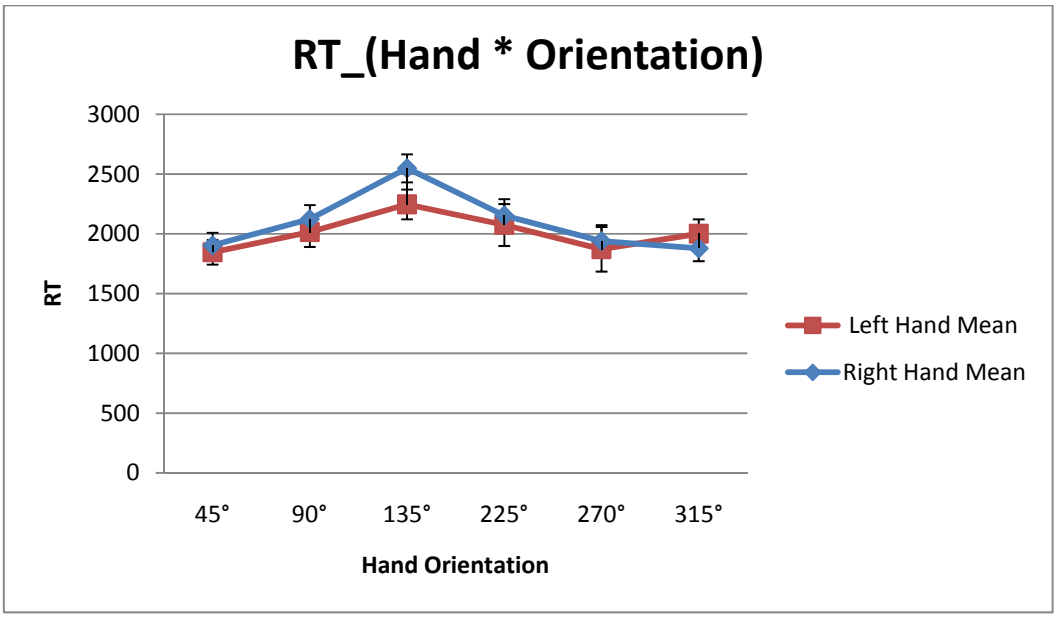

Figure 7:Reaction Time (RT) and standard errors for Hand * Orientation.

Right Hand: (135 ° > 225° > 90° > 270° > 45° > 315°)

Left Hand: (135 ° > 225° > 90° > 315° > 270° > 45°)

Post hoc analysis on Hand x Orientation interaction

A further post hoc analysis performed on Hand x Orientation interaction, better clarified the direction of the interaction.

Hand stimulus at orientation 135°

The result showed that The effect of laterality (R hand vs. L hand) was significant at 135° only ($F(1,19)=18,7$, $p < 0.001$, with significantly longer RTs for the R than for the L hand (2548.6±117.3 ms; 2246.7±124.7 ms)for the Right and Left hand respectively. Mean Reaction Times and Standard Errors are represented in Fig. 8

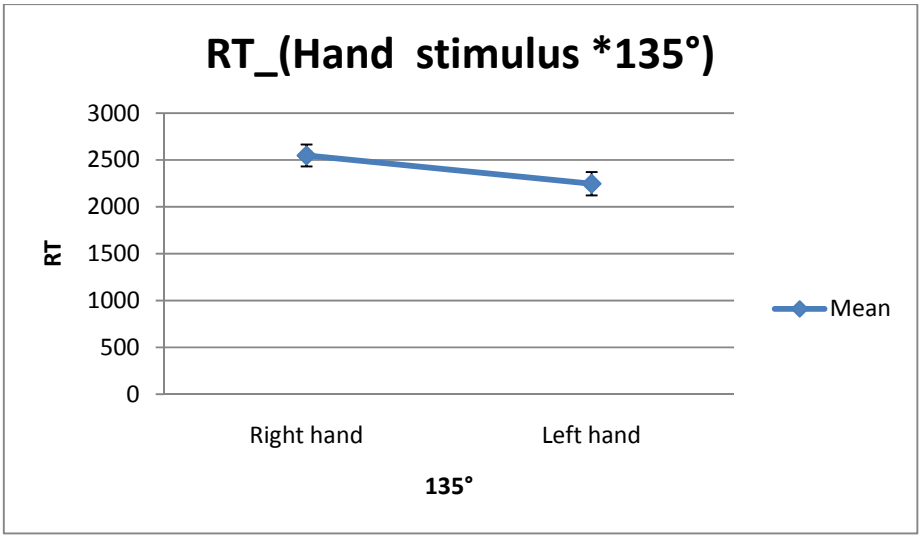

Figure 8: Mean Reaction Time (RT) and standard errors for Hand stimulus at orientation 135°.

Hand stimulus at orientation 45°

By contrast, the effect of laterality was not significant for all the other orientations: at 45° (F (1, 19) =2,891, p > .05, n.s., (1904.2±105.7 ms; 1846.2 ±102.7 ms) for the Right and Left hand respectively. Mean Reaction Times and Standard Errors are represented in Fig. 9

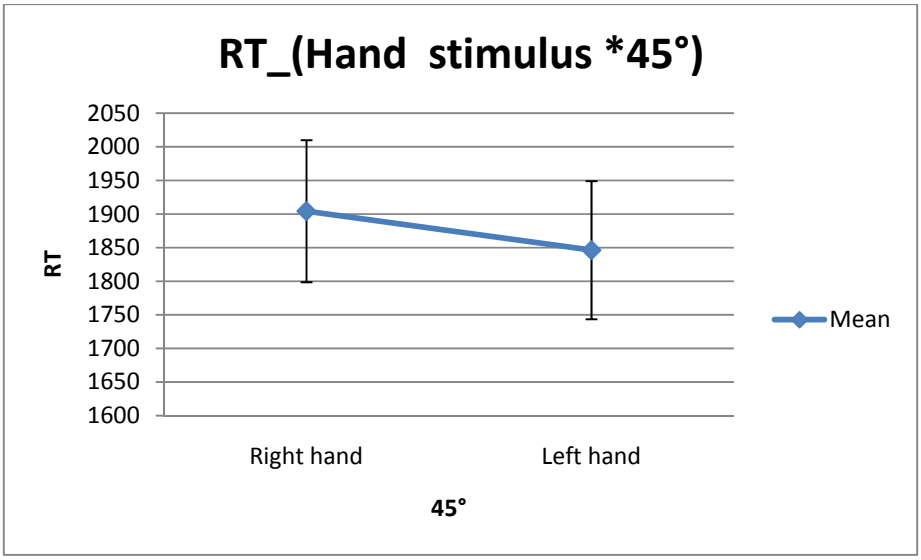

Figure 9: Mean Reaction Time (RT) and standard errors for Hand stimulus at orientation 45°.

Hand stimulus at orientation 90°

At 90° (F (1, 19) =2,341, p > .05, n.s., (2123.7±117.7 ms; 2015.1± 123.6 ms) for the Right and Left hand respectively. Mean Reaction Times and Standard Errors are represented in Fig. 10

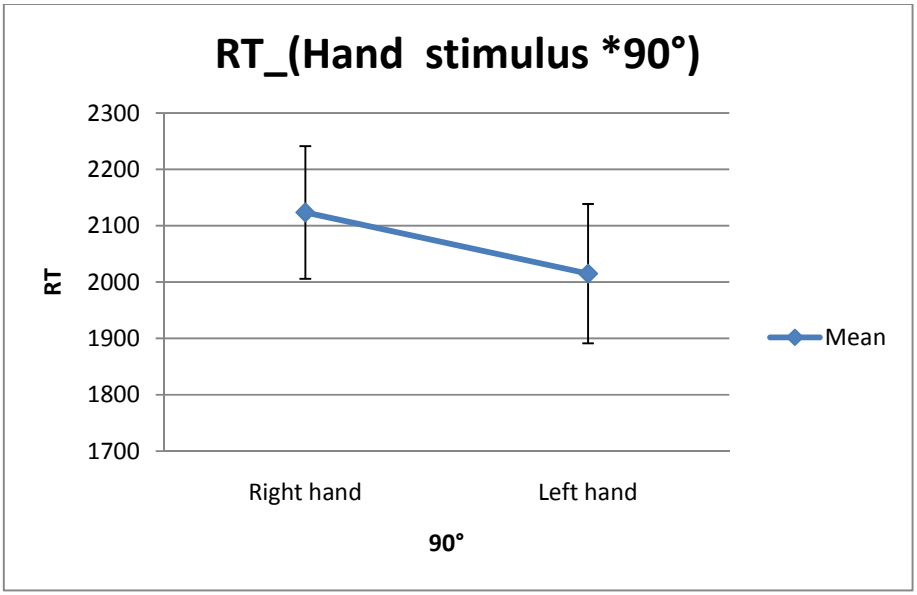

Figure 10: Mean Reaction Time (RT) and standard errors for Hand stimulus at orientation 90°.

Hand stimulus at orientation 225°

At 225° (F (1, 19) =1,215, p > .05, n.s., (2074.8 ±175.4 ms, 2153.5±137.2ms) for the Right and Left hand respectively. Mean Reaction Times and Standard Errors are represented in Fig. 10

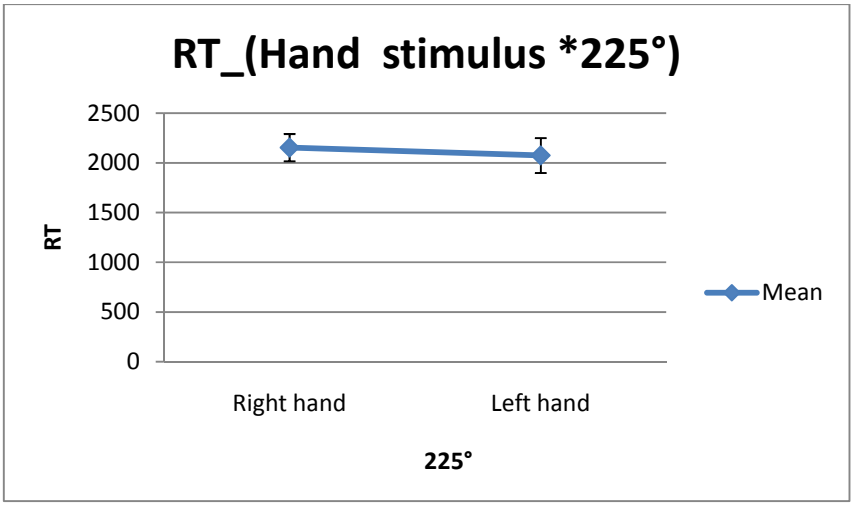

Figure 11: Mean Reaction Time (RT) and standard errors for Hand stimulus at orientation 225°.

Hand stimulus at orientation 270°

At 270° (F (1, 19) =1,223, p > .05, n.s., (1939.9±133.9ms, 1871.5± 186.2 ms) for the Right and Left hand respectively. Mean Reaction Times and Standard Errors are represented in Fig. 12

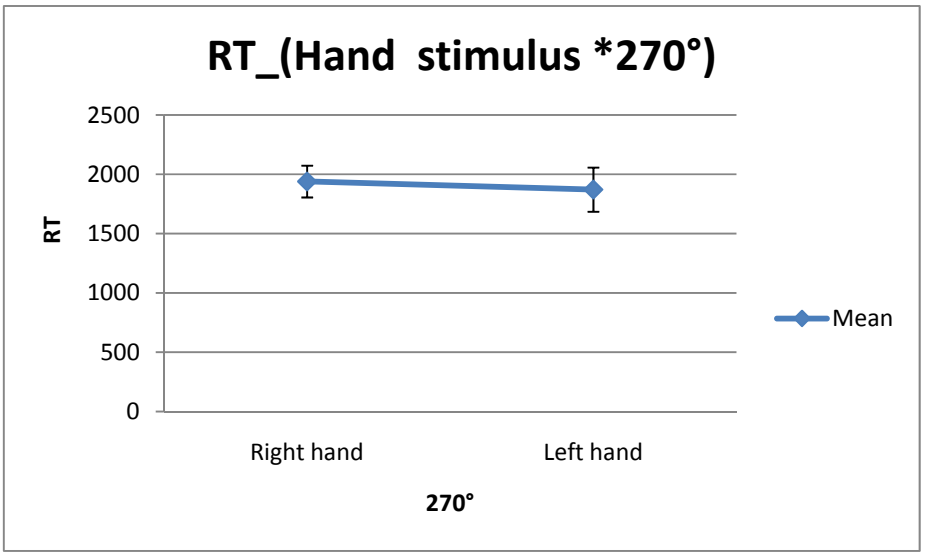

Figure 12: Mean Reaction Time (RT) and standard errors for Hand stimulus at orientation 270°.

Hand stimulus at orientation 315°

As a final point at 315° (F (1, 19) =3.302, p > .05, n.s., (1878.6±106.1 ms, 2001.4±120.4 ms) for the Right and Left hand respectively. Mean Reaction Times and Standard Errors are represented in Fig. 13

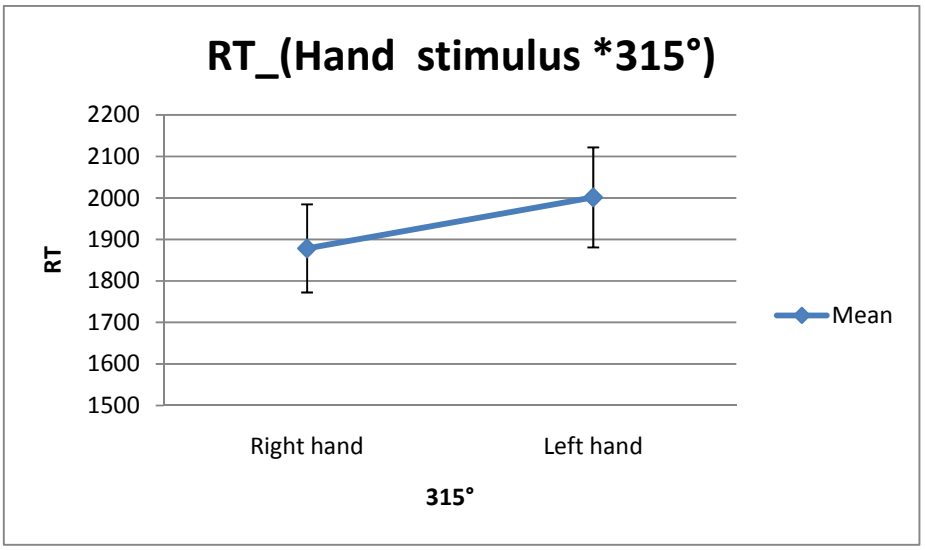

Figure 13: Mean Reaction Time (RT) and standard errors for Hand stimulus at orientation 315°.

Orientation * position interaction

We found a significant two-way Orientation * position interaction (F (10,190) = 2.48, p=0.008). Post hoc analysis was performed on the RVF (Right Visual Field), on the Centre and on the LVF (Left Visual Field), separately.

Post hoc analysis on Orientation * position interaction:

A further post hoc analysis performed on Orientation * position interaction, better clarified the direction of the interaction.

Right Visual Field (RVF)

For the RVF we found a significant main effect of ORIENTATION (F (5,395) =14.49, p = 0.000).The stimulus orientation at 135° displayed on the Right Visual Field (RVF) had a higher

response time(135°= 2373.9±84.5) than the other orientations and the calculated mean was significantly higher than all orientations showed on the identical visual field (RVF) except 225°[(45°=1931.1±71.8,p=0.000),(90°=2098.6±75.0,p=0.000),(270°=1994.5±87.8,p=0.000) (315°=2025.8±75.8, p =0.000)].The stimulus orientation at 225° presented on the Right Visual Field (RVF) had a second highest response time(225°= 2330.8±88.2) among all the other orientations and the calculated mean was significantly higher than all orientations showed on the identical Visual Field (RVF) except 135° [(45°=1931.1±71.8, p=0.000), (90°=2098.644±75.049, p=0.028), (270°=1994.5±87.8, p =0.000) (315°=2025.8±75.8, p =0.000)]. See details in Table 11 and 12. Mean Reaction Times and Standard Errors are represented in Fig. 14

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1931.159	71.808	1788.228	2074.090
90°	2098.644	75.049	1949.263	2248.025
135°	2373.987	84.583	2205.629	2542.345
225°	2330.844	88.230	2155.227	2506.461
270°	1994.506	87.876	1819.593	2169.418
315°	2025.820	75.898	1874.749	2176.891

Table 11: Mean Reaction Times and Standard Errors for Right Visual Field *Orientation .

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-167.485	65.503	.187	-365.768	30.799
	135°	-442.828(*)	67.289	.000	-646.517	-239.138
	225°	-399.684(*)	67.033	.000	-602.598	-196.771
	270°	-63.346	65.706	1.000	-262.245	135.552
	315°	-94.660	63.369	1.000	-286.483	97.163
90°	45°	167.485	65.503	.187	-30.799	365.768
	135°	-275.343(*)	59.863	.000	-456.553	-94.133
	225°	-232.200(*)	72.172	.028	-450.671	-13.729
	270°	104.138	73.837	1.000	-119.373	327.650
	315°	72.824	66.854	1.000	-129.547	275.195
135°	45°	442.828(*)	67.289	.000	239.138	646.517
	90°	275.343(*)	59.863	.000	94.133	456.553
	225°	43.143	80.383	1.000	-200.183	286.469
	270°	379.481(*)	76.811	.000	146.968	611.995
	315°	348.167(*)	77.645	.000	113.130	583.204
225°	45°	399.684(*)	67.033	.000	196.771	602.598
	90°	232.200(*)	72.172	.028	13.729	450.671
	135°	-43.143	80.383	1.000	-286.469	200.183
	270°	336.338(*)	59.730	.000	155.530	517.147
	315°	305.024(*)	62.052	.000	117.190	492.859
270°	45°	63.346	65.706	1.000	-135.552	262.245
	90°	-104.138	73.837	1.000	-327.650	119.373
	135°	-379.481(*)	76.811	.000	-611.995	-146.968
	225°	-336.338(*)	59.730	.000	-517.147	-155.530
	315°	-31.314	63.284	1.000	-222.880	160.252
315°	45°	94.660	63.369	1.000	-97.163	286.483
	90°	-72.824	66.854	1.000	-275.195	129.547
	135°	-348.167(*)	77.645	.000	-583.204	-113.130
	225°	-305.024(*)	62.052	.000	-492.859	-117.190
	270°	31.314	63.284	1.000	-160.252	222.880

Table 12: Pairwise Comparisons for Right Visual Field *Orientation

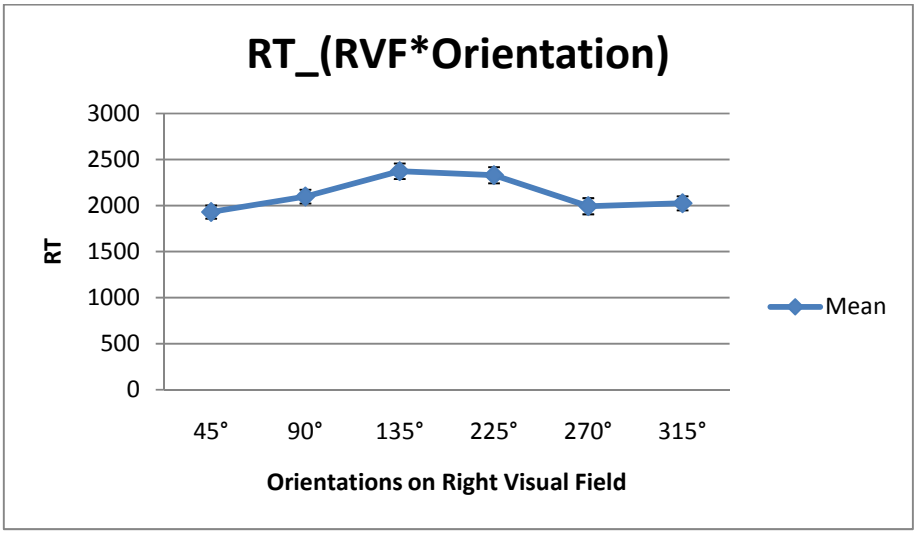

Figure 14: Mean Reaction Times and Standard Errors for Orientations on Right Visual Field.

Central Visual Field (C)

For the center we found a significant main effect of Orientation ($F(5,395)=23.499$, $p = .000$), with 90°(1978.0±75ms) higher than 45°(1826.4± 66.2 ms , $p =0.013$).The stimulus orientation at 135° displayed on the Central Visual Field (C) had a higher response time (135°=2410.3± 84.2) than the other orientations and the calculated mean was significantly higher than all orientations showed on the identical visual field (C) except 225° [(45°=1826.4± 66.2,p=0.000);(90°=1978±75,p=0.000);(270°=2118.3±95.8,p=0.002);(315°=1907.7±74.9,p=0.000)]. The stimulus orientation at 225° presented on the Central Visual Field (C) had a second highest response time (225°=2284.1±92.5 ms) among all the other orientations and the calculated mean was significantly higher than all orientations showed on the identical visual field (C) except 135° and 270° [(45°=1826.4±66.2, p=0.000), (90°=1978.0±75.0, p=0.001), (315°=1907.7±74.9, p=0.001).Eventually the stimulus orientation at 270° presented on the Central Visual Field was significantly higher than 45° and 315°[(45°=1826.4± 66.2 , p=0.001);(315°=1907.7±74.9, p=0.024). See details in Table 13 and 14. Mean Reaction Times and Standard Errors are represented in Fig. 15

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1826.499	66.203	1694.726	1958.272
90°	1978.005	75.021	1828.680	2127.331
135°	2410.336	84.245	2242.651	2578.022
225°	2284.141	92.502	2100.021	2468.262
270°	2118.342	95.807	1927.644	2309.041
315°	1907.782	74.992	1758.514	2057.051

Table 13: Mean Reaction Times and Standard Errors for Central Visual Field *Orientation.

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-151.506(*)	43.685	.013	-283.744	-19.269
	135°	-583.837(*)	63.567	.000	-776.259	-391.416
	225°	-457.642(*)	69.560	.000	-668.206	-247.079
	270°	-291.843(*)	69.210	.001	-501.348	-82.338
	315°	-81.283	48.030	1.000	-226.673	64.106
90°	45°	151.506(*)	43.685	.013	19.269	283.744
	135°	-432.331(*)	65.461	.000	-630.485	-234.176
	225°	-306.136(*)	73.054	.001	-527.277	-84.995
	270°	-140.337	67.496	.613	-344.653	63.979
	315°	70.223	54.898	1.000	-95.957	236.403
135°	45°	583.837(*)	63.567	.000	391.416	776.259
	90°	432.331(*)	65.461	.000	234.176	630.485
	225°	126.195	81.939	1.000	-121.840	374.230
	270°	291.994(*)	72.931	.002	71.226	512.762
	315°	502.554(*)	68.977	.000	293.755	711.353
225°	45°	457.642(*)	69.560	.000	247.079	668.206
	90°	306.136(*)	73.054	.001	84.995	527.277
	135°	-126.195	81.939	1.000	-374.230	121.840
	270°	165.799	72.239	.366	-52.874	384.471
	315°	376.359(*)	64.891	.000	179.930	572.788
270°	45°	291.843(*)	69.210	.001	82.338	501.348
	90°	140.337	67.496	.613	-63.979	344.653
	135°	-291.994(*)	72.931	.002	-512.762	-71.226
	225°	-165.799	72.239	.366	-384.471	52.874
	315°	210.560(*)	64.289	.024	15.953	405.168
315°	45°	81.283	48.030	1.000	-64.106	226.673
	90°	-70.223	54.898	1.000	-236.403	95.957
	135°	-502.554(*)	68.977	.000	-711.353	-293.755
	225°	-376.359(*)	64.891	.000	-572.788	-179.930
	270°	-210.560(*)	64.289	.024	-405.168	-15.953

Table 14: Pairwise Comparisons for Central Visual Field *Orientation.

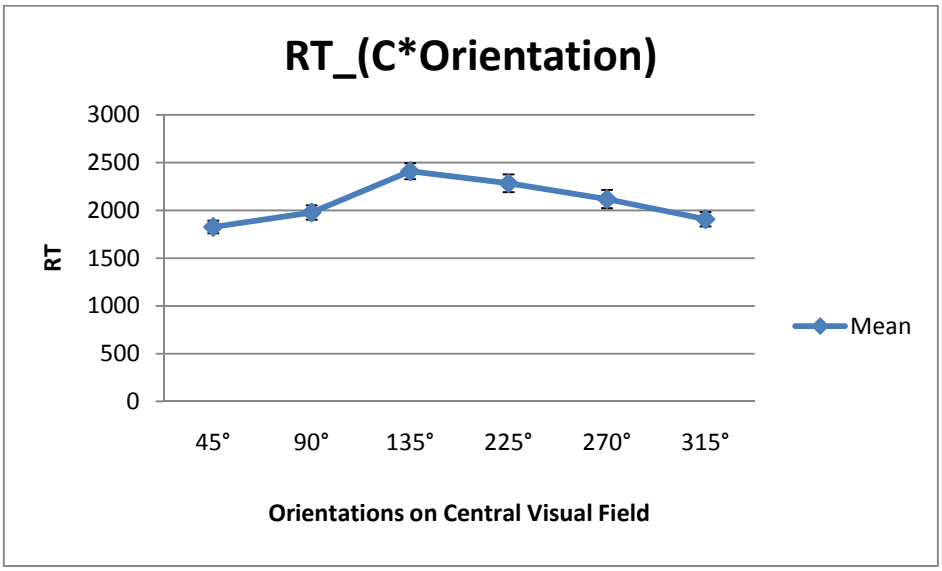

Figure 15: Mean Reaction Times and Standard Errors for Orientations on Central Visual Field .

Left Visual Field (LVF)

For the LVF we found a significant main effect of Orientation (F (5,395) =23.499, p = .000), with 90° (2131.5±82.4ms) higher than 45° and 315° [(45° =1868.1±69.1 ms, p =0.000) ;(315°=1913.6±70.3, p=0.006).

The stimulus orientation at 135° displayed on the Left Visual Field (LVF) had a higher response time (135°=2408.7± 85.7) than the other orientations and the calculated mean was significantly higher than all orientations showed on the identical visual field (LVF) except 225° [(45°=1868.1±69.1, p = 0.000) ;(90°=2131.5±82.4, p = 0.001); (270°=2037.9± 84.1, p = 0.001); (315°=1913.6±70.3, p = 0.000)]

Eventually The stimulus orientation at 225° presented on the Left Visual Field (C) had a second highest response time (225°=2272.9 ±87.1 ms) among all the other orientations and the calculated mean was significantly higher than all orientations showed on the identical visual field (C) except 90° and135° [(45°=1868.1±69.1, p = 0.000); (270°=2037.9± 84.1, p = 0.002); (315°=1913.6±70.3, p = 0.000)]See details in Table 15 and 16. Mean Reaction Times and Standard Errors are represented in Fig. 16

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1868.104	69.160	1730.444	2005.765
90°	2131.581	82.436	1967.496	2295.667
135°	2408.714	85.777	2237.979	2579.449
225°	2272.955	87.157	2099.473	2446.437
270°	2037.986	84.106	1870.578	2205.394
315°	1913.686	70.397	1773.565	2053.807

Table 15: Mean Reaction Times and Standard Errors for Left Visual Field *Orientation.

Orientation	Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-263.477(*)	57.925	.000	-438.821	-88.133
	135°	-540.609(*)	69.312	.000	-750.423	-330.795
	225°	-404.850(*)	68.799	.000	-613.109	-196.592
	270°	-169.881	63.838	.141	-363.124	23.362
	315°	-45.582	52.087	1.000	-203.253	112.090
90°	45°	263.477(*)	57.925	.000	88.133	438.821
	135°	-277.132(*)	65.653	.001	-475.869	-78.396
	225°	-141.373	77.137	1.000	-374.873	92.127
	270°	93.596	75.130	1.000	-133.830	321.021
	315°	217.895(*)	58.638	.006	40.392	395.398
135°	45°	540.609(*)	69.312	.000	330.795	750.423
	90°	277.132(*)	65.653	.001	78.396	475.869
	225°	135.759	89.656	1.000	-135.636	407.154
	270°	370.728(*)	86.178	.001	109.862	631.594
	315°	495.028(*)	66.757	.000	292.950	697.105
225°	45°	404.850(*)	68.799	.000	196.592	613.109
	90°	141.373	77.137	1.000	-92.127	374.873
	135°	-135.759	89.656	1.000	-407.154	135.636
	270°	234.969(*)	57.985	.002	59.445	410.493
	315°	359.268(*)	67.725	.000	154.260	564.277
270°	45°	169.881	63.838	.141	-23.362	363.124
	90°	-93.596	75.130	1.000	-321.021	133.830
	135°	-370.728(*)	86.178	.001	-631.594	-109.862
	225°	-234.969(*)	57.985	.002	-410.493	-59.445
	315°	124.299	59.731	.610	-56.511	305.110
315°	45°	45.582	52.087	1.000	-112.090	203.253
	90°	-217.895(*)	58.638	.006	-395.398	-40.392
	135°	-495.028(*)	66.757	.000	-697.105	-292.950
	225°	-359.268(*)	67.725	.000	-564.277	-154.260
	270°	-124.299	59.731	.610	-305.110	56.511

Table 16: Pairwise Comparisons for Left Visual Field *Orientation.

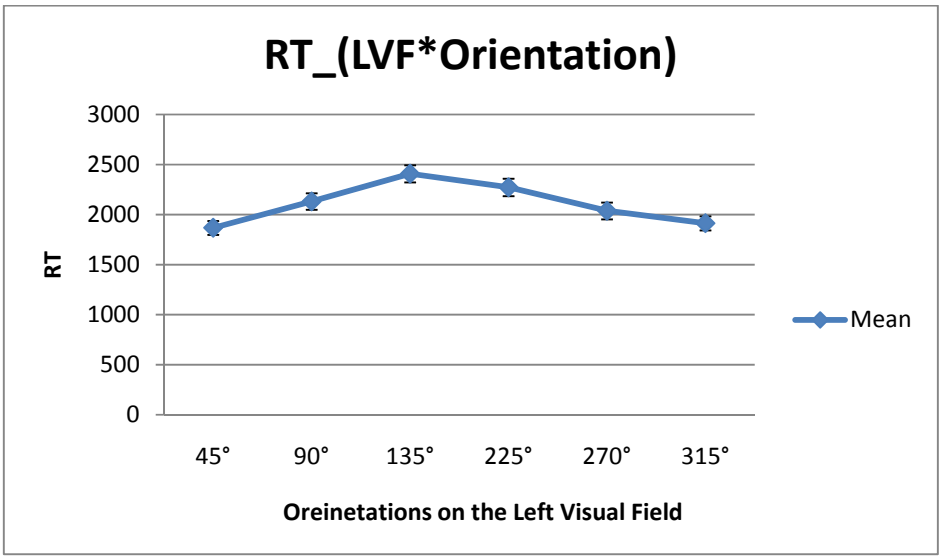

Figure 16: Mean Reaction Times and Standard Errors for Orientations on Left Visual Field .

RVF vs. C vs. LVF

Below you can see the Result for all the three views in table 17. Mean Reaction Times and Standard Errors for all the visual fields are represented in Fig. 17

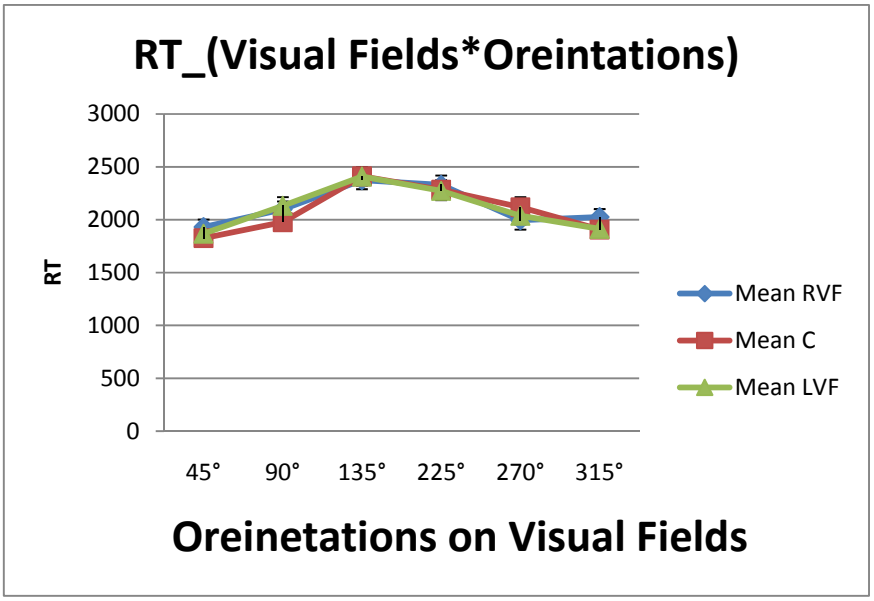

Figure 17: Mean Reaction Times and Standard Errors for all visual fields.

Orientation	position	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
45°	RVF	1931.159	114.831	1690.816	2171.503
	C	1826.499	100.069	1617.053	2035.945
	LVF	1868.104	105.019	1648.296	2087.913
90°	RVF	2098.644	108.712	1871.107	2326.181
	C	1978.005	120.358	1726.094	2229.917
	LVF	2131.581	129.625	1860.273	2402.890
135°	RVF	2373.987	123.697	2115.085	2632.889
	C	2410.336	124.686	2149.365	2671.308
	LVF	2408.714	114.891	2168.244	2649.183
225°	RVF	2330.844	136.272	2045.624	2616.063
	C	2284.141	131.613	2008.673	2559.610
	LVF	2272.955	127.077	2006.979	2538.930
270°	RVF	1994.506	141.853	1697.603	2291.408
	C	2118.342	163.134	1776.898	2459.786
	LVF	2037.986	125.695	1774.904	2301.067
315°	RVF	2025.820	111.637	1792.160	2259.480
	C	1907.782	108.623	1680.431	2135.134
	LVF	1886.520	113.744	1648.451	2124.589

Table 17: Mean Reaction Times and Standard Errors for Orientation * position.

Post hoc analysis on Position * Orientation interaction

A further post hoc analysis performed on Position x Orientation interaction, better clarified the direction of the interaction.

Position * Orientation at 90°

The ANOVA performed for each Orientation separately showed that the effect of position (RVF, centre, LVF) was significant at 90° ($F(2, 38) = 4.14$, $p < .05$, with significantly longer RTs for the RVF than for centre [(RVF = 2098.6±108.7); (C= 1978.0±120.3)]. The insignificant effect of Stimulus position at 90° in the Right visual Field (RVF) versus LVF (2131.5±129.6) and Center

versus LVF indicates that the time requested for mentally rotating hands in these Positions were comparable. See details in Table 19 and 20. Mean Reaction Times and Standard Errors are represented in Fig. 18

Position at 90°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2098.644	108.712	1871.107	2326.181
C	1978.005	120.358	1726.094	2229.917
LVF	2131.581	129.625	1860.273	2402.890

Table 18: Mean Reaction Times and Standard Errors for Position * Orientation at 90°.

(I) Position at 90°	(J) Position at 90°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	120.639(*)	45.588	.048	.966	240.311
	LVF	-32.937	62.489	1.000	-196.977	131.102
C	RVF	-120.639(*)	45.588	.048	-240.311	-.966
	LVF	-153.576	58.917	.052	-308.239	1.087
LVF	RVF	32.937	62.489	1.000	-131.102	196.977
	C	153.576	58.917	.052	-1.087	308.239

Table 19: Pairwise Comparisons for Position * Orientation at 90°.

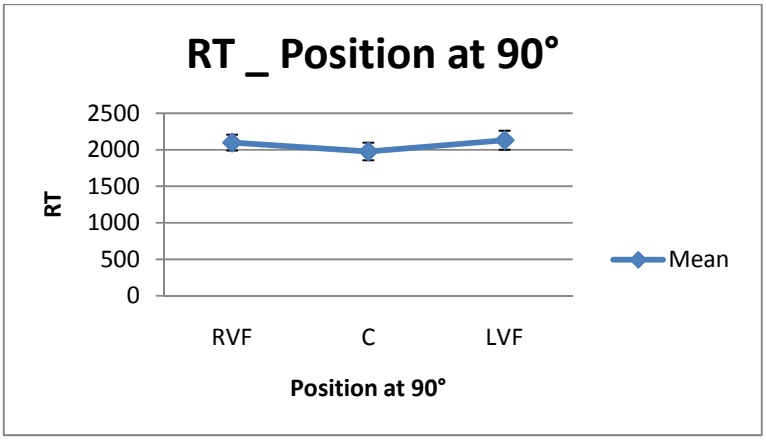

Figure 18: Mean Reaction Times and Standard Errors for all Position at 90°.

Position * Orientation at 315°

The effect of stimulus orientation at 315° (F (2, 38) =5.78, p<.02) displayed on the Right Visual Field (RVF) had a significantly longer response time (2025.8±111.6) than LVF (1886.5±113.7). The insignificant effect of Stimulus position at 315° in the Central visual Field (C= 1907.7 ± 108.6) versus RVF and LVF indicates that the time requested for mentally rotating hands in these Positions were comparable. See details in Table 20 and 21. Mean Reaction Times and Standard Errors are represented in Fig. 19

Position at 315°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2025.820	111.637	1792.160	2259.480
C	1907.782	108.623	1680.431	2135.134
LVF	1886.520	113.744	1648.451	2124.589

Table 20: Mean Reaction Times and Standard Errors for Position * Orientation at 315°

(I) Position at 315°	(J) Position at 315°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	118.037	45.279	.052	-.826	236.900
	LVF	139.300(*)	45.399	.019	20.122	258.477
C	RVF	-118.037	45.279	.052	-236.900	.826
	LVF	21.262	41.639	1.000	-88.043	130.568
LVF	RVF	-139.300(*)	45.399	.019	-258.477	-20.122
	C	-21.262	41.639	1.000	-130.568	88.043

Table 21: Pairwise Comparisons for Position * Orientation at 315°

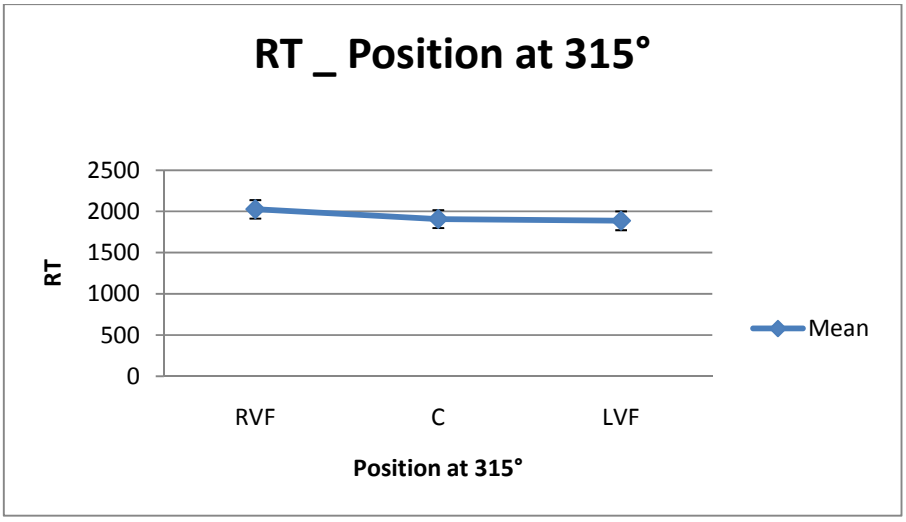

Figure 19: Mean Reaction Times and Standard Errors for all Position at 315°.

Position * Orientation at 45°

By contrast, the effect of position was not significant for all the other orientations: at 45° (F (2, 38) =2.22, p >.05) See details in Table 22 and 23

Position at 45°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	1931.159	114.831	1690.816	2171.503
C	1826.499	100.069	1617.053	2035.945
LVF	1868.104	105.019	1648.296	2087.913

Table 22: Mean Reaction Times and Standard Errors for Position * Orientation at 45°

(I) Position at 45°	(J) Position at 45°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	104.660	52.287	.179	-32.598	241.918
	LVF	63.055	45.978	.559	-57.642	183.752
C	RVF	-104.660	52.287	.179	-241.918	32.598
	LVF	-41.605	51.324	1.000	-176.335	93.125
LVF	RVF	-63.055	45.978	.559	-183.752	57.642
	C	41.605	51.324	1.000	-93.125	176.335

Table 23: Pairwise Comparisons for Position * Orientation at 45°

Position * Orientation at 135°

The effect of position was not significant for the orientation at 135° ($F(2, 38) = 0.22$, $p > .05$) See details in Table 24 and 25

Position at 135°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2373.987	123.697	2115.085	2632.889
C	2410.336	124.686	2149.365	2671.308
LVF	2408.714	114.891	2168.244	2649.183

Table 24: Mean Reaction Times and Standard Errors for Position * Orientation at 135°.

(I) Position at 135°	(J) Position at 135°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	-36.349	60.518	1.000	-195.217	122.518
	LVF	-34.727	56.884	1.000	-184.052	114.598
C	RVF	36.349	60.518	1.000	-122.518	195.217
	LVF	1.623	64.662	1.000	-168.122	171.368
LVF	RVF	34.727	56.884	1.000	-114.598	184.052
	C	-1.623	64.662	1.000	-171.368	168.122

Table 25: Pairwise Comparisons for Position * Orientation at 135°

Position * Orientation at 225°

The effect of position was not significant for the orientation at 225° (F (2, 38) =2.22, p >.05) See details in Table 26 and 27

Position at 225°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2330.844	136.272	2045.624	2616.063
C	2284.141	131.613	2008.673	2559.610
LVF	2272.955	127.077	2006.979	2538.930

Table 26: Mean Reaction Times and Standard Errors for Position * Orientation at 225°.

(I) Position at 225°	(J) Position at 225°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	46.703	54.697	1.000	-96.883	190.288
	LVF	57.889	56.176	.947	-89.579	205.357
C	RVF	-46.703	54.697	1.000	-190.288	96.883
	LVF	11.187	54.877	1.000	-132.871	155.244
LVF	RVF	-57.889	56.176	.947	-205.357	89.579
	C	-11.187	54.877	1.000	-155.244	132.871

Table 27: Pairwise Comparisons for Position * Orientation at 225°

Position * Orientation at 270°

The effect of position was not significant for the orientation at 270° (F (2, 38) =2.22, p >.05. See details in Table 28 and 29

Position at 270°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	1994.506	141.853	1697.603	2291.408
C	2118.342	163.134	1776.898	2459.786
LVF	2037.986	125.695	1774.904	2301.067

Table 28: Mean Reaction Times and Standard Errors for Position * Orientation at 270°.

(I) Position at 270°	(J) Position at 270°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	-123.837	51.201	.077	-258.244	10.571
	LVF	-43.480	50.640	1.000	-176.416	89.456
C	RVF	123.837	51.201	.077	-10.571	258.244
	LVF	80.357	66.467	.725	-94.126	254.839
LVF	RVF	43.480	50.640	1.000	-89.456	176.416
	C	-80.357	66.467	.725	-254.839	94.126

Table 29: Pairwise Comparisons for Position * Orientation at 270°

Strategy*Hand*Orientation

We found a significant three-way Strategy*Hand*Orientation interaction F (5, 95) = 3,005, p=.015).Post hoc analysis was performed on the motor and the visual strategy separately.
Post hoc analysis on

Motor strategy:

For the motor strategy we found a significant main effect of HAND (F (1, 19) =5.75, p = .027), with longer RTs for the Right Hand than for the Left Hand. moreover the effect of Orientation was significant (F(5,95)=15,247, p = .000) along with a significant effect of hand* Orientation interaction (F(5,95)=4,44, p = .001). See details in Table 30. Mean Reaction Times and Standard Errors are represented in Fig. 20

hand	Orientation	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Right	45°	2002.885	102.298	1788.772	2216.997
	90°	2312.026	107.830	2086.336	2537.716
	135°	2775.741	125.297	2513.490	3037.992
	225°	2307.146	121.002	2053.885	2560.407
	270°	2024.613	96.947	1821.700	2227.527
	315°	2010.635	96.357	1808.958	2212.312
Left	45°	1967.183	85.039	1789.194	2145.171
	90°	2132.119	121.211	1878.422	2385.817
	135°	2392.505	93.048	2197.753	2587.257
	225°	1999.927	178.416	1626.497	2373.356
	270°	1855.331	190.518	1456.571	2254.090
	315°	2192.344	106.768	1968.876	2415.813

Table 30: Mean Reaction Times and Standard Errors for Motor strategy*Hand*Orientation

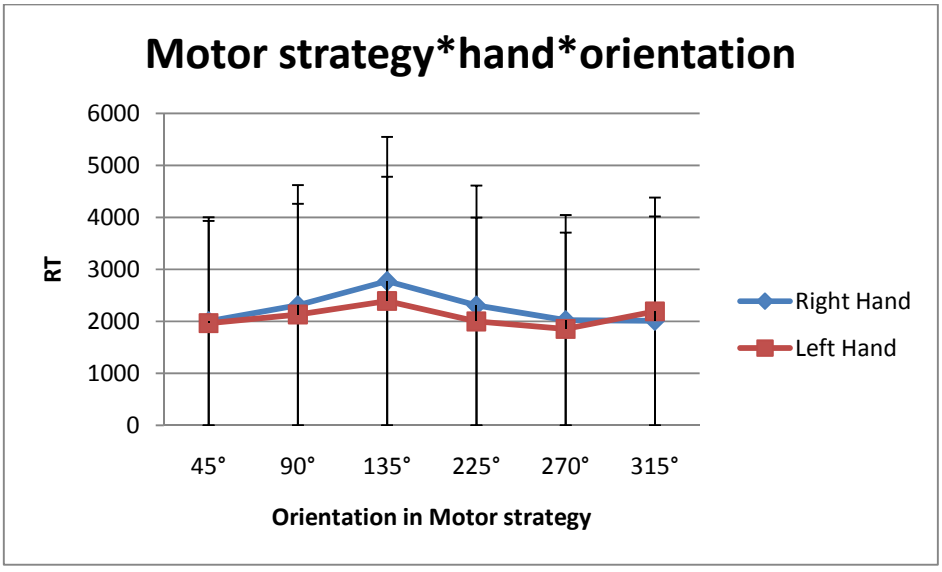

Figure 20: Mean Reaction Times and Standard Errors for Motor strategy*hand(R - L) *orientation

Visual Strategy

By contrast for the visual strategy we found a significant main effect of Orientation only (F (5, 95) =16, 2, p = .000) and a significant hand * Orientation interaction (F (5, 95) =2,691, p = .026). See details in Table 31. Mean Reaction Times and Standard Errors are represented in Fig. 21

hand	Orientation	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Right	45°	1805.627	147.527	1496.849	2114.406
	90°	1935.405	154.241	1612.576	2258.235
	135°	2321.547	151.143	2005.200	2637.894
	225°	1999.927	178.416	1626.497	2373.356
	270°	1855.331	190.518	1456.571	2254.090
	315°	1746.597	145.027	1443.052	2050.143
Left	45°	1725.322	149.771	1411.849	2038.796
	90°	1898.091	166.349	1549.919	2246.263
	135°	2100.923	194.041	1694.791	2507.055
	225°	2149.870	181.299	1770.406	2529.334
	270°	1887.793	185.848	1498.810	2276.777
	315°	1810.586	162.687	1470.079	2151.093

Table 31: Mean Reaction Times and Standard Errors for Visual strategy*Hand*Orientation.

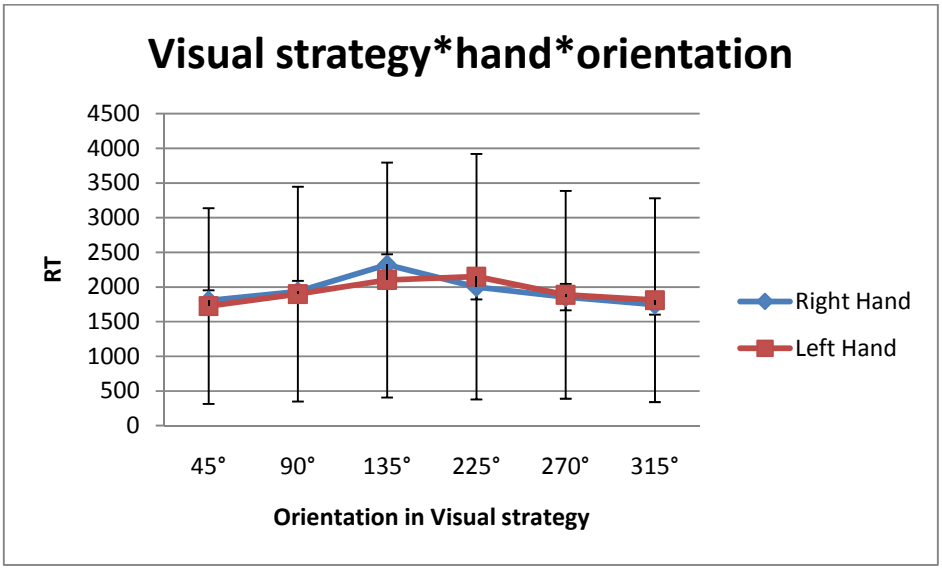

Figure 21: Mean Reaction Times and Standard Errors for Visual strategy*hand(R - L) *orientation

ANOVA for Hand* Orientation

To understand the nature of the significant hand* Orientation interactions we performed further ANOVA analysis for left hand and right hand independently, for the motor and the visual strategy respectively.

Motor strategy- Right Hand

For the motor strategy, the ANOVA performed on the Right hand only showed a significant main effect of Orientation $F(5,95)=19.78$, $p = .000$).

The stimulus orientation at 90° had significantly longer response time (90°=2312.026±107.830 ms) than 45° and 270° [(45°=2002.8±102.2ms, p= 0.004) ;(270°=2024.6±96.9ms, p=0.034)].

The stimulus Orientation at 135° had a significantly longer RTs than all the other orientations[(45°=2002.8±102.2,p=0.000);(90°=2312.0±107.8,p=0.013);(225°=2307.1±121,p=0.030);(270°=2024.6±96.9, p=0.000);(315°=2010.6±96.3, p=0.000)].

The stimulus orientation at 225° had significantly longer response time (225°=2307.1±121ms) than 45°, 270° and 315° [(45°=2002.8±102.2, p=0.008); (270°=2024.6±96.9, p=0.013) ;(315°=2010.6±96.3, p=0.039)]. See details in Table 32 and 33. Mean Reaction Times and Standard Errors are represented in Fig.22

			95% Confidence Interval	
Orientation	Mean	Std. Error	Lower Bound	Upper Bound
45°	2002.885	102.298	1788.772	2216.997
90°	2312.026	107.830	2086.336	2537.716
135°	2775.741	125.297	2513.490	3037.992
225°	2307.146	121.002	2053.885	2560.407
270°	2024.613	96.947	1821.700	2227.527
315°	2010.635	96.357	1808.958	2212.312

Table 32: Mean Reaction Times and Standard Errors for Motor strategy*Right hand*Orientation

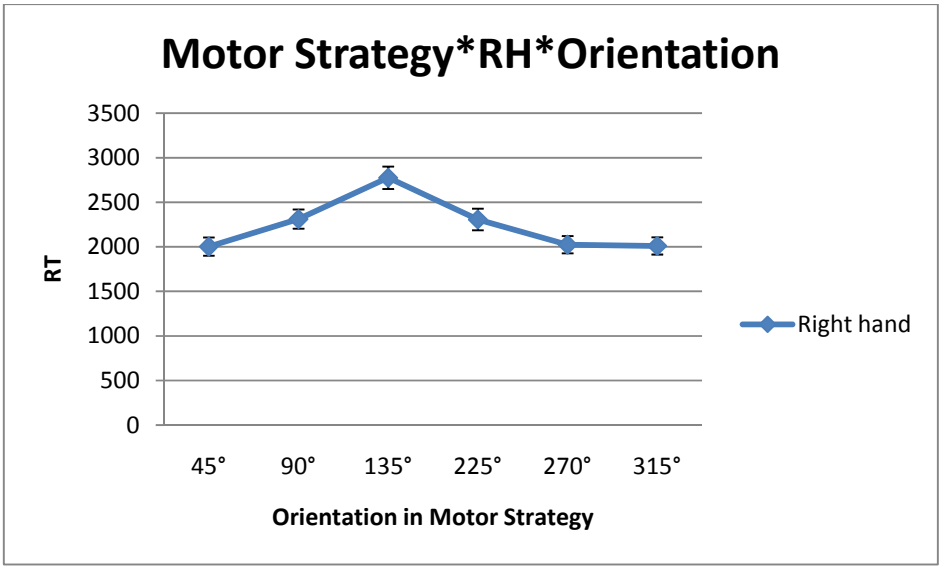

Figure 22: Mean Reaction Times and Standard Errors for Motor strategy*Right hand*Orientation

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-309.141(*)	68.402	.004	-538.564	-79.719
	135°	-772.856(*)	124.354	.000	-1189.945	-355.768
	225°	-304.262(*)	73.342	.008	-550.253	-58.271
	270°	-21.729	75.250	1.000	-274.121	230.663
	315°	-7.751	78.541	1.000	-271.180	255.678
90°	45°	309.141(*)	68.402	.004	79.719	538.564
	135°	-463.715(*)	117.897	.013	-859.144	-68.286
	225°	4.880	96.606	1.000	-319.139	328.898
	270°	287.413(*)	81.423	.034	14.315	560.510
	315°	301.391	91.009	.055	-3.857	606.638
135°	45°	772.856(*)	124.354	.000	355.768	1189.945
	90°	463.715(*)	117.897	.013	68.286	859.144
	225°	468.595(*)	130.674	.030	30.310	906.879
	270°	751.128(*)	99.793	.000	416.419	1085.836
	315°	765.106(*)	129.027	.000	332.346	1197.865
225°	45°	304.262(*)	73.342	.008	58.271	550.253
	90°	-4.880	96.606	1.000	-328.898	319.139
	135°	-468.595(*)	130.674	.030	-906.879	-30.310
	270°	282.533(*)	71.444	.013	42.908	522.158
	315°	296.511(*)	85.669	.039	9.173	583.849
270°	45°	21.729	75.250	1.000	-230.663	274.121
	90°	-287.413(*)	81.423	.034	-560.510	-14.315
	135°	-751.128(*)	99.793	.000	-1085.836	-416.419
	225°	-282.533(*)	71.444	.013	-522.158	-42.908
	315°	13.978	73.934	1.000	-234.001	261.957
315°	45°	7.751	78.541	1.000	-255.678	271.180
	90°	-301.391	91.009	.055	-606.638	3.857
	135°	-765.106(*)	129.027	.000	-1197.865	-332.346
	225°	-296.511(*)	85.669	.039	-583.849	-9.173
	270°	-13.978	73.934	1.000	-261.957	234.001

Table 33: Pairwise Comparisons for Motor strategy*Right hand*Orientation

Motor strategy- Left Hand

For the motor strategy, the ANOVA performed on Left hand only showed a significant main effect of Orientation F (5, 95) =5.207, p = .000).The stimulus orientation at 135° had a higher response time(135°= 2392.5±93) than the other orientations and the calculated mean was significantly higher than 45°, 90° and 270° [(45°=1967.1±85, p=0.000); (90°=2132.1±121.2, p=0.032); (270°=1855.3±190.5, p=0.044)]. See details in Table 34 and 35. Mean Reaction Times and Standard Errors are represented in Fig. 23

			95% Confidence Interval	
Orientation	Mean	Std. Error	Lower Bound	Upper Bound
45°	1967.183	85.039	1789.194	2145.171
90°	2132.119	121.211	1878.422	2385.817
135°	2392.505	93.048	2197.753	2587.257
225°	1999.927	178.416	1626.497	2373.356
270°	1855.331	190.518	1456.571	2254.090
315°	2192.344	106.768	1968.876	2415.813

Table 34: Mean Reaction Times and Standard Errors for Motor strategy*Left hand*Orientation

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-164.936	82.203	.889	-440.648	110.775
	135°	-425.322(*)	69.159	.000	-657.283	-193.361
	225°	-32.744	146.520	1.000	-524.178	458.690
	270°	111.852	160.454	1.000	-426.317	650.021
	315°	-225.161	76.537	.126	-481.870	31.547
90°	45°	164.936	82.203	.889	-110.775	440.648
	135°	-260.386(*)	73.345	.032	-506.388	-14.384
	225°	132.193	132.764	1.000	-313.104	577.489
	270°	276.788	134.830	.812	-175.437	729.014
	315°	-60.225	101.651	1.000	-401.166	280.715
135°	45°	425.322(*)	69.159	.000	193.361	657.283
	90°	260.386(*)	73.345	.032	14.384	506.388
	225°	392.578	148.904	.244	-106.851	892.007
	270°	537.174(*)	157.299	.044	9.586	1064.762
	315°	200.161	80.114	.327	-68.545	468.867
225°	45°	32.744	146.520	1.000	-458.690	524.178
	90°	-132.193	132.764	1.000	-577.489	313.104
	135°	-392.578	148.904	.244	-892.007	106.851
	270°	144.596	66.156	.623	-77.293	366.484
	315°	-192.418	126.686	1.000	-617.327	232.491
270°	45°	-111.852	160.454	1.000	-650.021	426.317
	90°	-276.788	134.830	.812	-729.014	175.437
	135°	-537.174(*)	157.299	.044	-1064.762	-9.586
	225°	-144.596	66.156	.623	-366.484	77.293
	315°	-337.013	140.848	.408	-809.422	135.395
315°	45°	225.161	76.537	.126	-31.547	481.870
	90°	60.225	101.651	1.000	-280.715	401.166
	135°	-200.161	80.114	.327	-468.867	68.545
	225°	192.418	126.686	1.000	-232.491	617.327
	270°	337.013	140.848	.408	-135.395	809.422

Table 35: Pairwise for Motor strategy*Left hand*Orientation

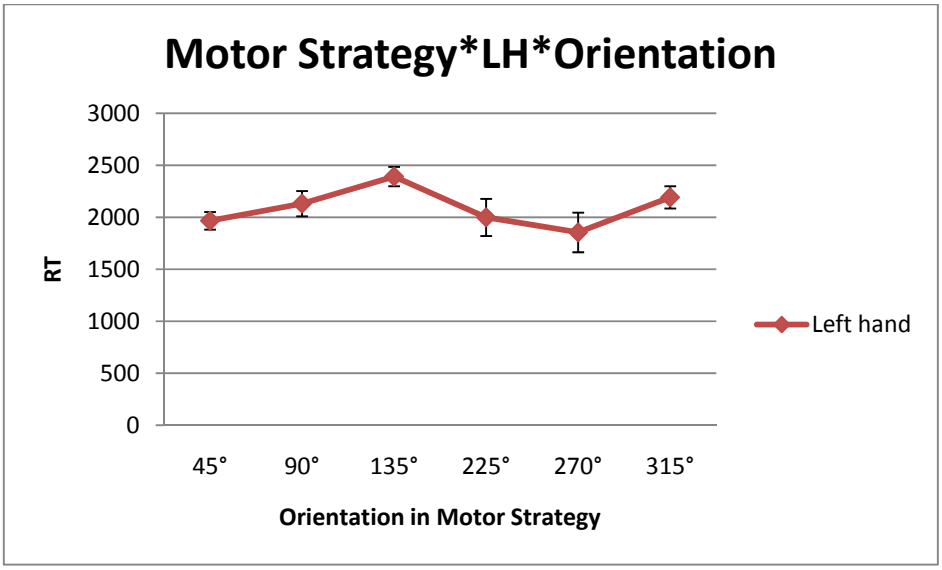

Figure 23: Mean Reaction Times and Standard Errors for Motor strategy*Left hand*Orientation

Visual strategy- Right Hand

For the visual strategy, the ANOVA performed on Right hand only showed a significant main effect of Orientation F(5,95)=12,54, p = .000).

The stimulus orientation at 135° had a longer response time (135°= 2321.5±151.1) than the other orientations and the calculated mean was significantly higher than all the orientations except 225°.[(45°=1805.6±147.5,p=0.000);(90°=1935.405±154.241,p=0.002);(270°=1855.331±190.518 , p=0.003) (315°=1746.597±145.027, p=0.000)]. See details in Table 36 and 37. Mean Reaction Times and Standard Errors are represented in Fig. 24

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1805.627	147.527	1496.849	2114.406
90°	1935.405	154.241	1612.576	2258.235
135°	2321.547	151.143	2005.200	2637.894
225°	1999.927	178.416	1626.497	2373.356
270°	1855.331	190.518	1456.571	2254.090
315°	1746.597	145.027	1443.052	2050.143

Table 36: Mean Reaction Times and Standard Errors for Visual strategy*Right hand*Orientation

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-129.778	76.825	1.000	-387.453	127.897
	135°	-515.920(*)	80.558	.000	-786.114	-245.726
	225°	-194.299	68.369	.156	-423.611	35.012
	270°	-49.703	90.364	1.000	-352.788	253.381
	315°	59.030	55.752	1.000	-127.964	246.024
90°	45°	129.778	76.825	1.000	-127.897	387.453
	135°	-386.142(*)	81.528	.002	-659.590	-112.694
	225°	-64.522	77.869	1.000	-325.699	196.656
	270°	80.074	72.498	1.000	-163.087	323.236
	315°	188.808	85.303	.590	-97.301	474.917
135°	45°	515.920(*)	80.558	.000	245.726	786.114
	90°	386.142(*)	81.528	.002	112.694	659.590
	225°	321.620	111.157	.140	-51.203	694.444
	270°	466.216(*)	102.246	.003	123.281	809.152
	315°	574.950(*)	81.557	.000	301.405	848.495
225°	45°	194.299	68.369	.156	-35.012	423.611
	90°	64.522	77.869	1.000	-196.656	325.699
	135°	-321.620	111.157	.140	-694.444	51.203
	270°	144.596	66.156	.623	-77.293	366.484
	315°	253.329	87.542	.140	-40.289	546.948
270°	45°	49.703	90.364	1.000	-253.381	352.788
	90°	-80.074	72.498	1.000	-323.236	163.087
	135°	-466.216(*)	102.246	.003	-809.152	-123.281
	225°	-144.596	66.156	.623	-366.484	77.293
	315°	108.734	78.553	1.000	-154.737	372.205
315°	45°	-59.030	55.752	1.000	-246.024	127.964
	90°	-188.808	85.303	.590	-474.917	97.301
	135°	-574.950(*)	81.557	.000	-848.495	-301.405
	225°	-253.329	87.542	.140	-546.948	40.289
	270°	-108.734	78.553	1.000	-372.205	154.737

Table 37: Pairwise Comparisons for Visual strategy*Right hand*Orientation

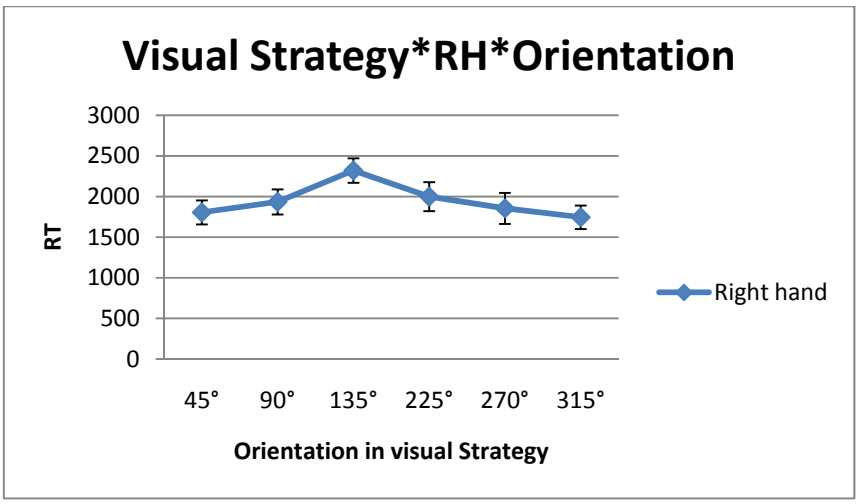

Figure 24: Mean Reaction Times and Standard Errors for Visual strategy*Right hand*Orientation

Visual strategy- Left Hand

For the visual strategy, the ANOVA perfumed on Left hand only showed a significant main effect of Orientation F(5,95)=7,82, p = .000).

The stimulus orientation at 135° had a longer response time (135°=2100.9±194) than the other orientations and the calculated mean was significantly higher than 45° and 315° [(45°=1725.3±149.7, p=0.001); (315°=1810.5±162.6, p=0.024)].

The stimulus orientation at 225° had significantly longer response time (225°=2307.1±121ms) than 45°, 270° and 315° [([(45°=1725.3±149.7, p=0.001); (270°=1887.7±185.8, p=0.004) ;(315°=1810.5±162.6, p=0.012)].See details in Table 38 and 39. Mean Reaction Times and Standard Errors are represented in Fig. 25

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1725.322	149.771	1411.849	2038.796
90°	1898.091	166.349	1549.919	2246.263
135°	2100.923	194.041	1694.791	2507.055
225°	2149.870	181.299	1770.406	2529.334
270°	1887.793	185.848	1498.810	2276.777
315°	1810.586	162.687	1470.079	2151.093

Table 38: Mean Reaction Times and Standard Errors for Visual strategy*Leftt hand*Orientation

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-172.769	62.373	.183	-381.969	36.431
	135°	-375.601(*)	76.053	.001	-630.686	-120.515
	225°	-424.548(*)	81.093	.001	-696.536	-152.560
	270°	-162.471	87.366	1.000	-455.500	130.558
	315°	-85.264	71.998	1.000	-326.749	156.221
90°	45°	172.769	62.373	.183	-36.431	381.969
	135°	-202.832	81.244	.328	-475.328	69.664
	225°	-251.779	101.383	.338	-591.821	88.263
	270°	10.298	114.019	1.000	-372.127	392.723
	315°	87.505	80.338	1.000	-181.950	356.961
135°	45°	375.601(*)	76.053	.001	120.515	630.686
	90°	202.832	81.244	.328	-69.664	475.328
	225°	-48.947	80.322	1.000	-318.350	220.456
	270°	213.130	88.711	.400	-84.411	510.670
	315°	290.337(*)	79.098	.024	25.040	555.635
225°	45°	424.548(*)	81.093	.001	152.560	696.536
	90°	251.779	101.383	.338	-88.263	591.821
	135°	48.947	80.322	1.000	-220.456	318.350
	270°	262.077(*)	58.893	.004	64.548	459.606
	315°	339.284(*)	85.455	.012	52.664	625.905
270°	45°	162.471	87.366	1.000	-130.558	455.500
	90°	-10.298	114.019	1.000	-392.723	372.127
	135°	-213.130	88.711	.400	-510.670	84.411
	225°	-262.077(*)	58.893	.004	-459.606	-64.548
	315°	77.207	88.786	1.000	-220.583	374.997
315°	45°	85.264	71.998	1.000	-156.221	326.749
	90°	-87.505	80.338	1.000	-356.961	181.950
	135°	-290.337(*)	79.098	.024	-555.635	-25.040
	225°	-339.284(*)	85.455	.012	-625.905	-52.664
	270°	-77.207	88.786	1.000	-374.997	220.583

Table 39: Pairwise Comparisons for Visual strategy*Left hand*Orientation

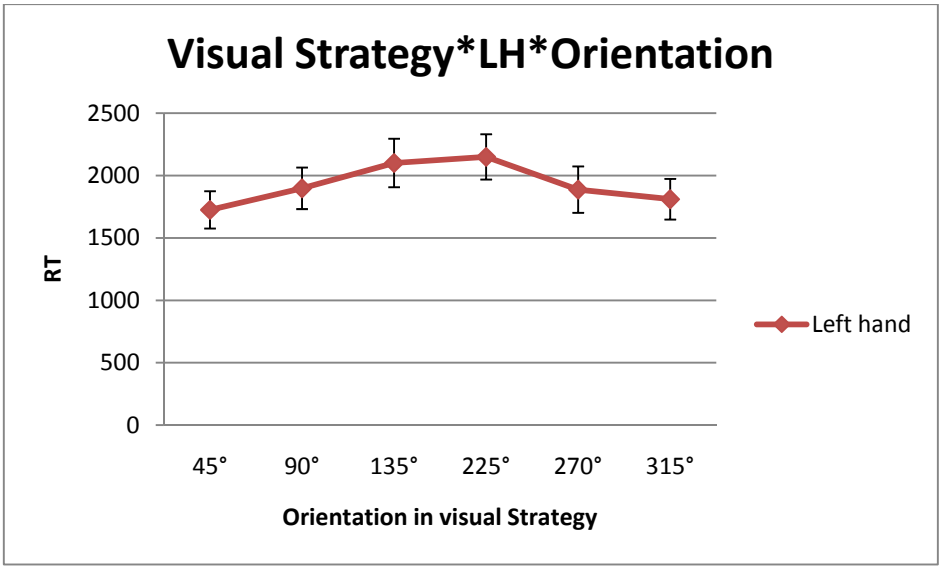

Figure 25: Mean Reaction Times and Standard Errors for Visual strategy*Leftt hand*Orientation

Post hoc analysis on Strategy *Hand *Orientation interaction

A further post hoc analysis performed on Strategy *Hand *Orientation interaction, in order to better clarified the direction of the interaction.

Motor Strategy*hand at 135°

The ANOVA performed for the motor and the visual strategy with each Orientation separately showed that for the motor strategy, the effect of laterality (Right hand vs. Left hand) was significant at 135° (F (1,19)=14,875, p < .001), with significantly longer RTs for the Right than for the Left hand. . See details in Table 40 and 41. Mean Reaction Times and Standard Errors are represented in Fig. 26

Motor Strategy*hand at 135°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2543.883	89.638	2362.574	2725.193
Left	2262.312	78.246	2104.044	2420.580

Table 40: Mean Reaction Times and Standard Errors for Motor Strategy*hand at 135°

(I) Motor Strategy*hand at 135°	(J) Motor Strategy*hand at 135°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	281.571(*)	73.007	.000	133.900	429.242
Left	Right	-281.571(*)	73.007	.000	-429.242	-133.900

Table 41: Pairwise Comparisons for Motor Strategy*hand at 135°

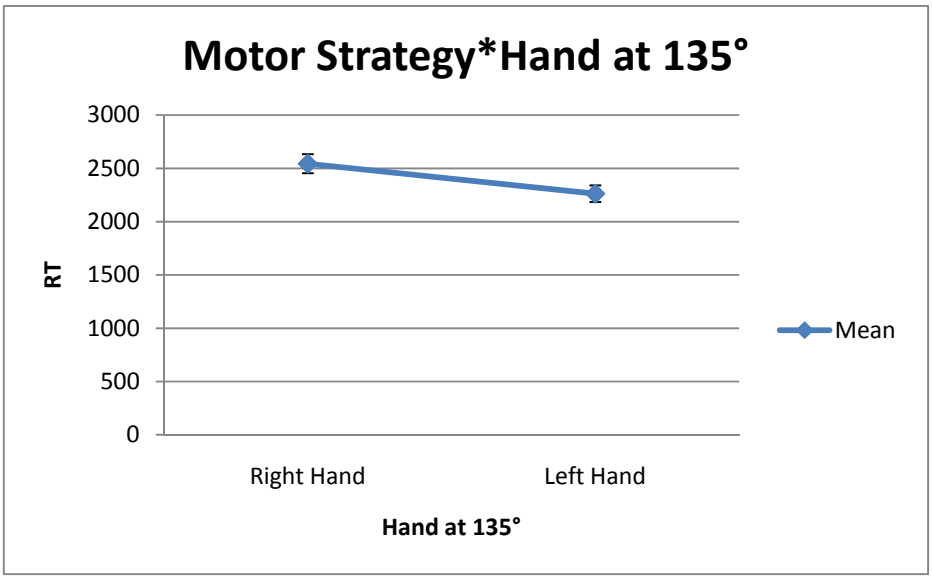

Figure 26: Mean Reaction Times and Standard Errors for Motor Strategy*hand at 135°

Motor Strategy*hand at 225°

Likewise the effect of laterality (Right hand vs. Left hand) was significant at 225° (F (1, 19) =9.396, p =.004, with significantly longer RTs for the Right than for the Left hand. See details in Table 42 and 43. Mean Reaction Times and Standard Errors are represented in Fig. 27

Motor Strategy*hand at 225°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2309.586	79.994	2147.784	2471.389
Left	2066.023	106.981	1849.634	2282.412

Table 42: Mean Reaction Times and Standard Errors for Motor Strategy*hand at 225°

(I) Motor Strategy*hand at 135°	(J) Motor Strategy*hand at 135°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	243.563(*)	79.459	.004	82.842	404.285
Left	Right	-243.563(*)	79.459	.004	-404.285	-82.842

Table 43: Pairwise Comparisons for Motor Strategy*hand at 225°

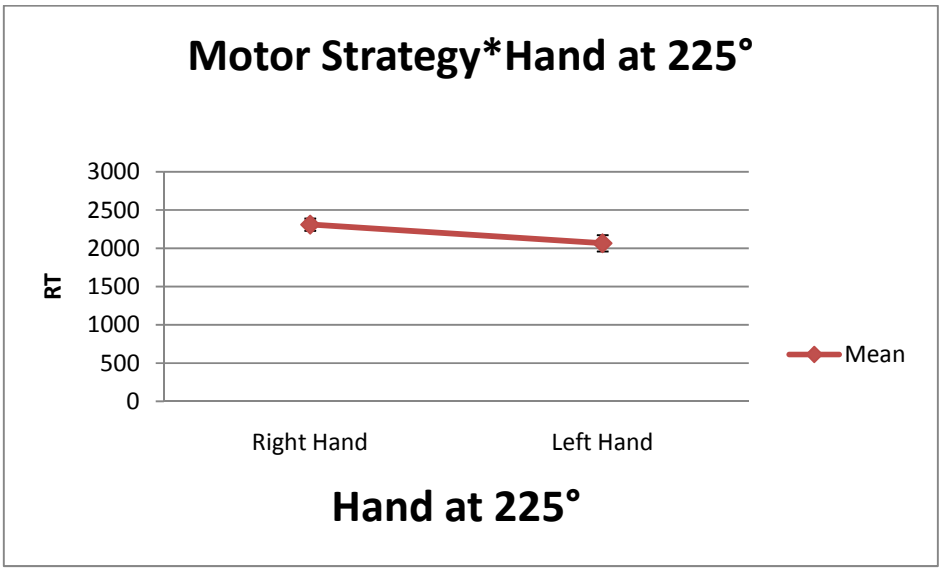

Figure 27: Mean Reaction Times and Standard Errors for Motor Strategy*hand at 225°

Motor Strategy*hand at 270°

Eventually, in the same manner, the effect of laterality (Right hand vs. Left hand) was significant at 270° (F (1, 19) =4.53, p =.04, with significantly longer RTs for the Right than for the Left hand. See details in Table 44 and 45. Mean Reaction Times and Standard Errors are represented in Fig. 28

Motor Strategy*hand at 270°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2168.320	75.175	2016.264	2320.375
Left	1993.725	113.629	1763.888	2223.562

Table 44: Mean Reaction Times and Standard Errors for Motor Strategy*hand at 270°

(I) Motor Strategy*hand at 270°	(J) Motor Strategy*hand at 270°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	174.595(*)	81.995	.040	8.744	340.445
Left	Right	-174.595(*)	81.995	.040	-340.445	-8.744

Table 45: Pairwise Comparisons for Motor Strategy*hand at 270°

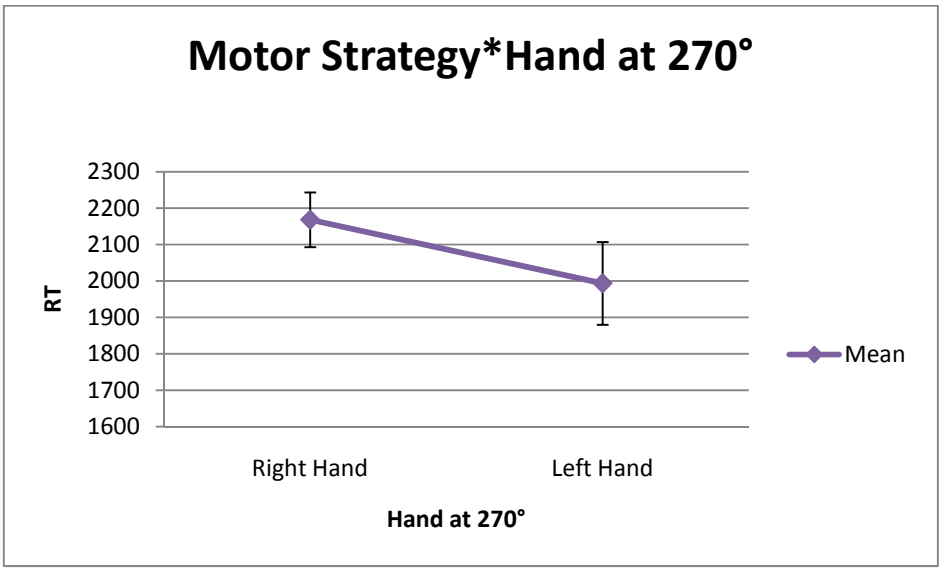

Figure 28: Mean Reaction Times and Standard Errors for Motor Strategy*hand at 270°

Motor Strategy*hand at 45°

By contrast, the effect of laterality was not significant for all the other orientations: at 45° (F (1, 19) =0.400, p > .05, n.s.) See details in Table 46 and 47.

Motor Strategy*hand at 45°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2002.885	102.298	1788.772	2216.997
Left	1967.183	85.039	1789.194	2145.171

Table 46: Mean Reaction Times and Standard Errors for Motor Strategy*hand at 45°

(I) Motor Strategy*hand at 45°	(J Motor Strategy*hand at 45°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	35.702	56.431	.534	-82.411	153.814
Left	Right	-35.702	56.431	.534	-153.814	82.411

Table 47: Pairwise Comparisons for Motor Strategy*hand at 45°

Motor Strategy*hand at 90°

Additionally the effect of laterality was not significant at 90° (F (1, 19) =4.086, p = .058, n.s. See details in Table 48 and 49.

Motor Strategy*hand at 90°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2312.026	107.830	2086.336	2537.716
Left	2132.119	121.211	1878.422	2385.817

Table 48: Mean Reaction Times and Standard Errors for Motor Strategy*hand at 90°

(I)Motor Strategy*hand at 90°	(J)Motor Strategy*hand at 90°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	179.907	89.004	.058	-6.381	366.195
Left	Right	-179.907	89.004	.058	-366.195	6.381

Table 49: Pairwise Comparisons for Motor Strategy*hand at 90°

Motor Strategy*hand at 315°

Lastly, the effect of laterality was not significant at 315° :(F (1, 19) =0.000, p > .05, n.s. See details in Table 50 and 51.

Motor Strategy*hand at 315°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2161.331	75.341	2008.940	2313.721
Left	2162.232	79.868	2000.684	2323.780

Table 50: Mean Reaction Times and Standard Errors for Motor Strategy*hand at 315°

(I)Motor Strategy*hand at 315°	(J)Motor Strategy*hand at 315°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	-.901	68.145	.990	-138.737	136.934
Left	Right	.901	68.145	.990	-136.934	138.737

Table 51: Pairwise Comparisons for Motor Strategy*hand at 315°

Visual Strategy *Hand *Orientation

The ANOVA performed for the visual strategy with each Orientation separately.

Visual Strategy*hand at 45°

The result showed that the effect of laterality (Right hand vs. Left hand) was significant at 45° ($F(1, 19) = 6{,}411$, $p < .05$, with longer RTs for the Right than for the Left hand. See details in Table 52 and 53. Mean Reaction Times and Standard Errors are represented in Fig. 29

Visual Strategy*hand at 45°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2058.827	98.882	1858.818	2258.835
Left	1928.721	100.517	1725.406	2132.035

Table 52: Mean Reaction Times and Standard Errors for Visual Strategy*hand at 45°

(I)Visual Strategy*hand at 45°	(J)Visual Strategy*hand at 45°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	130.106(*)	51.386	.015	26.168	234.044
Left	Right	-130.106(*)	51.386	.015	-234.044	-26.168

Table 53: Pairwise Comparisons for Visual Strategy*hand at 45°

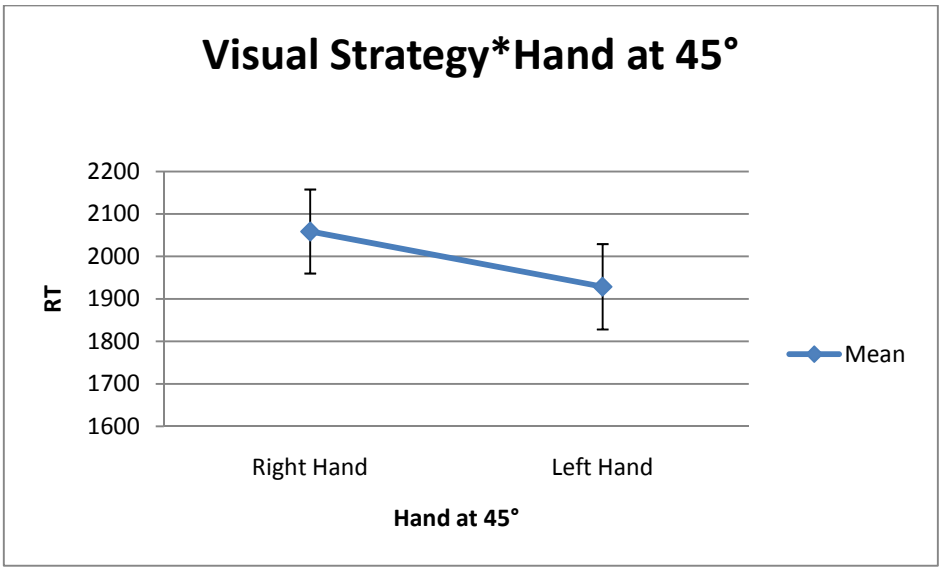

Figure 29: Mean Reaction Times and Standard Errors for Visual Strategy*hand at 45°

Visual Strategy*hand at 135°

Likewise, the effect of laterality (Right hand vs. Left hand) was significant at 135° (F (1, 19) =10,072, p =.003, with longer RTs for the Right than for the Left hand. See details in Table 54 and 55. Mean Reaction Times and Standard Errors are represented in Fig. 30

(I) Visual Strategy*hand at 135°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2316.787	91.638	2131.431	2502.142
Left	2116.521	112.946	1888.067	2344.975

Table 54: Mean Reaction Times and Standard Errors for Visual Strategy*hand at 135°

(I) Visual Strategy*hand at 135°	(J) Visual Strategy*hand at 135°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	200.265(*)	63.102	.003	72.629	327.902
Left	Right	-200.265(*)	63.102	.003	-327.902	-72.629

Table 55: Pairwise Comparisons for Visual Strategy*hand at 135°

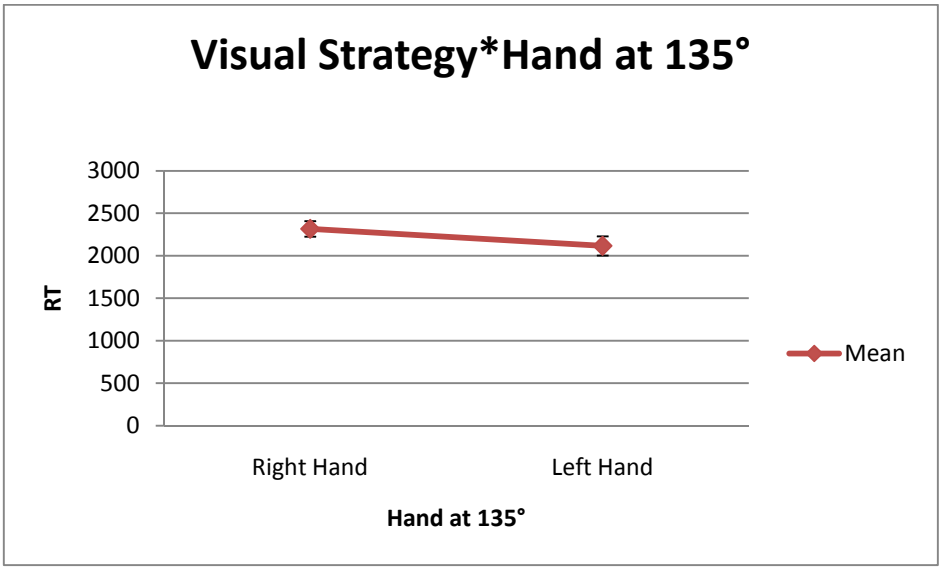

Figure 30: Mean Reaction Times and Standard Errors for Visual Strategy*hand at 135°

Visual Strategy*hand at 90°

By contrast, the effect of laterality was not significant for all the other orientations: at 90° (F (1, 19) =2.34, p >.05, n.s. see details in table 56 and 57

(I) Visual Strategy*hand at 90°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2123.716	97.655	1926.189	2321.242
Left	2015.105	103.298	1806.165	2224.045

Table 56: Mean Reaction Times and Standard Errors for Visual Strategy*hand at 90°

(I) Visual Strategy*hand at 90°	(J) Visual Strategy*hand at 90°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	108.610	70.881	.134	-34.760	251.981
Left	Right	-108.610	70.881	.134	-251.981	34.760

Table 57: Pairwise Comparisons for Visual Strategy*hand at 90°

Visual Strategy*hand at 225°

In addition, the effect of laterality was not significant at 225° (F (1, 19) =0.054, p > .05, n.s.See details in table 58 and 59

Visual Strategy*hand at 225°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2155.976	105.881	1941.812	2370.140
Left	2140.995	107.645	1923.261	2358.728

Table 58: Mean Reaction Times and Standard Errors for Visual Strategy*hand at 225°

(I)Visual Strategy*hand at 225°	(J)Visual Strategy*hand at 225°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	14.982	64.551	.818	-115.585	145.549
Left	Right	-14.982	64.551	.818	-145.549	115.585

Table 59: Pairwise Comparisons for Visual Strategy*hand at 225°

Visual Strategy*hand at 270°

Lastly the effect of laterality was not significant at 270° (F (1, 19) =1.85 p > .05, n.s., See details in table 60 and 61

Visual Strategy*hand at 270°	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2083.678	114.065	1852.959	2314.397
Left	2009.956	111.243	1784.947	2234.966

Table 60: Mean Reaction Times and Standard Errors for Visual Strategy*hand at 270°

(I) Visual Strategy*hand at 270°	(J) Visual Strategy*hand at 270°	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	73.722	54.204	.182	-35.915	183.360
Left	Right	-73.722	54.204	.182	-183.360	35.915

Table 61: Pairwise Comparisons for Visual Strategy*hand at 270°

Strategy * hand * Orientation * position

We found a significant four-way strategy * hand * Orientation * position interaction F (10,190) = 2.52, p=.007).

Post hoc analysis on Strategy * hand * Orientation * position

Post hoc analysis was performed on the Motor and the Visual strategy separately.

Motor strategy

For the motor strategy, we found a significant main effect of Orientation (F (5, 95) =23.52, p <.001, Hand *Orientation (F (5, 95) =23.52, p < .001) and hand * Orientation* position integrations (F (10,190) =2.43, p < .01).

Visual strategy

For the visual strategy, we found a significant main effect of Orientation (F (5, 95) =16.2, p <.001, and a Hand *Orientation (F (5, 95) =2.69, p < .05) interaction.

Motor strategy*Right hand* Orientation * position

A further ANOVA was performed on Right hand and Left hand separately, for the motor and the visual strategy respectively. For the motor strategy, right hand, results showed a significant main effect of Orientation (F (5, 95) =19.78, p <. 001), and a significant Orientation* Position interaction (F (10,190) =2.22, p < .05). See details in Table 62 .Mean Reaction Times and Standard Errors are represented in Fig. 31

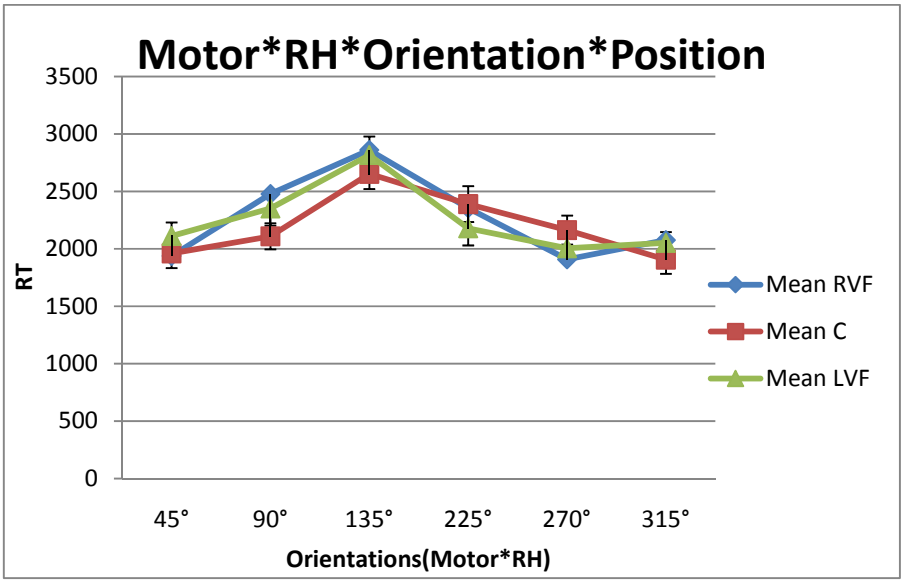

Figure 31: Mean Reaction Times and Standard Errors for Motor strategy*Right hand* Orientation * position

Orientation	position	Mean	Std. Error	95% Confidence Interval	95% Confidence Interval
				Lower Bound	Upper Bound
45°	RVF	1937.712	102.019	1724.185	2151.240
	C	1959.677	128.181	1691.390	2227.964
	LVF	2111.264	117.999	1864.290	2358.238
90°	RVF	2476.835	102.892	2261.480	2692.191
	C	2108.767	113.340	1871.543	2345.990
	LVF	2350.476	149.713	2037.122	2663.830
135°	RVF	2859.657	154.807	2535.642	3183.673
	C	2651.344	130.901	2377.365	2925.323
	LVF	2816.221	160.386	2480.529	3151.913
225°	RVF	2354.142	129.174	2083.777	2624.507
	C	2389.119	156.378	2061.817	2716.422
	LVF	2178.178	149.253	1865.788	2490.568
270°	RVF	1907.515	146.095	1601.735	2213.295
	C	2162.583	126.507	1897.800	2427.366
	LVF	2003.742	92.228	1810.707	2196.778
315°	RVF	2075.699	131.743	1799.958	2351.440
	C	1904.872	123.539	1646.303	2163.442
	LVF	2051.334	93.937	1854.722	2247.946

Table 62: Mean Reaction Times and Standard Errors for Motor strategy*Right hand* Orientation * position

Motor strategy*Left hand* Orientation * position

For the Motor Strategy, left hand, results showed a significant main effect of Orientation ($F(5, 95) = 12.69$, $p < .001$), and a significant Orientation* position interaction ($F(10,190) = 2.3$, $p < .05$). See details in Table 63 .Mean Reaction Times and Standard Errors are represented in Fig. 32

Orientation	position	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
45°	RVF	2049.770	106.156	1826.745	2272.795
	C	1916.167	108.170	1688.911	2143.423
	LVF	1820.777	89.937	1631.826	2009.728
90°	RVF	2100.050	144.743	1795.955	2404.144
	C	2036.639	128.892	1765.846	2307.431
	LVF	2178.463	146.728	1870.199	2486.728
135°	RVF	2283.937	113.794	2044.865	2523.009
	C	2505.321	139.698	2211.827	2798.816
	LVF	2362.386	123.444	2103.040	2621.733
225°	RVF	2727.311	150.924	2410.232	3044.390
	C	2596.721	171.586	2236.233	2957.209
	LVF	2791.773	141.328	2494.854	3088.693
270°	RVF	2380.553	178.765	2004.981	2756.125
	C	2430.920	179.566	2053.666	2808.174
	LVF	2391.638	149.696	2077.139	2706.137
315°	RVF	2345.992	106.070	2123.146	2568.837
	C	2182.363	137.264	1893.981	2470.745
	LVF	1947.518	110.958	1714.403	2180.632

Table 63: Mean Reaction Times and Standard Errors for Motor strategy*Left hand* Orientation * position

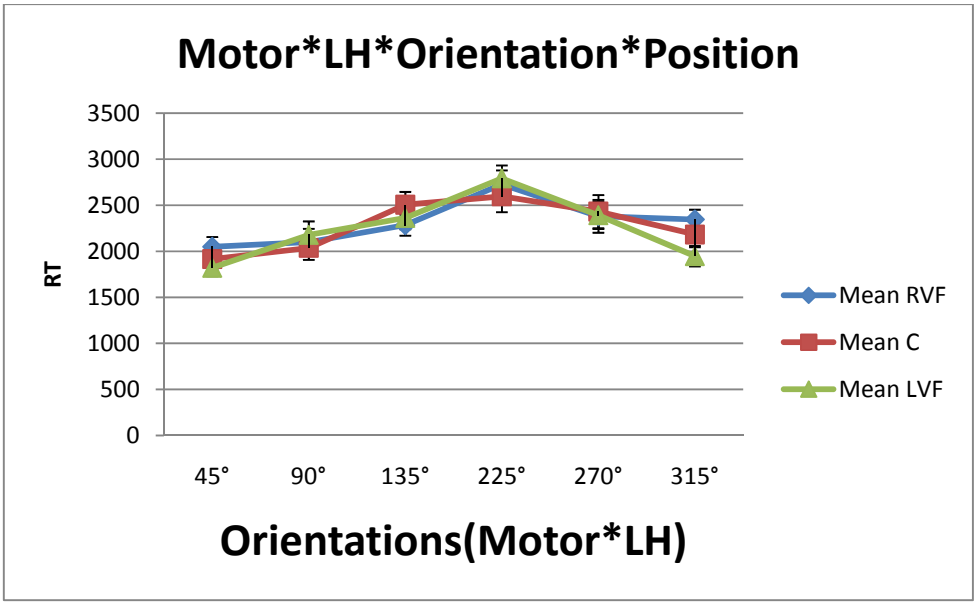

Figure 32: Mean Reaction Times and Standard Errors for Motor strategy*Left hand* Orientation * position

Visual strategy*Right hand* Orientation * position

For the visual strategy, both for the right and the left hands, results showed a significant main effect of Orientation only (F (5, 95) =12.54, p <. 001 and F (5, 95) =7.82, p <. 001 respectively). See details in Table 64 .Mean Reaction Times and Standard Errors are represented in Fig. 33

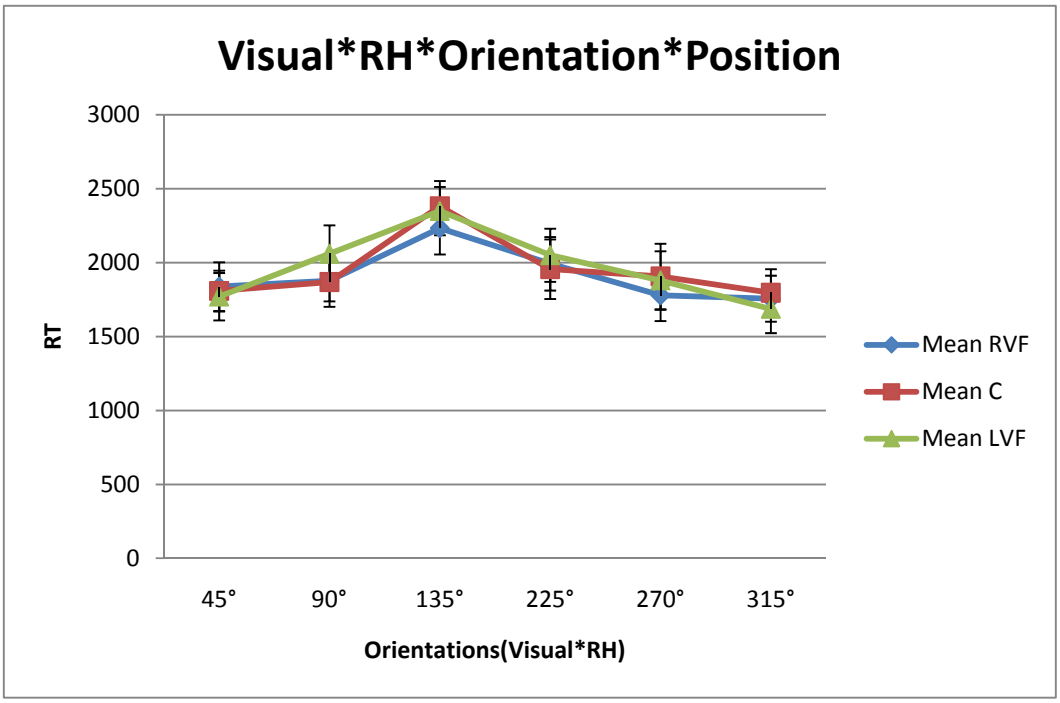

Figure 33: Mean Reaction Times and Standard Errors for Visual strategy*Right hand* Orientation * positio

Orientation	position	Mean	Std. Error	95% Confidence Interval	95% Confidence Interval
				Lower Bound	Upper Bound
45°	RVF	1838.158	164.937	1492.940	2183.375
	C	1808.397	138.046	1519.462	2097.331
	LVF	1770.328	160.467	1434.467	2106.189
90°	RVF	1876.892	138.269	1587.491	2166.293
	C	1868.996	167.209	1519.023	2218.969
	LVF	2060.327	192.576	1657.261	2463.394
135°	RVF	2233.325	177.890	1860.997	2605.653
	C	2381.828	171.416	2023.049	2740.606
	LVF	2349.489	163.379	2007.532	2691.446
225°	RVF	1992.936	181.200	1613.679	2372.192
	C	1956.206	201.298	1534.886	2377.527
	LVF	2050.638	179.817	1674.277	2426.999
270°	RVF	1779.201	173.396	1416.279	2142.122
	C	1907.203	221.603	1443.384	2371.023
	LVF	1879.588	198.263	1464.619	2294.557
315°	RVF	1756.578	155.771	1430.544	2082.611
	C	1795.940	160.072	1460.904	2130.975
	LVF	1687.275	163.512	1345.039	2029.510

Table 64: Mean Reaction Times and Standard Errors for Visual strategy*Right hand* Orientation * position

Visual strategy*Left hand* Orientation * position

Orientation	position	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
45°	RVF	1837.503	177.757	1465.453	2209.554
	C	1579.353	141.398	1283.403	1875.302
	LVF	1759.111	167.836	1407.827	2110.395
90°	RVF	1908.838	178.947	1534.298	2283.378
	C	1847.526	179.710	1471.390	2223.663
	LVF	1937.909	171.091	1579.811	2296.007
135°	RVF	2100.835	183.676	1716.397	2485.273
	C	2089.495	211.285	1647.269	2531.720
	LVF	2112.439	206.203	1680.852	2544.026
225°	RVF	2207.691	202.041	1784.815	2630.568
	C	2173.677	194.087	1767.447	2579.906
	LVF	2068.243	184.753	1681.550	2454.935
270°	RVF	1851.875	174.544	1486.550	2217.200
	C	1933.553	215.042	1483.466	2383.641
	LVF	1877.951	200.967	1457.322	2298.581
315°	RVF	1931.188	185.511	1542.910	2319.467
	C	1705.560	160.607	1369.405	2041.714
	LVF	1795.010	172.317	1434.345	2155.674

Table 65: Mean Reaction Times and Standard Errors for Visual strategy*Left hand* Orientation * position

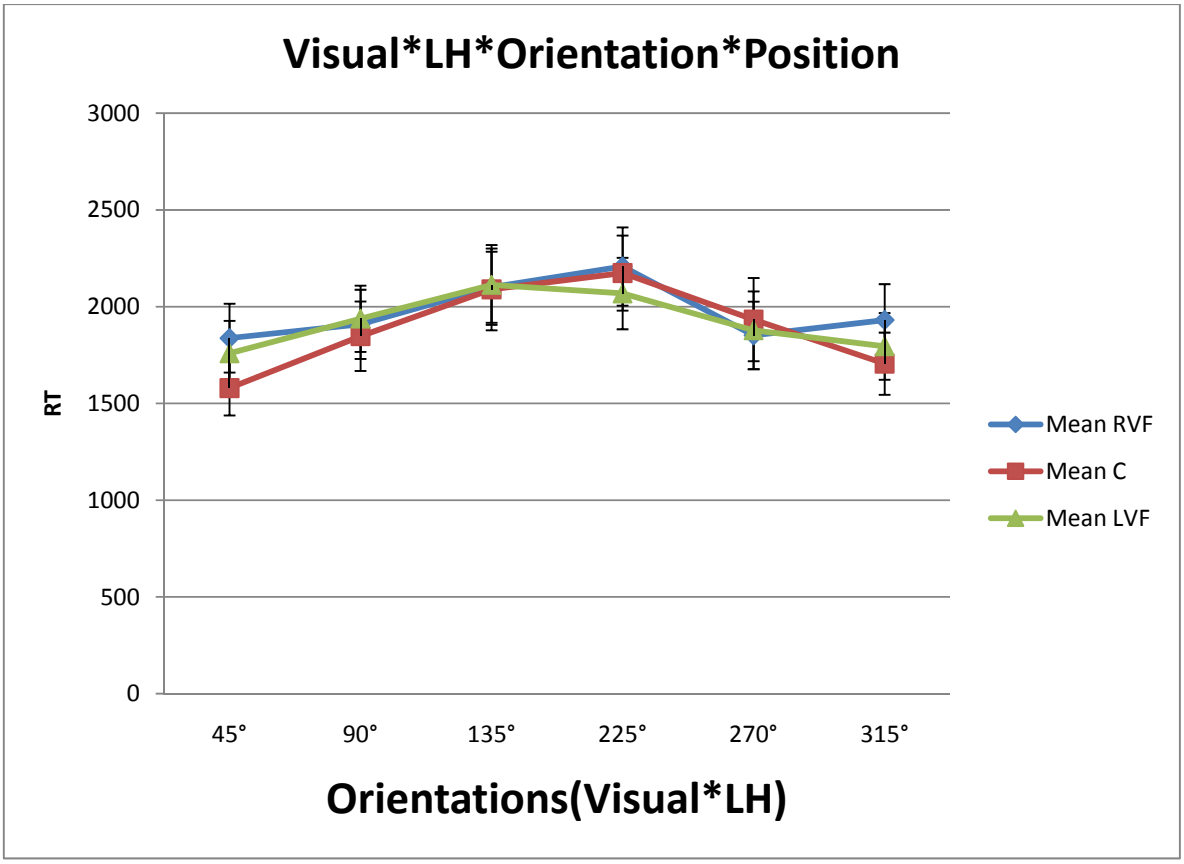

Figure 34: Mean Reaction Times and Standard Errors for Visual strategy*Left hand* Orientation * position

*Motor*RH*Orientation*RVF*

A further ANOVA was performed on for each hand and for each stimulus position separately, for motor and visual strategy respectively. For the motor strategy, right hand and RVF, the effect of Orientation was significant (F (5, 95) =16.54, p<.000).The stimulus orientation at 90° had significantly longer response time (90°=2476.8±102.8ms) than 45° and 270° [(45°=1937.7±102ms, p= 0.000) ;(270°=1907.5±146 ms, p=0.000)].

The stimulus orientation at 135° had a longer response time (135°=2859.6±154.8ms) than other orientations and the calculated mean was significantly higher than all the orientation except 90°[(45°=1937.7±102, p=0.000); (225°=2354.1±129.1, p=0.036); (270°=1907.5 ±146, p=0.000) ;(315°=2075.6±131.7, p=0.006)].The stimulus orientation at 225° had significantly longer response time (225°=2354.1±129.1) than 45° and 270°°[(45°=1937.7±102, p=0.037) ;(

270°=1907.5 ±146, p=0.006)]. See details in Table 66 and 67 .Mean Reaction Times and Standard Errors are represented in Fig. 35

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1937.712	102.019	1724.185	2151.240
90°	2476.835	102.892	2261.480	2692.191
135°	2859.657	154.807	2535.642	3183.673
225°	2354.142	129.174	2083.777	2624.507
270°	1907.515	146.095	1601.735	2213.295
315°	2075.699	131.743	1799.958	2351.440

Table 66: Mean Reaction Times and Standard Errors for Motor*RH*Orientation*RVF

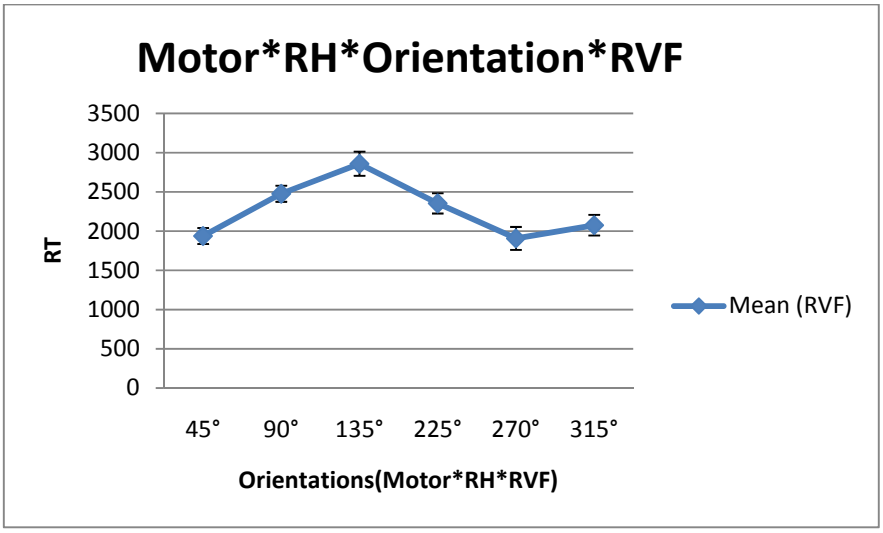

Figure 35: Mean Reaction Times and Standard Errors for Motor*RH*Orientation*RVF

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-539.123(*)	86.486	.000	-829.202	-249.044
	135°	-921.945(*)	147.918	.000	-1418.067	-425.823
	225°	-416.429(*)	119.520	.037	-817.304	-15.555
	270°	30.198	103.634	1.000	-317.395	377.790
	315°	-137.987	133.291	1.000	-585.050	309.077
90°	45°	539.123(*)	86.486	.000	249.044	829.202
	135°	-382.822	134.075	.152	-832.516	66.872
	225°	122.694	106.685	1.000	-235.132	480.520
	270°	569.320(*)	89.879	.000	267.864	870.777
	315°	401.136	120.577	.053	-3.284	805.556
135°	45°	921.945(*)	147.918	.000	425.823	1418.067
	90°	382.822	134.075	.152	-66.872	832.516
	225°	505.516(*)	144.414	.036	21.145	989.886
	270°	952.143(*)	125.497	.000	531.222	1373.063
	315°	783.958(*)	183.949	.006	166.987	1400.930
225°	45°	416.429(*)	119.520	.037	15.555	817.304
	90°	-122.694	106.685	1.000	-480.520	235.132
	135°	-505.516(*)	144.414	.036	-989.886	-21.145
	270°	446.627(*)	104.479	.006	96.202	797.051
	315°	278.443	134.805	.792	-173.698	730.583
270°	45°	-30.198	103.634	1.000	-377.790	317.395
	90°	-569.320(*)	89.879	.000	-870.777	-267.864
	135°	-952.143(*)	125.497	.000	-1373.063	-531.222
	225°	-446.627(*)	104.479	.006	-797.051	-96.202
	315°	-168.184	148.026	1.000	-664.669	328.301
315°	45°	137.987	133.291	1.000	-309.077	585.050
	90°	-401.136	120.577	.053	-805.556	3.284
	135°	-783.958(*)	183.949	.006	-1400.930	-166.987
	225°	-278.443	134.805	.792	-730.583	173.698
	270°	168.184	148.026	1.000	-328.301	664.669

Table 67: Pairwise comparison for Motor*RH*Orientation*RVF

*Motor*RH*Orientation*C*

For the motor strategy, right hand and centre, the effect of ORIENTATION was significant (F (5, 95) =7,108, p<.000). The stimulus orientation at 135° had a longer response time (135°=2651.3±130.9ms) than other orientations and the calculated mean was significantly higher than 45° and 315° [(45°=1959.6±128.1, p=0.014); (315°=1904.8±123.5, p=0.006)].The stimulus orientation at 225° had significantly longer response time (225° °=2389.1±156.3ms) than 315° (1904.8±123.5, p=0.006). See details in Table 68and 69 .Mean Reaction Times and Standard Errors are represented in Fig. 36

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1959.677	128.181	1691.390	2227.964
90°	2108.767	113.340	1871.543	2345.990
135°	2651.344	130.901	2377.365	2925.323
225°	2389.119	156.378	2061.817	2716.422
270°	2162.583	126.507	1897.800	2427.366
315°	1904.872	123.539	1646.303	2163.442

Table 68: Mean Reaction Times and Standard Errors for Motor*RH*Orientation*C

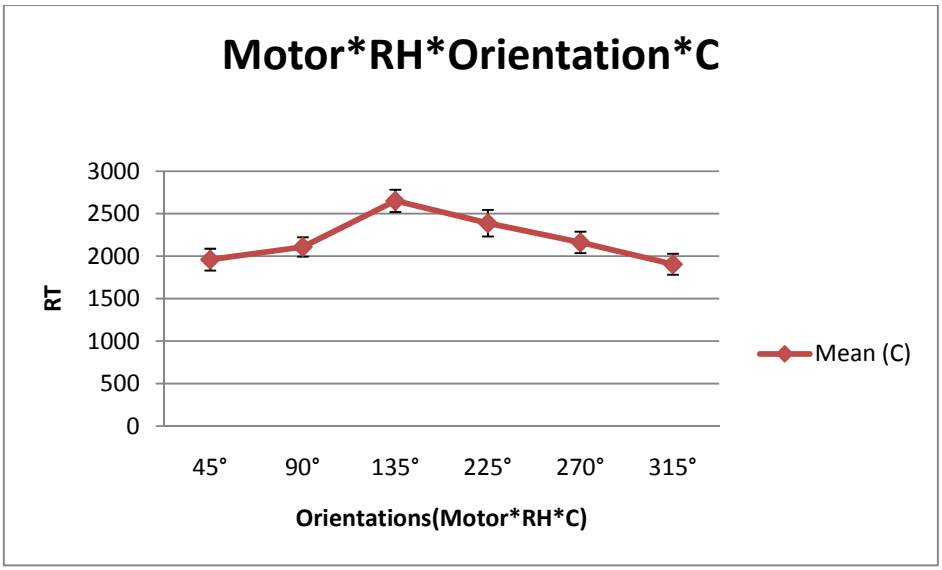

Figure 36: Mean Reaction Times and Standard Errors for Motor*RH*Orientation*C

(I)Orientation	(J)Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-149.090	99.892	1.000	-484.129	185.950
	135°	-691.667(*)	177.011	.014	-1285.368	-97.967
	225°	-429.442	146.959	.131	-922.349	63.465
	270°	-202.906	139.351	1.000	-670.293	264.481
	315°	54.805	81.003	1.000	-216.882	326.491
90°	45°	149.090	99.892	1.000	-185.950	484.129
	135°	-542.578	170.778	.074	-1115.374	30.219
	225°	-280.353	152.411	1.000	-791.546	230.841
	270°	-53.816	148.891	1.000	-553.200	445.568
	315°	203.894	117.601	1.000	-190.543	598.331
135°	45°	691.667(*)	177.011	.014	97.967	1285.368
	90°	542.578	170.778	.074	-30.219	1115.374
	225°	262.225	203.761	1.000	-421.197	945.647
	270°	488.761	155.200	.079	-31.784	1009.306
	315°	746.472(*)	173.095	.006	165.903	1327.040
225°	45°	429.442	146.959	.131	-63.465	922.349
	90°	280.353	152.411	1.000	-230.841	791.546
	135°	-262.225	203.761	1.000	-945.647	421.197
	270°	226.536	166.440	1.000	-331.710	784.783
	315°	484.247(*)	112.920	.006	105.508	862.986
270°	45°	202.906	139.351	1.000	-264.481	670.293
	90°	53.816	148.891	1.000	-445.568	553.200
	135°	-488.761	155.200	.079	-1009.306	31.784
	225°	-226.536	166.440	1.000	-784.783	331.710
	315°	257.710	138.690	1.000	-207.460	722.881
315°	45°	-54.805	81.003	1.000	-326.491	216.882
	90°	-203.894	117.601	1.000	-598.331	190.543
	135°	-746.472(*)	173.095	.006	-1327.040	-165.903
	225°	-484.247(*)	112.920	.006	-862.986	-105.508
	270°	-257.710	138.690	1.000	-722.881	207.460

Table 69: Pairwise Comparisons for Motor*RH*Orientation*C

*Motor*RH*Orientation*LVF*

For the motor strategy, right hand and LVF, the effect of ORIENTATION was significant (F(5,95)=9,294, p<.000).The stimulus orientation at 135° had a longer response time (135°=2816.221±160.386ms) than other orientations and the calculated mean was significantly higher than all the Orientation except 90° [(45°=2111.2±117.9, p=0.006);(225°=2178.1±149.2, p=0.020); (270°=2003.7±92.2, p=0.001) ;(315°=2051.3±93.9, p=0.001)]. See details in Table 70 and 71 .Mean Reaction Times and Standard Errors are represented in Fig. 37

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	2111.264	117.999	1864.290	2358.238
90°	2350.476	149.713	2037.122	2663.830
135°	2816.221	160.386	2480.529	3151.913
225°	2178.178	149.253	1865.788	2490.568
270°	2003.742	92.228	1810.707	2196.778
315°	2051.334	93.937	1854.722	2247.946

Table 70: Mean Reaction Times and Standard Errors for Motor*RH*Orientation*LVF

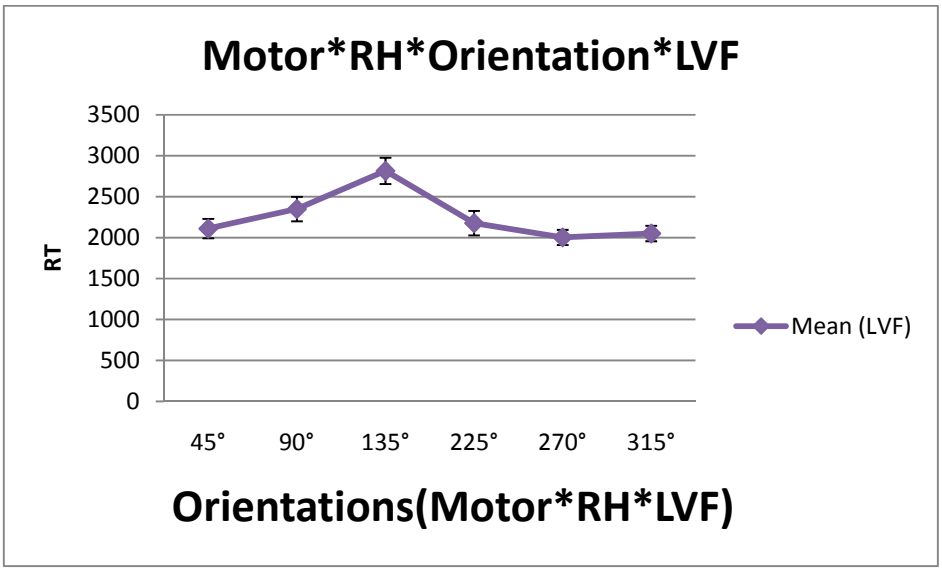

Figure 37: Mean Reaction Times and Standard Errors for Motor*RH*Orientation*LVF

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-239.212	139.279	1.000	-706.357	227.934
	135°	-704.957(*)	163.721	.006	-1254.083	-155.831
	225°	-66.914	97.944	1.000	-395.420	261.592
	270°	107.522	122.624	1.000	-303.765	518.808
	315°	59.930	130.333	1.000	-377.211	497.071
90°	45°	239.212	139.279	1.000	-227.934	706.357
	135°	-465.745	147.839	.079	-961.604	30.113
	225°	172.298	160.657	1.000	-366.552	711.147
	270°	346.733	131.727	.246	-95.084	788.550
	315°	299.142	133.530	.558	-148.723	747.007
135°	45°	704.957(*)	163.721	.006	155.831	1254.083
	90°	465.745	147.839	.079	-30.113	961.604
	225°	638.043(*)	170.020	.020	67.790	1208.296
	270°	812.479(*)	159.184	.001	278.569	1346.388
	315°	764.887(*)	146.249	.001	274.362	1255.412
225°	45°	66.914	97.944	1.000	-261.592	395.420
	90°	-172.298	160.657	1.000	-711.147	366.552
	135°	-638.043(*)	170.020	.020	-1208.296	-67.790
	270°	174.436	116.845	1.000	-217.466	566.338
	315°	126.844	145.450	1.000	-361.000	614.688
270°	45°	-107.522	122.624	1.000	-518.808	303.765
	90°	-346.733	131.727	.246	-788.550	95.084
	135°	-812.479(*)	159.184	.001	-1346.388	-278.569
	225°	-174.436	116.845	1.000	-566.338	217.466
	315°	-47.592	112.877	1.000	-426.186	331.003
315°	45°	-59.930	130.333	1.000	-497.071	377.211
	90°	-299.142	133.530	.558	-747.007	148.723
	135°	-764.887(*)	146.249	.001	-1255.412	-274.362
	225°	-126.844	145.450	1.000	-614.688	361.000
	270°	47.592	112.877	1.000	-331.003	426.186

Table 71: Pairwise Comparisons for Motor*RH*Orientation*LVF

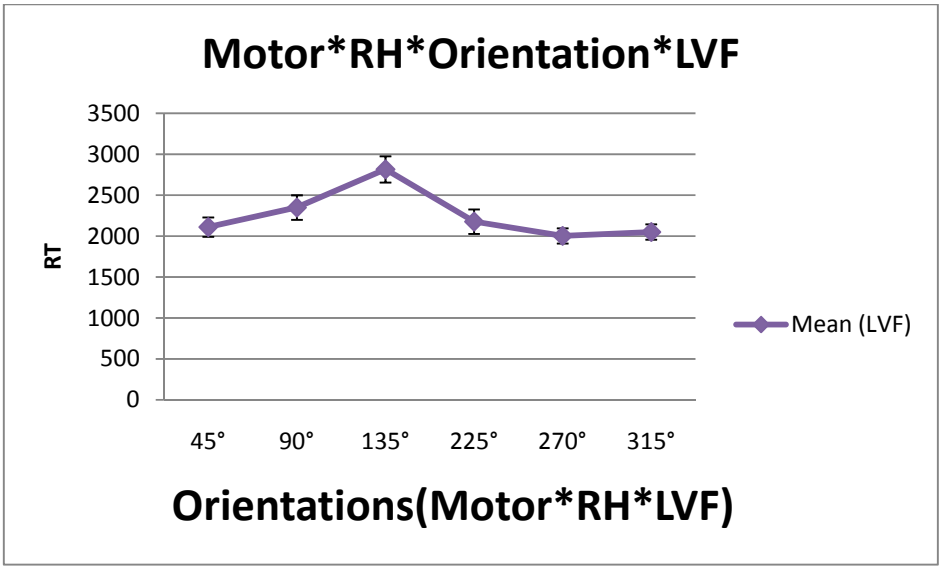

Figure 38: Mean Reaction Times and Standard Errors for Motor*RH*Orientation*LVF

*Motor*LH*Orientation*RVF*

For the motor strategy, LEFT hand and RVF, the effect of ORIENTATION was significant (F (5, 95) =5.15, p<.000).

The stimulus orientation at 225° had a longer response time (225°=2768.607±149.015ms) than other orientations and the calculated mean was significantly higher than all the Orientation except 135° and 270° [(45°=2111.2±117.9, p=0.026) ;(90°=2132±140.9, p=0.024) ;(315°=2339.8±100.8, p=0.030)]. See details in Table 72 and 73 .Mean Reaction Times and Standard Errors are represented in Fig. 38

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	2111.264	117.999	1864.290	2358.238
90°	2132.011	140.986	1836.924	2427.098
135°	2302.130	109.477	2072.993	2531.267
225°	2768.607	149.015	2456.714	3080.499
270°	2439.432	179.522	2063.688	2815.175
315°	2339.814	100.816	2128.802	2550.825

Table 72:Mean Reaction Times and Standard Errors for Motor*LH*Orientation*RV

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-20.747	154.199	1.000	-537.934	496.441
	135°	-190.866	93.207	.820	-503.487	121.755
	225°	-657.343(*)	180.724	.026	-1263.497	-51.188
	270°	-328.168	168.785	1.000	-894.278	237.943
	315°	-228.550	131.805	1.000	-670.627	213.528
90°	45°	20.747	154.199	1.000	-496.441	537.934
	135°	-170.119	141.850	1.000	-645.888	305.650
	225°	-636.596(*)	172.945	.024	-1216.659	-56.532
	270°	-307.421	173.792	1.000	-890.324	275.483
	315°	-207.803	145.937	1.000	-697.282	281.676
135°	45°	190.866	93.207	.820	-121.755	503.487
	90°	170.119	141.850	1.000	-305.650	645.888
	225°	-466.477	169.402	.190	-1034.656	101.703
	270°	-137.302	177.162	1.000	-731.510	456.906
	315°	-37.684	118.418	1.000	-434.861	359.493
225°	45°	657.343(*)	180.724	.026	51.188	1263.497
	90°	636.596(*)	172.945	.024	56.532	1216.659
	135°	466.477	169.402	.190	-101.703	1034.656
	270°	329.175	143.548	.501	-152.291	810.641
	315°	428.793(*)	119.596	.030	27.662	829.924
270°	45°	328.168	168.785	1.000	-237.943	894.278
	90°	307.421	173.792	1.000	-275.483	890.324
	135°	137.302	177.162	1.000	-456.906	731.510
	225°	-329.175	143.548	.501	-810.641	152.291
	315°	99.618	125.954	1.000	-322.837	522.073
315°	45°	228.550	131.805	1.000	-213.528	670.627
	90°	207.803	145.937	1.000	-281.676	697.282
	135°	37.684	118.418	1.000	-359.493	434.861
	225°	-428.793(*)	119.596	.030	-829.924	-27.662
	270°	-99.618	125.954	1.000	-522.073	322.837

Table 73: Pairwise Comparisons for Motor*LH*Orientation*RVF

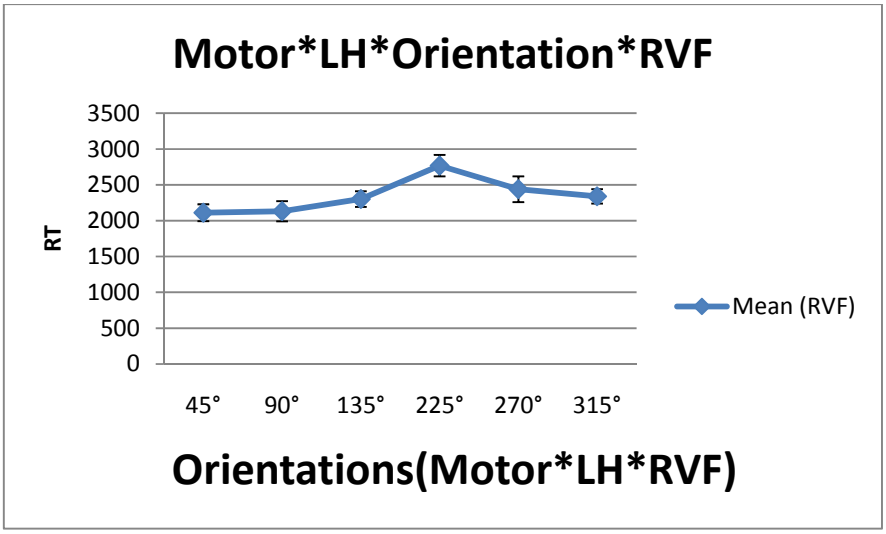

Figure 39:Mean Reaction Times and Standard Errors for Motor*LH*Orientation*RVF

*Motor*LH*Orientation*C*

For the motor strategy, LEFT hand and centre, the effect of ORIENTATION was significant (F(5,95)=7,702, p<.000).The stimulus orientation at 225° had a longer response time (225°=2617.5±164.1 ms) than other orientations and the calculated mean was significantly higher than 45° and 90° [(45°=1958.5±111, p=0.002);(90°=2086.7±132.1, p=0.042)].In the same manner, the stimulus orientation at 135° had significantly longer response time (135°=2518.6±133.2ms ms) than 45° and 90° [(45°=1958.5±111, p=0.002) ;(90°=2086.7±132.1, p=0.008)].Finally, the result showed that the stimulus orientation at 270° had significantly longer response time (270°=2470±174.7ms) than 45° (1958.5±111, p=0.021). See details in Table 74 and 75 .Mean Reaction Times and Standard Errors are represented in Fig. 39

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1958.570	111.034	1726.172	2190.968
90°	2086.733	132.141	1810.158	2363.308
135°	2518.679	133.201	2239.887	2797.471
225°	2617.563	164.109	2274.079	2961.048
270°	2470.030	174.783	2104.205	2835.855
315°	2224.758	136.948	1938.123	2511.392

Table 74:Mean Reaction Times and Standard Errors for Motor*LH*Orientation*C

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-128.163	90.190	1.000	-430.663	174.337
	135°	-560.109(*)	117.273	.002	-953.448	-166.771
	225°	-658.993(*)	139.095	.002	-1125.522	-192.465
	270°	-511.460(*)	137.152	.021	-971.472	-51.448
	315°	-266.188	116.890	.518	-658.240	125.865
90°	45°	128.163	90.190	1.000	-174.337	430.663
	135°	-431.946(*)	104.096	.008	-781.089	-82.803
	225°	-530.830(*)	154.692	.042	-1049.674	-11.987
	270°	-383.297	128.306	.114	-813.639	47.045
	315°	-138.025	111.398	1.000	-511.658	235.609
135°	45°	560.109(*)	117.273	.002	166.771	953.448
	90°	431.946(*)	104.096	.008	82.803	781.089
	225°	-98.884	161.315	1.000	-639.942	442.174
	270°	48.649	148.786	1.000	-450.384	547.682
	315°	293.922	109.685	.222	-73.964	661.808
225°	45°	658.993(*)	139.095	.002	192.465	1125.522
	90°	530.830(*)	154.692	.042	11.987	1049.674
	135°	98.884	161.315	1.000	-442.174	639.942
	270°	147.533	180.946	1.000	-459.366	754.432
	315°	392.806	146.543	.222	-98.703	884.315
270°	45°	511.460(*)	137.152	.021	51.448	971.472
	90°	383.297	128.306	.114	-47.045	813.639
	135°	-48.649	148.786	1.000	-547.682	450.384
	225°	-147.533	180.946	1.000	-754.432	459.366
	315°	245.273	128.418	1.000	-185.447	675.992
315°	45°	266.188	116.890	.518	-125.865	658.240
	90°	138.025	111.398	1.000	-235.609	511.658
	135°	-293.922	109.685	.222	-661.808	73.964
	225°	-392.806	146.543	.222	-884.315	98.703
	270°	-245.273	128.418	1.000	-675.992	185.447

Table 75: Pairwise Comparisons for Motor*LH*Orientation*C

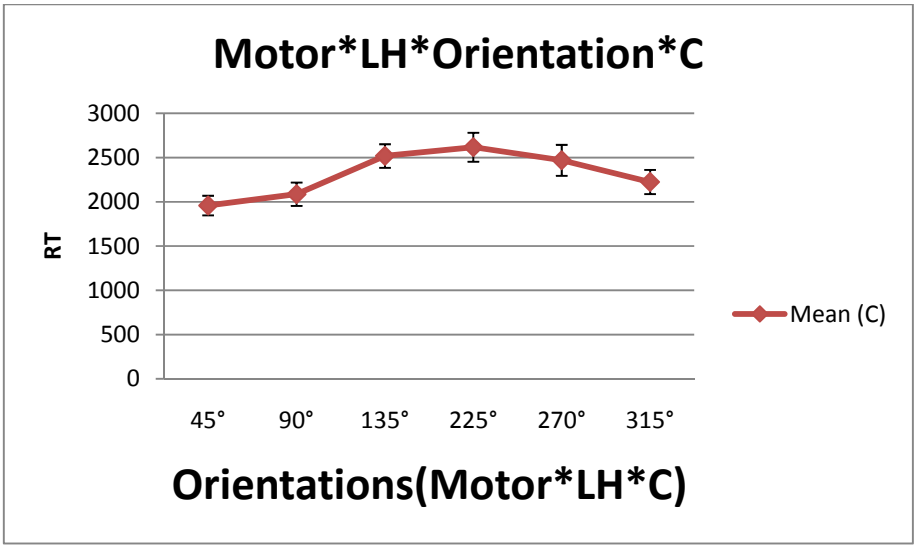

Figure 40: Mean Reaction Times and Standard Errors for Motor*LH*Orientation*C

*Motor*LH*Orientation*LVF*

For the motor strategy, LEFT hand and LVF, the effect of ORIENTATION was significant (F (5, 95) =12, 48, p<.000). The stimulus orientation at 225° had a longer response time (225°=2794.760±134.109 ms) than other orientations and the calculated mean was significantly higher than 45° , 90° and 315° [(45°=1831.7±86, p=0.000);(90°=2177.6±139.2, p=0.018));(315°=2012.4±123.6, p=0.000)].The stimulus orientation at 270° had significantly longer response time (270°=2390.6±142ms) than 45° [(45°=1831.7±86, p=0.001)].In the same manner, the result showed that the stimulus orientation at135° had significantly longer response time (135°=2356.7±117.2ms) than 45° (1831.7±86, p=0.003). See details in Table 76 and 77 .Mean Reaction Times and Standard Errors are represented in Fig. 40

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1831.715	86.020	1651.672	2011.757
90°	2177.614	139.201	1886.262	2468.965
135°	2356.706	117.247	2111.305	2602.107
225°	2794.760	134.109	2514.066	3075.453
270°	2390.661	142.017	2093.416	2687.906
315°	2012.462	123.686	1753.583	2271.340

Table 76: Mean Reaction Times and Standard Errors for Motor*LH*Orientation*LVF

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-345.899	118.303	.131	-742.691	50.893
	135°	-524.991(*)	115.156	.003	-911.229	-138.754
	225°	-963.045(*)	132.673	.000	-1408.035	-518.055
	270°	-558.946(*)	113.577	.001	-939.887	-178.005
	315°	-180.747	97.851	1.000	-508.944	147.450
90°	45°	345.899	118.303	.131	-50.893	742.691
	135°	-179.092	94.376	1.000	-495.632	137.448
	225°	-617.146(*)	161.956	.018	-1160.352	-73.940
	270°	-213.047	167.175	1.000	-773.758	347.664
	315°	165.152	116.516	1.000	-225.648	555.952
135°	45°	524.991(*)	115.156	.003	138.754	911.229
	90°	179.092	94.376	1.000	-137.448	495.632
	225°	-438.054	166.777	.249	-997.431	121.323
	270°	-33.955	164.687	1.000	-586.320	518.410
	315°	344.244	130.366	.242	-93.008	781.496
225°	45°	963.045(*)	132.673	.000	518.055	1408.035
	90°	617.146(*)	161.956	.018	73.940	1160.352
	135°	438.054	166.777	.249	-121.323	997.431
	270°	404.099	136.625	.121	-54.147	862.344
	315°	782.298(*)	134.282	.000	331.910	1232.685
270°	45°	558.946(*)	113.577	.001	178.005	939.887
	90°	213.047	167.175	1.000	-347.664	773.758
	135°	33.955	164.687	1.000	-518.410	586.320
	225°	-404.099	136.625	.121	-862.344	54.147
	315°	378.199	135.833	.177	-77.391	833.789
315°	45°	180.747	97.851	1.000	-147.450	508.944
	90°	-165.152	116.516	1.000	-555.952	225.648
	135°	-344.244	130.366	.242	-781.496	93.008
	225°	-782.298(*)	134.282	.000	-1232.685	-331.910
	270°	-378.199	135.833	.177	-833.789	77.391

Table 77: Pairwise Comparisons for Motor*LH*Orientation*LVF

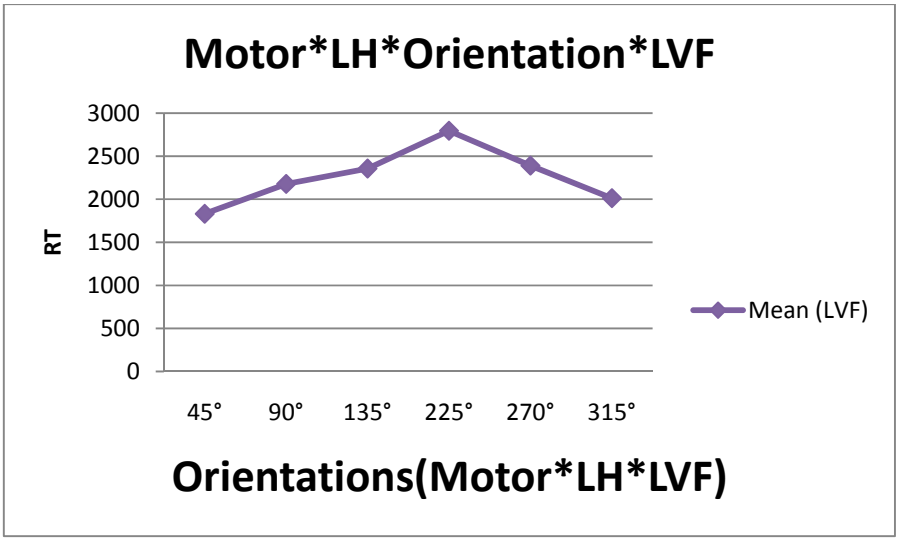

Figure 41: Mean Reaction Times and Standard Errors for Motor*LH*Orientation*LVF

*Visual*RH*Orientation*RVF*

For the Visual strategy, right hand and RVF, the effect of Orientation was significant (F (5, 95) =4.352, p<.001). The stimulus orientation at 135° had a longer response time (135°=2233.3±177.8ms) than other orientations and the calculated mean was significantly higher than 90° and 270° [(90°=1876.8±138.2, p=0.038); (270°=1779.2±173.3, p=0.000)]. See details in Table 78 and 79 .Mean Reaction Times and Standard Errors are represented in Fig. 41

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1838.157	164.937	1492.940	2183.375
90°	1876.892	138.269	1587.491	2166.293
135°	2233.325	177.890	1860.997	2605.653
225°	1992.936	181.200	1613.679	2372.192
270°	1779.201	173.396	1416.279	2142.122
315°	1756.578	155.771	1430.544	2082.611

Table 78: Mean Reaction Times and Standard Errors for Visual*RH*Orientation*RVF

(I) Orientation	(J)Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-38.735	129.620	1.000	-473.485	396.016
	135°	-395.168	136.251	.138	-852.159	61.824
	225°	-154.778	94.971	1.000	-473.314	163.757
	270°	58.957	115.482	1.000	-328.373	446.286
	315°	81.580	119.506	1.000	-319.247	482.407
90°	45°	38.735	129.620	1.000	-396.016	473.485
	135°	356.433(*)	102.669	.038	-700.789	-12.076
	225°	-116.044	122.989	1.000	-528.553	296.466
	270°	97.691	99.218	1.000	-235.090	430.472
	315°	120.315	131.879	1.000	-322.011	562.640
135°	45°	395.168	136.251	.138	-61.824	852.159
	90°	356.433(*)	102.669	.038	12.076	700.789
	225°	240.389	145.766	1.000	-248.514	729.293
	270°	454.124(*)	82.426	.000	177.664	730.584
	315°	476.747	148.448	.069	-21.151	974.646
225°	45°	154.778	94.971	1.000	-163.757	473.314
	90°	116.044	122.989	1.000	-296.466	528.553
	135°	-240.389	145.766	1.000	-729.293	248.514
	270°	213.735	111.243	1.000	-159.378	586.848
	315°	236.358	138.120	1.000	-226.903	699.619
270°	45°	-58.957	115.482	1.000	-446.286	328.373
	90°	-97.691	99.218	1.000	-430.472	235.090
	135°	454.124(*)	82.426	.000	-730.584	-177.664
	225°	-213.735	111.243	1.000	-586.848	159.378
	315°	22.623	108.388	1.000	-340.915	386.161
315°	45°	-81.580	119.506	1.000	-482.407	319.247
	90°	-120.315	131.879	1.000	-562.640	322.011
	135°	-476.747	148.448	.069	-974.646	21.151
	225°	-236.358	138.120	1.000	-699.619	226.903
	270°	-22.623	108.388	1.000	-386.161	340.915

Table 79: Pairwise Comparisons for Visual*RH*Orientation*RVF

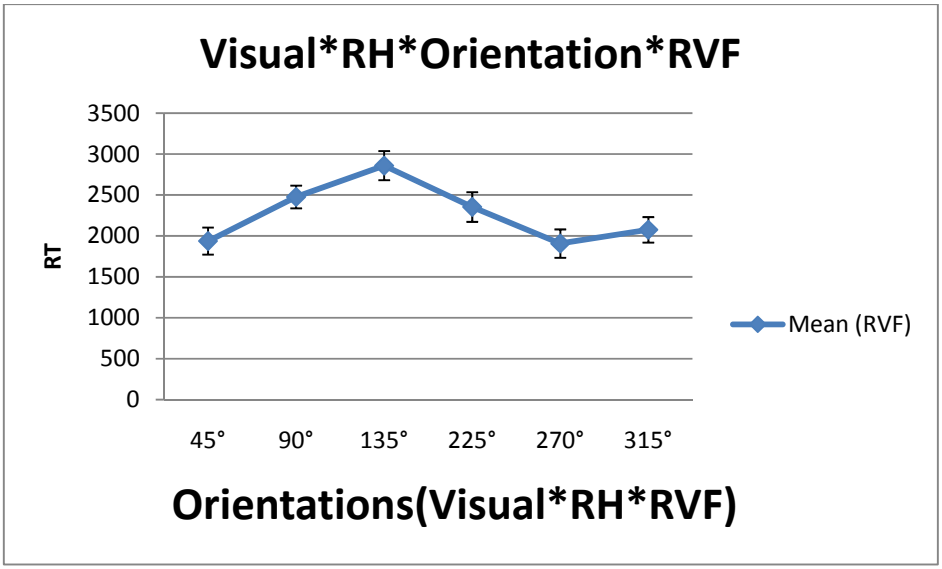

Figure 42: Mean Reaction Times and Standard Errors for Visual*RH*Orientation*RVF

*Visual*RH*Orientation*C*

For the Visual strategy, right hand and Center, the effect of Orientation was significant (F (5, 95) =6.762, p<.000).

The stimulus orientation at 135° had a longer response time (135°=2381.828±171.416ms) than other orientations and the calculated mean was significantly higher than 45°,90° and315° [(45°=1808.3±138,p=0.000)(90°=1868.9±167.2,p=0.016); (315°=1795.9±160, p=0.002)]. See details in Table 80 and 81 .Mean Reaction Times and Standard Errors are represented in Fig. 42

			95% Confidence Interval	
Orientation	Mean	Std. Error	Lower Bound	Upper Bound
45°	1808.397	138.046	1519.462	2097.331
90°	1868.996	167.209	1519.023	2218.969
135°	2381.828	171.416	2023.049	2740.606
225°	1956.206	201.298	1534.886	2377.527
270°	1907.203	221.603	1443.384	2371.023
315°	1795.940	160.072	1460.904	2130.975

Table 80: Mean Reaction Times and Standard Errors for Visual*RH*Orientation*C

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-60.599	87.385	1.000	-353.692	232.494
	135°	-573.431(*)	106.149	.000	-929.459	-217.403
	225°	-147.810	126.283	1.000	-571.368	275.749
	270°	-98.807	136.782	1.000	-557.580	359.966
	315°	12.457	75.058	1.000	-239.291	264.205
90°	45°	60.599	87.385	1.000	-232.494	353.692
	135°	-512.832(*)	132.811	.016	-958.283	-67.380
	225°	-87.210	129.411	1.000	-521.258	346.837
	270°	-38.208	111.716	1.000	-412.906	336.491
	315°	73.056	86.660	1.000	-217.605	363.718
135°	45°	573.431(*)	106.149	.000	217.403	929.459
	90°	512.832(*)	132.811	.016	67.380	958.283
	225°	425.621	147.704	.143	-69.782	921.025
	270°	474.624	159.987	.119	-61.979	1011.228
	315°	585.888(*)	123.421	.002	171.931	999.845
225°	45°	147.810	126.283	1.000	-275.749	571.368
	90°	87.210	129.411	1.000	-346.837	521.258
	135°	-425.621	147.704	.143	-921.025	69.782
	270°	49.003	110.973	1.000	-323.205	421.211
	315°	160.267	104.678	1.000	-190.827	511.360
270°	45°	98.807	136.782	1.000	-359.966	557.580
	90°	38.208	111.716	1.000	-336.491	412.906
	135°	-474.624	159.987	.119	-1011.228	61.979
	225°	-49.003	110.973	1.000	-421.211	323.205
	315°	111.264	110.765	1.000	-260.247	482.775
315°	45°	-12.457	75.058	1.000	-264.205	239.291
	90°	-73.056	86.660	1.000	-363.718	217.605
	135°	-585.888(*)	123.421	.002	-999.845	-171.931
	225°	-160.267	104.678	1.000	-511.360	190.827
	270°	-111.264	110.765	1.000	-482.775	260.247

Table 81: Pairwise Comparisons for Visual*RH*Orientation*C

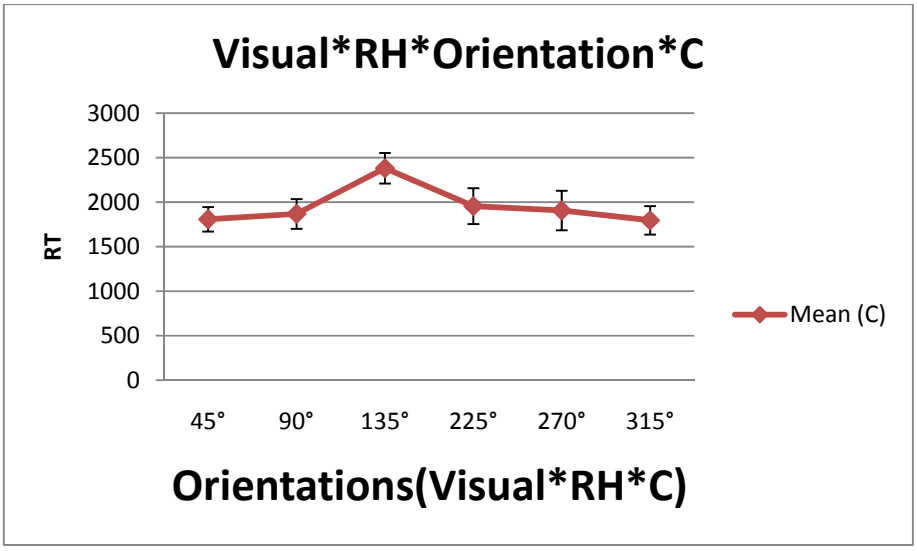

Figure 43: Mean Reaction Times and Standard Errors for Visual*RH*Orientation*C

*Visual*RH*Orientation*LVF*

For the Visual strategy, right hand and LVF, the effect of Orientation was significant (F (5, 95) =6.432, p<.000).The stimulus orientation at 135° had a longer response time (135°=2349.4±163.3ms) than other orientations and the calculated mean was significantly higher than 45°and315° [(45°=1770.3±160.4, p=0.011); (315°=1795.9±160, p=0.016)]. See details in Table 82 and 83 .Mean Reaction Times and Standard Errors are represented in Fig. 43

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1770.328	160.467	1434.467	2106.189
90°	2060.327	192.576	1657.261	2463.394
135°	2349.489	163.379	2007.532	2691.446
225°	2050.638	179.817	1674.277	2426.999
270°	1879.588	198.263	1464.619	2294.557
315°	1795.940	160.072	1460.904	2130.975

Table 82: Mean Reaction Times and Standard Errors for Visual*RH*Orientation*LVF

(I) Orientation	(J)Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-290.000	108.059	.220	-652.435	72.435
	135°	-579.161(*)	144.401	.011	-1063.488	-94.834
	225°	-280.310	106.005	.240	-635.853	75.233
	270°	-109.260	95.675	1.000	-430.157	211.636
	315°	-25.612	90.137	1.000	-327.934	276.711
90°	45°	290.000	108.059	.220	-72.435	652.435
	135°	-289.161	151.809	1.000	-798.334	220.012
	225°	9.690	98.104	1.000	-319.354	338.734
	270°	180.739	116.101	1.000	-208.666	570.145
	315°	264.388	136.446	1.000	-193.259	722.034
135°	45°	579.161(*)	144.401	.011	94.834	1063.488
	90°	289.161	151.809	1.000	-220.012	798.334
	225°	298.851	142.801	.750	-180.108	777.810
	270°	469.900	163.352	.145	-77.989	1017.790
	315°	553.549(*)	143.580	.016	71.977	1035.121
225°	45°	280.310	106.005	.240	-75.233	635.853
	90°	-9.690	98.104	1.000	-338.734	319.354
	135°	-298.851	142.801	.750	-777.810	180.108
	270°	171.050	96.331	1.000	-152.046	494.146
	315°	254.698	90.975	.171	-50.434	559.830
270°	45°	109.260	95.675	1.000	-211.636	430.157
	90°	-180.739	116.101	1.000	-570.145	208.666
	135°	-469.900	163.352	.145	-1017.790	77.989
	225°	-171.050	96.331	1.000	-494.146	152.046
	315°	83.649	94.259	1.000	-232.500	399.797
315°	45°	25.612	90.137	1.000	-276.711	327.934
	90°	-264.388	136.446	1.000	-722.034	193.259
	135°	-553.549(*)	143.580	.016	-1035.121	-71.977
	225°	-254.698	90.975	.171	-559.830	50.434
	270°	-83.649	94.259	1.000	-399.797	232.500

Table 83: Pairwise Comparisons for Visual*RH*Orientation*LVF

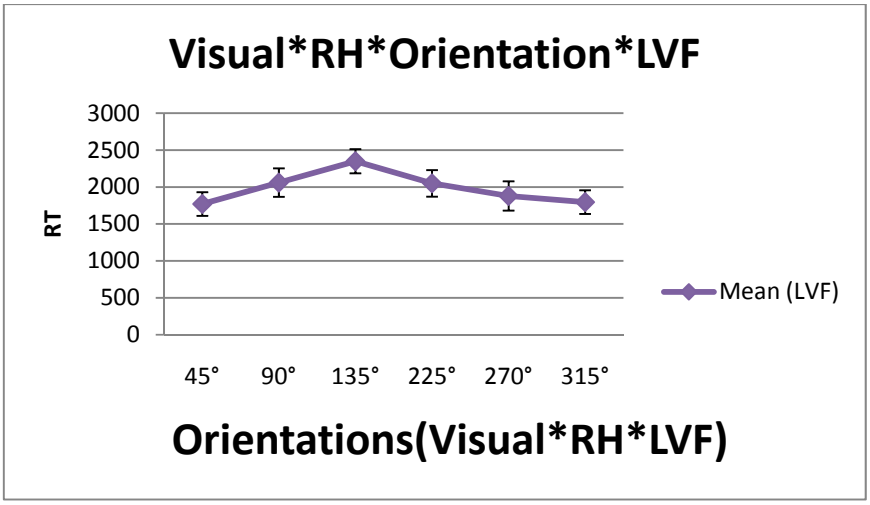

Figure 44: Mean Reaction Times and Standard Errors for Visual*RH*Orientation*LVF

*Visual*LH*Orientation*RVF*

For the Visual strategy, LEFT hand and RVF, the effect of ORIENTATION was significant ($F(5, 95) = 3.488$, $p < .006$). The stimulus orientation at 225° had a longer response time (225°=2207.6±202ms) than other orientations and the calculated mean was only significantly higher than 45° (1837.5±177.7, p=0.048). See details in Table 84 and 85 .Mean Reaction Times and Standard Errors are represented in Fig. 44

			95% Confidence Interval	
Orientation	Mean	Std. Error	Lower Bound	Upper Bound
45°	1837.503	177.757	1465.453	2209.554
90°	1908.838	178.947	1534.298	2283.378
135°	2100.835	183.676	1716.397	2485.273
225°	2207.691	202.041	1784.815	2630.568
270°	1851.875	174.544	1486.550	2217.200
315°	1931.188	185.511	1542.910	2319.467

Table 84: Mean Reaction Times and Standard Errors for Visual*LH*Orientation*RVF

(I) Orientation	(J)Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-71.335	116.365	1.000	-461.628	318.959
	135°	-263.332	94.524	.177	-580.370	53.707
	225°	370.188(*)	109.798	.048	-738.453	-1.923
	270°	-14.372	119.057	1.000	-413.694	384.951
	315°	-93.685	121.197	1.000	-500.183	312.813
90°	45°	71.335	116.365	1.000	-318.959	461.628
	135°	-191.997	95.182	.870	-511.241	127.247
	225°	-298.853	118.462	.311	-696.178	98.472
	270°	56.963	148.747	1.000	-441.939	555.865
	315°	-22.350	103.399	1.000	-369.156	324.455
135°	45°	263.332	94.524	.177	-53.707	580.370
	90°	191.997	95.182	.870	-127.247	511.241
	225°	-106.856	92.254	1.000	-416.281	202.569
	270°	248.960	108.120	.492	-113.679	611.599
	315°	169.647	99.960	1.000	-165.624	504.917
225°	45°	370.188(*)	109.798	.048	1.923	738.453
	90°	298.853	118.462	.311	-98.472	696.178
	135°	106.856	92.254	1.000	-202.569	416.281
	270°	355.816	118.262	.108	-40.838	752.471
	315°	276.503	106.540	.266	-80.835	633.841
270°	45°	14.372	119.057	1.000	-384.951	413.694
	90°	-56.963	148.747	1.000	-555.865	441.939
	135°	-248.960	108.120	.492	-611.599	113.679
	225°	-355.816	118.262	.108	-752.471	40.838
	315°	-79.313	122.152	1.000	-489.014	330.387
315°	45°	93.685	121.197	1.000	-312.813	500.183
	90°	22.350	103.399	1.000	-324.455	369.156
	135°	-169.647	99.960	1.000	-504.917	165.624
	225°	-276.503	106.540	.266	-633.841	80.835
	270°	79.313	122.152	1.000	-330.387	489.014

Table 85: Pairwise Comparisons for Visual*LH*Orientation*RVF

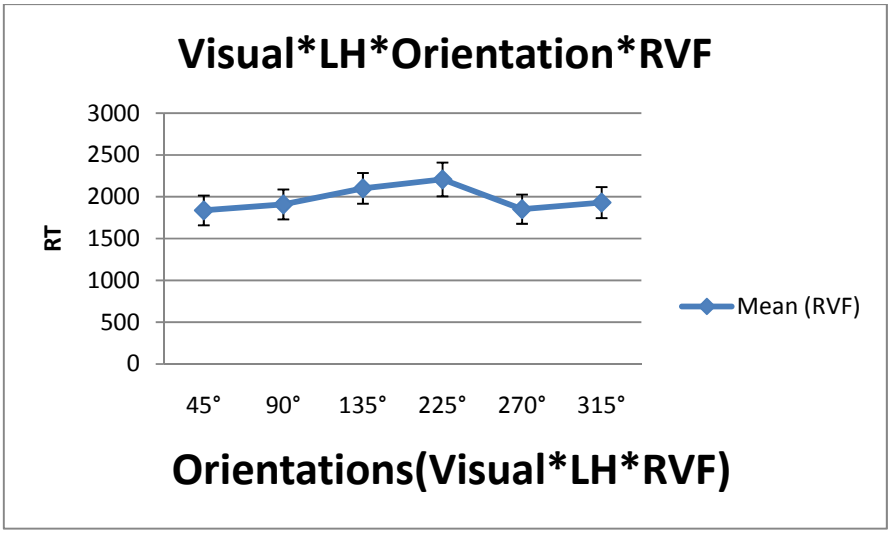

Figure 45: Mean Reaction Times and Standard Errors for Visual*LH*Orientation*RVF

*Visual*LH*Orientation*C*

For the Visual strategy, LEFT hand and Center, the effect of ORIENTATION was significant (F (5, 95) =7.254, p<.000). The stimulus orientation at 225° had a longer response time (225°=2173.6±194ms) than other orientations and the calculated mean was significantly higher than 45° (1579.3±141.3, p=0.002). For the stimulus orientation at 90° (1847.5±179.7) the calculated mean was significantly higher than 45° (1579.3±141.3, p=0.016). Finally, the stimulus orientation at 135° had a longer response time (225°=2173.6±194ms) than 45° (1579.3±141.3, p=0.001). See details in Table 86 and 87 .Mean Reaction Times and Standard Errors are represented in Fig. 45

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1579.353	141.398	1283.403	1875.302
90°	1847.526	179.710	1471.390	2223.663
135°	2089.495	211.285	1647.269	2531.720
225°	2173.677	194.087	1767.447	2579.906
270°	1933.553	215.042	1483.466	2383.641
315°	1705.560	160.607	1369.405	2041.714

Table 86: Mean Reaction Times and Standard Errors for Visual*LH*Orientation*C

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	268.174(*)	69.354	.016	-500.791	-35.556
	135°	510.142(*)	99.585	.001	-844.152	-176.132
	225°	594.324(*)	123.978	.002	-1010.151	-178.497
	270°	-354.201	132.692	.227	-799.254	90.853
	315°	-126.207	95.736	1.000	-447.308	194.894
90°	45°	268.174(*)	69.354	.016	35.556	500.791
	135°	-241.968	103.634	.460	-589.562	105.625
	225°	-326.150	140.072	.466	-795.956	143.655
	270°	-86.027	143.013	1.000	-565.698	393.644
	315°	141.967	113.491	1.000	-238.686	522.619
135°	45°	510.142(*)	99.585	.001	176.132	844.152
	90°	241.968	103.634	.460	-105.625	589.562
	225°	-84.182	107.786	1.000	-445.699	277.335
	270°	155.941	93.587	1.000	-157.955	469.837
	315°	383.935	124.002	.089	-31.971	799.841
225°	45°	594.324(*)	123.978	.002	178.497	1010.151
	90°	326.150	140.072	.466	-143.655	795.956
	135°	84.182	107.786	1.000	-277.335	445.699
	270°	240.123	113.190	.709	-139.519	619.766
	315°	468.117	146.018	.070	-21.634	957.868
270°	45°	354.201	132.692	.227	-90.853	799.254
	90°	86.027	143.013	1.000	-393.644	565.698
	135°	-155.941	93.587	1.000	-469.837	157.955
	225°	-240.123	113.190	.709	-619.766	139.519
	315°	227.994	141.524	1.000	-246.683	702.670
315°	45°	126.207	95.736	1.000	-194.894	447.308
	90°	-141.967	113.491	1.000	-522.619	238.686
	135°	-383.935	124.002	.089	-799.841	31.971
	225°	-468.117	146.018	.070	-957.868	21.634
	270°	-227.994	141.524	1.000	-702.670	246.683

Table 87: Pairwise Comparisons for Visual*LH*Orientation*C

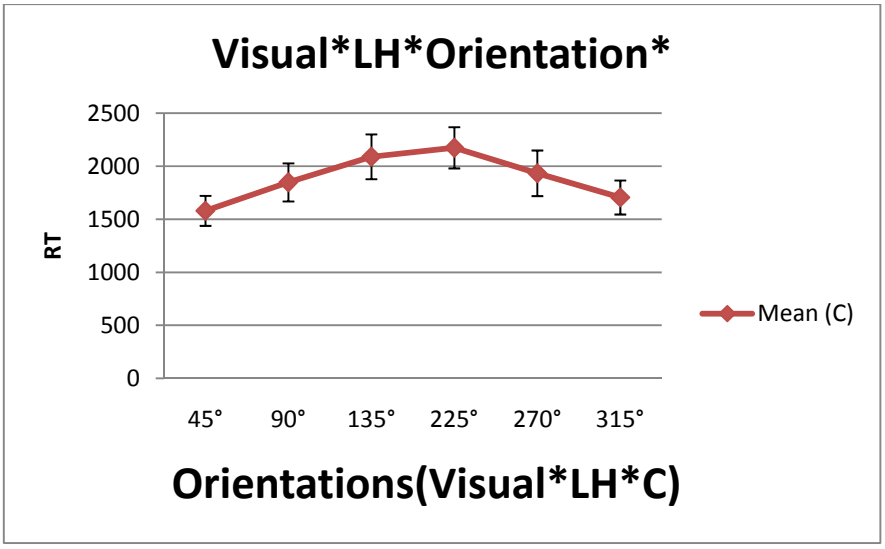

Figure 46: Mean Reaction Times and Standard Errors for Visual*LH*Orientation*C

*Visual*LH*Orientation*LVF*

For the Visual strategy, LEFT hand and LVF, the effect of ORIENTATION was significant (F (5, 95) =2.624, p<.029). The stimulus orientation at 135° had a longer response time (135°=2112.4±206.2ms) than 315° (1795±172.3, p=0.036). See details in Table 88 and 89 .Mean Reaction Times and Standard Errors are represented in Fig. 46

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	1759.111	167.836	1407.827	2110.395
90°	1937.909	171.091	1579.811	2296.007
135°	2112.439	206.203	1680.852	2544.026
225°	2068.242	184.753	1681.550	2454.935
270°	1877.951	200.967	1457.322	2298.581
315°	1795.010	172.317	1434.345	2155.674

Table 88: Mean Reaction Times and Standard Errors for Visual*LH*Orientation*LVF

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-178.798	99.651	1.000	-513.032	155.436
	135°	-353.328	125.004	.162	-772.595	65.938
	225°	-309.132	128.768	.402	-741.024	122.761
	270°	-118.840	135.430	1.000	-573.076	335.396
	315°	-35.899	94.143	1.000	-351.659	279.861
90°	45°	178.798	99.651	1.000	-155.436	513.032
	135°	-174.530	122.222	1.000	-584.468	235.407
	225°	-130.334	137.826	1.000	-592.609	331.941
	270°	59.958	162.231	1.000	-484.170	604.085
	315°	142.899	79.118	1.000	-122.464	408.263
135°	45°	353.328	125.004	.162	-65.938	772.595
	90°	174.530	122.222	1.000	-235.407	584.468
	225°	44.197	155.322	1.000	-476.760	565.153
	270°	234.488	154.873	1.000	-284.961	753.937
	315°	317.430(*)	90.824	.036	12.804	622.055
225°	45°	309.132	128.768	.402	-122.761	741.024
	90°	130.334	137.826	1.000	-331.941	592.609
	135°	-44.197	155.322	1.000	-565.153	476.760
	270°	190.291	110.913	1.000	-181.715	562.298
	315°	273.233	124.872	.620	-145.593	692.059
270°	45°	118.840	135.430	1.000	-335.396	573.076
	90°	-59.958	162.231	1.000	-604.085	484.170
	135°	-234.488	154.873	1.000	-753.937	284.961
	225°	-190.291	110.913	1.000	-562.298	181.715
	315°	82.942	118.897	1.000	-315.842	481.725
315°	45°	35.899	94.143	1.000	-279.861	351.659
	90°	-142.899	79.118	1.000	-408.263	122.464
	135°	-317.430(*)	90.824	.036	-622.055	-12.804
	225°	-273.233	124.872	.620	-692.059	145.593
	270°	-82.942	118.897	1.000	-481.725	315.842

Table 89: Pairwise Comparisons for Visual*LH*Orientation*LVF

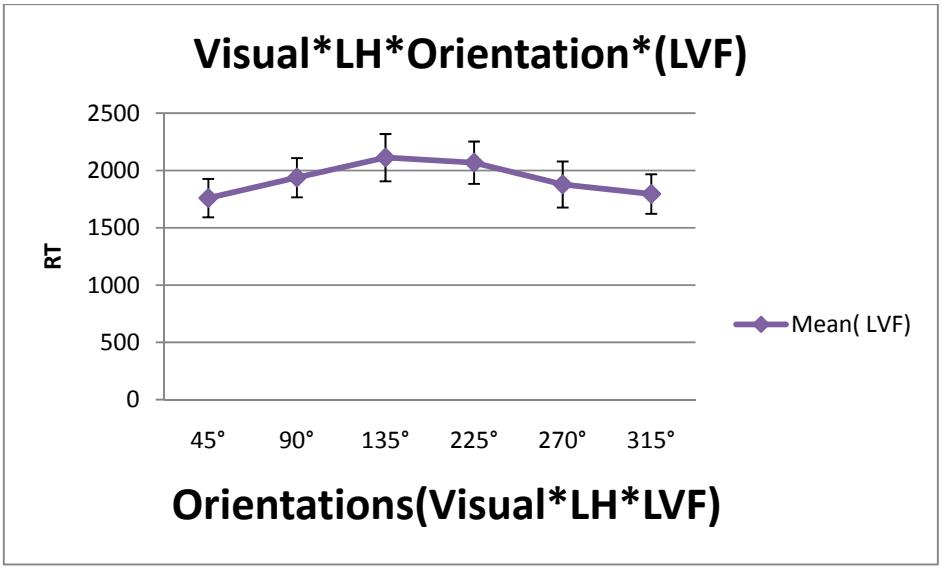

Figure 47: Mean Reaction Times and Standard Errors for Visual*LH*Orientation*LVF

Post hoc on Strategy Hand *Orientation* Position*

A further post hoc analysis performed on Strategy* Hand *Orientation* POSITION interaction, in order to better clarified the direction of the interaction. The ANOVA performed for each position with each angle separately for the motor and the visual strategy respectively showed that for the motor strategy, RVF the effect of laterality (Right hand vs. Left hand) was significant at 90° ($F(1, 19) = 8.72$, $p < .01$, with significantly longer RTs for the Right hand than for the Left hand. See details in Table 90.

Motor strategy*RVF *Hand* at (45°, 90°, 135°, 225°, 270°, 315°)

			95% Confidence Interval	
Hand	Mean	Std. Error	Lower Bound	Upper Bound
Right	2476.835	102.892	2261.480	2692.191
Left	2132.011	140.986	1836.924	2427.098

Table 90: Mean Reaction Times and Standard Errors for Motor strategy* RVF *Hand* at 90°

At 135° (F (1, 19) =11.446, p < .01, with significantly longer RTs for the Right than for the Left hand. See details in Table 91.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2859.657	154.807	2535.642	3183.673
Left	2302.130	109.477	2072.993	2531.267

Table 91: Mean Reaction Times and Standard Errors for Motor strategy* RVF *Hand* at 135°

At 225 (F (1, 19) =6.699, p < .05, with significantly longer RTs for the Right than for the Left hand. See details in Table 92.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2354.142	129.174	2083.777	2624.507
Left	2768.607	149.015	2456.714	3080.499

Table 92: Mean Reaction Times and Standard Errors for Motor strategy* RVF *Hand* at 225°

At 270 (F (1, 19) =17.28, p < .001, with significantly longer RTs for the Left than for the Right hand. See details in Table 93.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1907.515	146.095	1601.735	2213.295
Left	2439.432	179.522	2063.688	2815.175

Table 93: Mean Reaction Times and Standard Errors for Motor strategy* RVF *Hand* at 270°

At 315 (F (1, 19) =4.73, p < .001, with significantly longer RTs for the Left than for the Right hand. See details in Table 94.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2075.699	131.743	1799.958	2351.440
Left	2339.814	100.816	2128.802	2550.825

Table 94: Mean Reaction Times and Standard Errors for Motor strategy* RVF *Hand* at 315°

By contrast, the effect of laterality was not significant for 45° (F (1, 19) = 2.523, p >.05, n.s.. See details in Table 95.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1937.712	102.019	1724.185	2151.240
Left	2111.264	117.999	1864.290	2358.238

Table 95: Mean Reaction Times and Standard Errors for Motor strategy* RVF *Hand* at 45°

Motor strategy*C *Hand* at (45°, 90°, 135°, 225°, 270°, 315°)

For the motor strategy, centre, the effect of laterality (Right hand vs. Left hand) was significant at 315° (F (1, 19) =5.318, p < .001, with significantly longer RTs for the Left than for the Right hand. See details in Table 96.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1904.872	123.539	1646.303	2163.442
Left	2224.758	136.948	1938.123	2511.392

Table 96: Mean Reaction Times and Standard Errors for Motor strategy* C *Hand* at 135°

By contrast, the effect of laterality was not significant for 45° (F (1, 19) =.000, p >.05, n.s. See details in Table 97.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1959.677	128.181	1691.390	2227.964
Left	1958.570	111.034	1726.172	2190.968

Table 97: Mean Reaction Times and Standard Errors for Motor strategy* C *Hand* at 45°

The effect of laterality was neither significant for 90° (F (1, 19) =.035, p >.05, n.s. See details in Table 98.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2108.767	113.340	1871.543	2345.990
Left	2086.733	132.141	1810.158	2363.308

Table 98: Mean Reaction Times and Standard Errors for Motor strategy* C *Hand* at 90°

The effect of laterality was not either significant for 135 (F (1, 19) =.060, p >.05, n.s. See details in Table 99.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2651.344	130.901	2377.365	2925.323
Left	2518.679	133.201	2239.887	2797.471

Table 99: Mean Reaction Times and Standard Errors for Motor strategy* C *Hand* at 135°

In the same vein, the effect of laterality was not significant for 225 (F (1, 19) =1.07, p >.05, n.s. See details in Table 100.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2389.119	156.378	2061.817	2716.422
Left	2617.563	164.109	2274.079	2961.048

Table 100: Mean Reaction Times and Standard Errors for Motor strategy* C *Hand* at 225°

Lastly, The non-significant Stimulus laterality factor 270 (F (1, 19) =3.53, p =.075) indicates that the time requested for mentally rotating Right and Left hand was comparable. See details in Table 101.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2162.583	126.507	1897.800	2427.366
Left	2470.030	174.783	2104.205	2835.855

Table 101: Mean Reaction Times and Standard Errors for Motor strategy* C *Hand* at 270°

Motor strategy*LVF *Hand* at (45°, 90°, 135°, 225°, 270°, 315°)

For the motor strategy, LVF the effect of laterality (Right hand vs. Left hand) was significant at 45° (F (1, 19) =4.95, p < .05, with significantly longer RTs for the Right than for the Left hand. See details in Table 102.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2111.264	117.999	1864.290	2358.238
Left	1831.715	86.020	1651.672	2011.757

Table 102: Mean Reaction Times and Standard Errors for Motor strategy* LVF *Hand* at 45°

At 135° (F (1, 19) =7.05, p < .05, with significantly longer RTs for the R than for the L hand. See details in Table 103.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2816.221	160.386	2480.529	3151.913
Left	2356.706	117.247	2111.305	2602.107

Table 103: Mean Reaction Times and Standard Errors for Motor strategy* LVF *Hand* at 135°

At 225° (F (1, 19) =10.31 p < .001, with significantly longer RTs for the Left than for the Right hand. See details in Table 104.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2178.178	149.253	1865.788	2490.568
Left	2794.760	134.109	2514.066	3075.453

Table 104: Mean Reaction Times and Standard Errors for Motor strategy* LVF *Hand* at 225°

At 270° (F (1, 19) =8.71, p < .001, with significantly longer RTs for the Left than for the Right hand. See details in Table 105.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2003.742	92.228	1810.707	2196.778
Left	2390.661	142.017	2093.416	2687.906

Table 105: Mean Reaction Times and Standard Errors for Motor strategy* LVF *Hand* at 270°

The non-significant Stimulus laterality factor for 90° (F (1, 19) =1.68, p >.05 indicates that the time requested for mentally rotating Right and Left hand was comparable. See details in Table 106.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2350.476	149.713	2037.122	2663.830
Left	2177.614	139.201	1886.262	2468.965

Table 106: Mean Reaction Times and Standard Errors for Motor strategy* LVF *Hand* at 90°

Lastly, the effect of laterality was neither significant for 315° (F (1, 19) =0.76, p >.05. See details in Table 107.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2051.334	93.937	1854.722	2247.946
Left	2012.462	123.686	1753.583	2271.340

Table 107: Mean Reaction Times and Standard Errors for Motor strategy* LVF *Hand* at 315°

Visual strategy * RVF * Hand* at (45°, 90°, 135°, 225°, 270°, 315°)

For the VISUAL strategy, RVF the effect of laterality (Right hand vs. Left hand) was significant at 225° only(F(1,19)=4,604, p < .05, with significantly longer RTs for the Left than for the Right hand. See details in Table 108.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1992.936	181.200	1613.679	2372.192
Left	2207.691	202.041	1784.815	2630.568

Table 108: Mean Reaction Times and Standard Errors for Visual strategy * RVF *Hand* at 225°

By contrast, the effect of laterality was not significant for 45° (F (1, 19) =.000, p >.05, n.s.). See details in Table 109.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1838.158	164.937	1492.940	2183.375
Left	1837.503	177.757	1465.453	2209.554

Table 109: Mean Reaction Times and Standard Errors for Visual strategy * RVF *Hand* at 45°

The effect of laterality was neither significant for 90° (F (1, 19) =.052, p >.05, n.s. See details in Table 110.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1876.892	138.269	1587.491	2166.293
Left	1908.838	178.947	1534.298	2283.378

Table 110: Mean Reaction Times and Standard Errors for Visual strategy * RVF *Hand* at 90°

The effect of laterality was not either significant for 135 (F (1, 19) =1.51, p >.05, n.s. See details in Table 111.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2233.325	177.890	1860.997	2605.653
Left	2100.835	183.676	1716.397	2485.273

Table 111: Mean Reaction Times and Standard Errors for Visual strategy * RVF *Hand* at 135°

In the same vein, the effect of laterality was not significant for 270 (F (1, 19) =.295, p >.05, n.s. See details in Table 112.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1779.201	173.396	1416.279	2142.122
Left	1851.875	174.544	1486.550	2217.200

Table 112: Mean Reaction Times and Standard Errors for Visual strategy * RVF *Hand* at 270°

Lastly, The non-significant Stimulus laterality factor for 315 (F (1, 19) =1.43, p >.05) indicates that the time requested for mentally rotating Right and Left hand was comparable. See details in Table 113.

			95% Confidence Interval	
Hand	Mean	Std. Error	Lower Bound	Upper Bound
Right	1756.578	155.771	1430.544	2082.611
Left	1931.188	185.511	1542.910	2319.467

Table 113: Mean Reaction Times and Standard Errors for Visual strategy * RVF *Hand* at 315°

Visual strategy * C * Hand* at (45°, 90°, 135°, 225°, 270°, 315°)

For the VISUAL strategy, Center the effect of laterality (Right hand vs. Left hand) was significant at 45° (F (1, 19) =8.54, p < .001, with significantly longer RTs for the R than for the L hand. See details in Table 114.

			95% Confidence Interval	
Hand	Mean	Std. Error	Lower Bound	Upper Bound
Right	1808.397	138.046	1519.462	2097.331
Left	1579.353	141.398	1283.403	1875.302

Table 114: Mean Reaction Times and Standard Errors for Visual strategy * C *Hand* at 45°

The effect of laterality at 135 (F (1, 19) =6.58, p < .05) with significantly longer RTs for the Right than for the Left hand. See details in Table 115.

			95% Confidence Interval	
Hand	Mean	Std. Error	Lower Bound	Upper Bound
Right	2381.828	171.416	2023.049	2740.606
Left	2089.495	211.285	1647.269	2531.720

Table 115: Mean Reaction Times and Standard Errors for Visual strategy * C *Hand* at 135°

By contrast, the effect of laterality was not significant for 90° (F (1, 19) =.037, p >.05, n.s. See details in Table 116.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1868.996	167.209	1519.023	2218.969
Left	1847.526	179.710	1471.390	2223.663

Table 116: Mean Reaction Times and Standard Errors for Visual strategy * C *Hand* at 90°

The effect of laterality was neither significant for 225° (F (1, 19) =2,167, p >.05, n.s. See details in Table 117.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1956.206	201.298	1534.886	2377.527
Left	2173.677	194.087	1767.447	2579.906

Table 117: Mean Reaction Times and Standard Errors for Visual strategy * C *Hand* at 225°

The effect of laterality was not either significant for 270° (F (1, 19) =.144, p >.05, n.s. See details in Table 118.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1907.203	221.603	1443.384	2371.023
Left	1933.553	215.042	1483.466	2383.641

Table 118: Mean Reaction Times and Standard Errors for Visual strategy * C *Hand* at 270°

Lastly, The non-significant Stimulus laterality factor for 315° (F (1, 19) =501, p >.05) indicates that the time requested for mentally rotating Right and Left hand was comparable. See details in Table 119.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1795.940	160.072	1460.904	2130.975

Left	1705.560	160.607	1369.405	2041.714

Table 119: Mean Reaction Times and Standard Errors for Visual strategy * C *Hand* at 315°

Visual strategy *LVF * Hand* at (45°, 90°, 135°, 225°, 270°, 315°)

For the VISUAL strategy, LVF the effect of laterality (Right hand vs. Left hand) was not significant for none of orientations [45° (F (1, 19) =.010, p >.05, n.s.:

			95% Confidence Interval	
Hand	Mean	Std. Error	Lower Bound	Upper Bound
Right	1770.328	160.467	1434.467	2106.189
Left	1759.111	167.836	1407.827	2110.395

Table 120: Mean Reaction Times and Standard Errors for Visual strategy * LVF *Hand* at 45°

90° (F (1, 19) =.676, p >.05, n.s.:

			95% Confidence Interval	
Hand	Mean	Std. Error	Lower Bound	Upper Bound
Right	2060.327	192.576	1657.261	2463.394
Left	1937.909	171.091	1579.811	2296.007

Table 121: Mean Reaction Times and Standard Errors for Visual strategy * LVF *Hand* at 90°

135° (F (1, 19) =1.875, p >.05, n.s.:

			95% Confidence Interval	
Hand	Mean	Std. Error	Lower Bound	Upper Bound
Right	2349.489	163.379	2007.532	2691.446
Left	2112.439	206.203	1680.852	2544.026

Table 122: Mean Reaction Times and Standard Errors for Visual strategy * LVF *Hand* at 135°

225° (F (1, 19) =.021, p >.05, n.s.:

			95% Confidence Interval	
Hand	Mean	Std. Error	Lower Bound	Upper Bound
Right	2050.638	179.817	1674.277	2426.999
Left	2068.243	184.753	1681.550	2454.935

Table 123: Mean Reaction Times and Standard Errors for Visual strategy * LVF *Hand* at 225°

270° (F (1, 19) =, 000, p >.05, n.s.:

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1879.588	198.263	1464.619	2294.557
Left	1877.951	200.967	1457.322	2298.581

Table 124: Mean Reaction Times and Standard Errors for Visual strategy * LVF *Hand* at 270°

And at 315° (F (1, 19) =1.023, p >.05, n.s.:

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1687.275	163.512	1345.039	2029.510
Left	1795.010	172.317	1434.345	2155.674

Table 125: Mean Reaction Times and Standard Errors for Visual strategy * LVF *Hand* at 315°

LATERAL/MEDIAL

STRATEGY (LAT/MED)

Results showed significant main effects of the type of STRATEGY [(F1,19)=7.96, p =.011, with significantly longer RTs for the motor (2273,1±88,6) than the visual strategy (1936,4±158,3)], of the LAT-MED [(F1,19)=22,959, p =.000, with significantly longer RTs for the lateral (mean and Std.Error: 2196,1±115,3) than the medial orientations (2013,3±115,8)]

Orientation (LAT/MED)

For Orientation [F (2, 38) =20, 315, p=.000, with significantly longer RTs for 135° (2246, 7±124.737 ms) than for 45° (2007.7 ±108.5, p =.000, and significantly longer RTs for 135° than for 90° (2059. 8±125.9, p =.000). See details in Table 126 and 127 .Mean Reaction Times and Standard Errors are represented in Fig. 47

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	2007.763	108.557	1780.551	2234.975
90°	2059.844	125.946	1796.237	2323.451
135°	2246.714	113.673	2008.793	2484.635

Table 126: Mean Reaction Times and Standard Errors for Orientation (LAT/MED)

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-52.081	39.290	.602	-155.222	51.060
	135°	-238.951(*)	39.154	.000	-341.734	-136.169
90°	45°	52.081	39.290	.602	-51.060	155.222
	135°	-186.870(*)	39.829	.000	-291.426	-82.314
135°	45°	238.951(*)	39.154	.000	136.169	341.734
	90°	186.870(*)	39.829	.000	82.314	291.426

Table 127: Pairwise Comparisons for Orientation (LAT/MED)

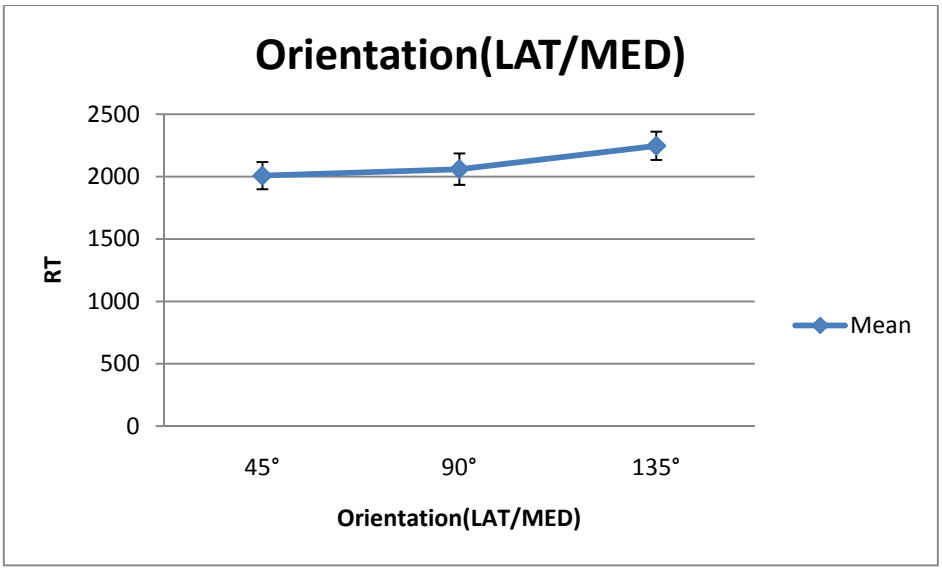

Figure 48: Mean Reaction Times and Standard Errors for Orientation (LAT/MED)

STRATEGY *LAT MED

We found a significant two-way STRATEGY *LAT MED interaction (F (1, 19) = 5, 94, p=.025.).

*Post hoc analysis on STRATEGY *LAT MED*

To understand the nature of the significant STRATEGY * LAT MED interactions we performed further Post hoc analysis for Motor and Visual Strategy independently.

MOTOR STRATEGY *LAT MED

For the motor strategy, the effect of Lateral/Medial was significant ($F(1, 19) = 19.093$, $p < .000$), with significantly longer RTs for Lateral (2407.2±99.9) than for the Medial (2139±89.3, $p = 0.000$). See details in Table 128 and 129. Mean Reaction Times and Standard Errors are represented in Fig. 48

			95% Confidence Interval	
LAT.MED	Mean	Std. Error	Lower Bound	Upper Bound
Lateral	2407.224	99.920	2198.090	2616.359
Medial	2139.034	89.361	1952.000	2326.068

Table 128: Mean Reaction Times and Standard Errors for MOTOR STRATEGY *LAT MED

					95% Confidence Interval for Difference(a)	
(I) LAT.MED	(J) LAT.MED	Mean Difference (I-J)	Std. Error	Sig.(a)	Lower Bound	Upper Bound
Lateral	Medial	268.191(*)	61.377	.000	139.727	396.654
Medial	Lateral	-268.191(*)	61.377	.000	-396.654	-139.727

Table 129: Pairwise Comparisons for MOTOR STRATEGY *LAT MED

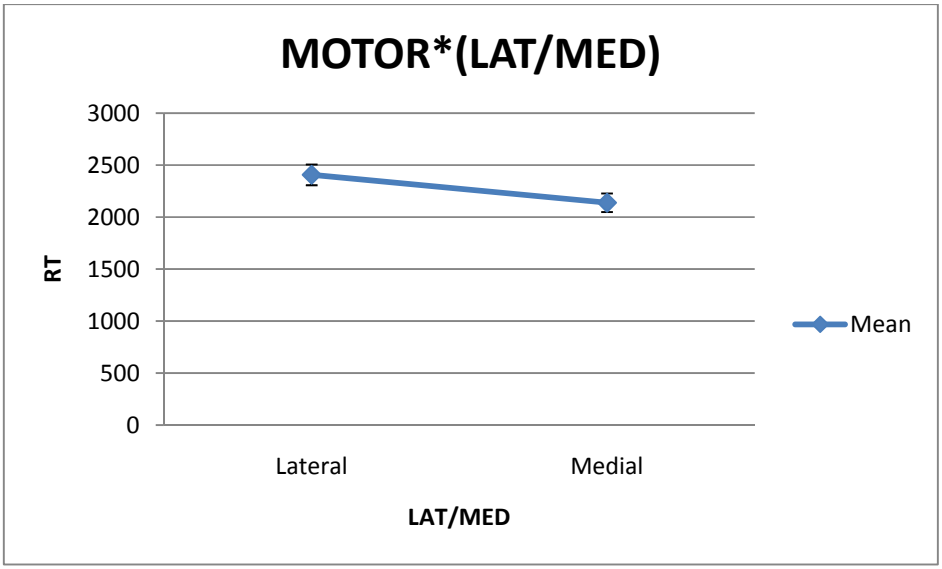

Figure 49: Mean Reaction Times and Standard Errors for MOTOR STRATEGY *LAT MED

VISUAL STRATEGY *LAT MED

For the Visual strategy, the effect of Lateral/Medial was not significant (F (1, 19) = 2.639, p >0.12), with not significantly longer RTs for Lateral (1985.1±155.4) than for the Medial (1965.7±156.1, p = 0.121). See details in Table 130 and 131. Mean Reaction Times and Standard Errors are represented in Fig. 49

LAT.MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Lateral	1985.138	155.494	1659.686	2310.591
Medial	1965.718	156.163	1638.865	2292.570

Table 130: Mean Reaction Times and Standard Errors for VISUAL STRATEGY *LAT MED

(I) LAT.MED	(J) LAT.MED	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Lateral	Medial	19.420	11.955	.121	-5.601	44.442
Medial	Lateral	-19.420	11.955	.121	-44.442	5.601

Table 131: Pairwise Comparisons for VISUAL STRATEGY *LAT MED

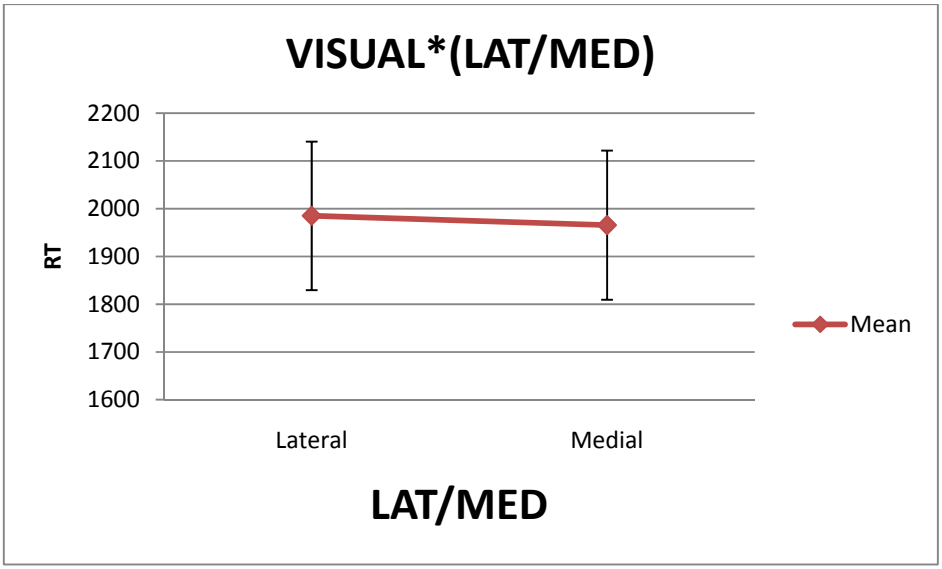

Figure 50: Mean Reaction Times and Standard Errors for VISUAL STRATEGY *LAT MED

HAND *Orientation (LAT/MED)

We found a significant two-way HAND *Orientation interaction F (2, 38) = 39,195, p=.000).

Post hoc analysis on HAND *Orientation (LAT/MED)

A further post hoc analysis performed on Hand x Orientation interaction, better clarified the direction of the interaction.

HAND * at 45° (LAT/MED)

The result showed that the effect of laterality (R hand vs. L hand) was significant at 45° (F (1, 19) = 13.294, p < .003) with significantly longer RTs for the Left than for the Right hand for the Right and Left hand respectively. See details in table 132 and 133. Mean Reaction Times and Standard Errors are represented in Fig. 50

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1829.079	98.351	1623.229	2034.930
Left	2024.767	121.258	1770.970	2278.564

Table 132: Mean Reaction Times and Standard Errors for HAND * at 45° (LAT/MED)

(I) Hand	(J) Hand	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	-195.688(*)	53.670	.002	-308.021	-83.354
Left	Right	195.688(*)	53.670	.002	83.354	308.021

Table 133: Pairwise Comparisons for HAND * at 45° (LAT/MED)

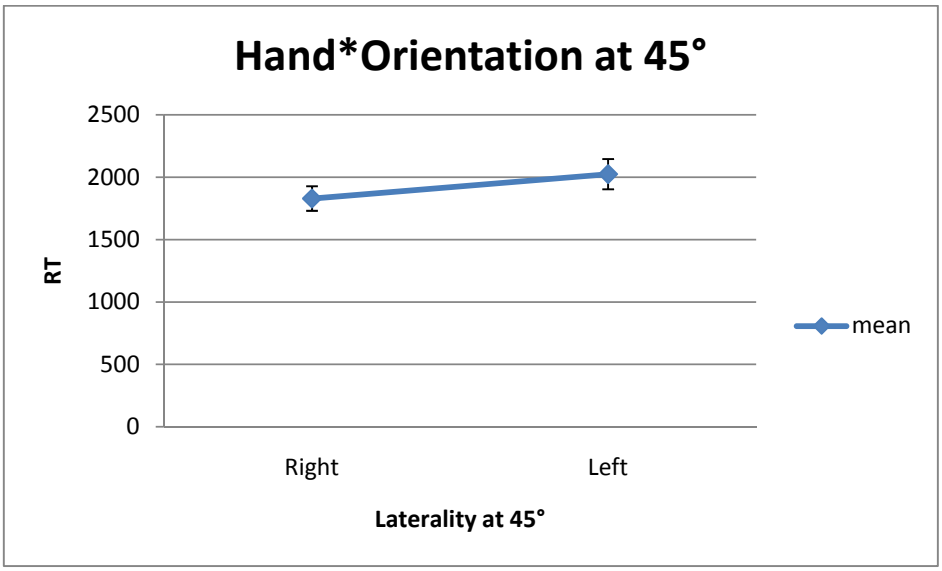

Figure 51: Mean Reaction Times and Standard Errors for HAND * at 45° (LAT/MED)

HAND * at 135° (LAT/MED)

Likewise the effect of laterality (Right hand vs. Left hand) was significant at 135° (F (1, 19) =20.319, p <.000, with significantly longer RTs for the Right than for the Left hand. See details in Table 134 and 135. Mean Reaction Times and Standard Errors are represented in Fig. 51

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2249.829	124.540	1989.163	2510.494
Left	2051.339	113.970	1812.798	2289.881

Table 134: Mean Reaction Times and Standard Errors for HAND * at 135° (LAT/MED)

(I) Hand	(J) Hand	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	198.489(*)	44.034	.000	106.324	290.654
Left	Right	-198.489(*)	44.034	.000	-290.654	-106.324

Table 135: Pairwise Comparisons for HAND * at 135° (LAT/MED)

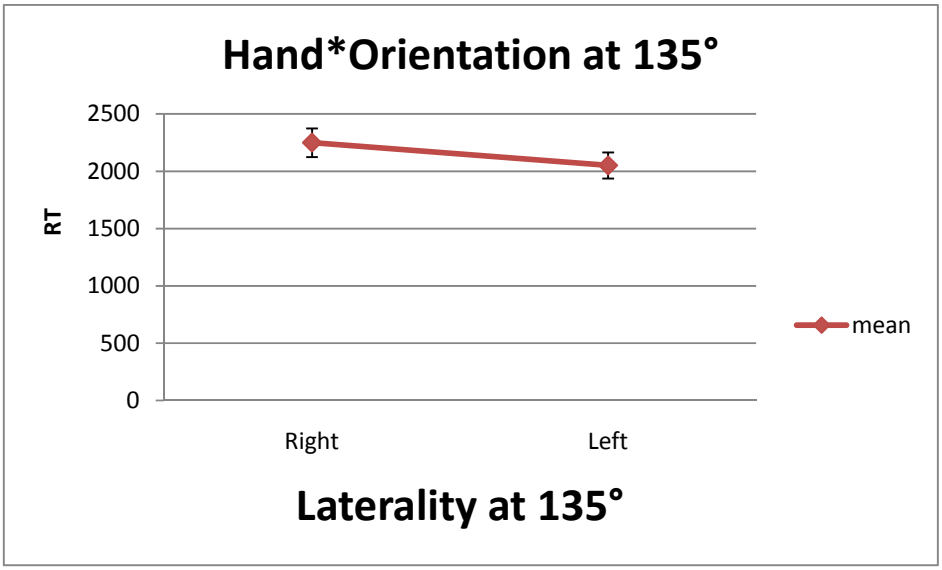

Figure 52: Mean Reaction Times and Standard Errors for HAND * at 135° (LAT/MED)

HAND * at 90° (LAT/MED)

By contrast, the effect of laterality was not significant for the orientation at 90° (F (1, 19) =2.667, p > .05, n.s.) See details in Table 136 and 137.

Hand	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1954.552	124.995	1692.935	2216.169
Left	2003.076	132.215	1726.346	2279.806

Table 136: Mean Reaction Times and Standard Errors for HAND * at 90° (LAT/MED)

(I) Hand	(J) Hand	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	-48.523	29.712	.119	-110.711	13.664
Left	Right	48.523	29.712	.119	-13.664	110.711

Table 137: Pairwise Comparisons for HAND * at 90° (LAT/MED)

LATERAL-MEDIAL *Orientation

We found a significant two-way (LATERAL-MEDIAL *Orientation) interaction F (2, 38) = 28.113, p=.000).

Post hoc analysis on LATERAL-MEDIAL *Orientation

A further post hoc analysis performed on (LATERAL-MEDIAL *Orientation) interaction, in order to better clarified the direction of the interaction.

LATERAL-MEDIAL *Orientation at 45°

The result showed that the effect of lateral–medial gradient was significant at 45° (F (1, 19) = 20.319, p < .000) with significantly longer RTs for the Lateral than for the Medial .See details in table 138 and 139. Mean Reaction Times and Standard Errors are represented in Fig. 52

LAT/MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	2249.829	124.540	1989.163	2510.494
MEDIAL	2051.339	113.970	1812.798	2289.881

Table 138: Mean Reaction Times and Standard Errors for LATERAL-MEDIAL *Orientation at 45°

LAT/MED	LAT/MED	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LATERAL	MEDIAL	198.489(*)	44.034	.000	106.324	290.654
MEDIAL	LATERAL	-198.489(*)	44.034	.000	-290.654	-106.324

Table 139: Pairwise Comparisons for LATERAL-MEDIAL *Orientation at 45°

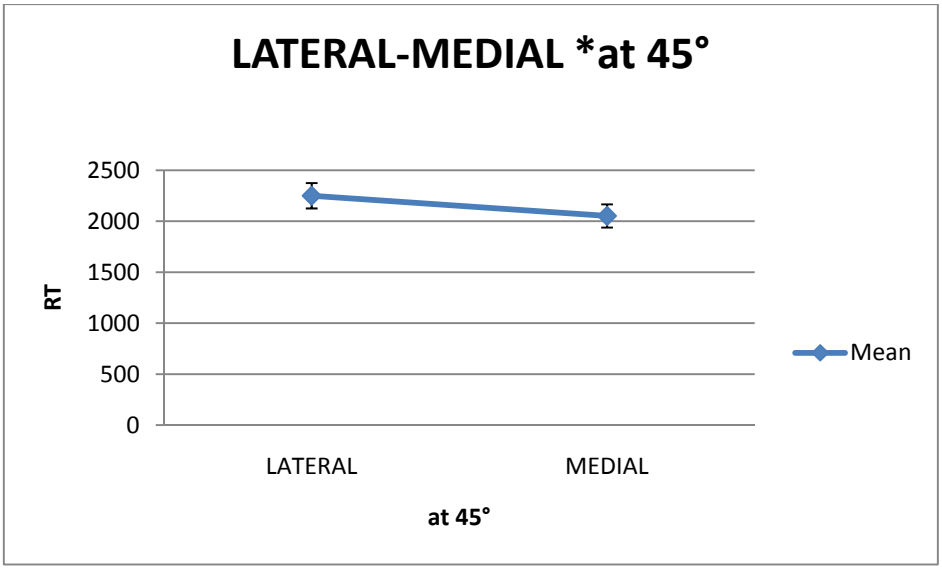

Figure 53: Mean Reaction Times and Standard Errors for LATERAL-MEDIAL *Orientation at 45°

LATERAL-MEDIAL *Orientation at 90°

Likewise the effect of lateral–medial gradient was significant at 90° ($F(1, 19) = 8.334$, $p < .01$) with significantly longer RTs for the Lateral than for the Medial .See details in table 140 and 141. Mean Reaction Times and Standard Errors are represented in Fig. 53

			95% Confidence Interval	
LAT/MED	Mean	Std. Error	Lower Bound	Upper Bound
LATERAL	2057.461	135.643	1773.556	2341.365
MEDIAL	1900.167	125.493	1637.508	2162.827

Table 140: Mean Reaction Times and Standard Errors for LATERAL-MEDIAL *Orientation at 90°

(I) LAT/MED	(J) LAT/MED	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LATERAL	MEDIAL	157.293(*)	54.486	.009	43.252	271.334
MEDIAL	LATERAL	-157.293(*)	54.486	.009	-271.334	-43.252

Table 141: Pairwise Comparisons for LATERAL-MEDIAL *Orientation at 90°

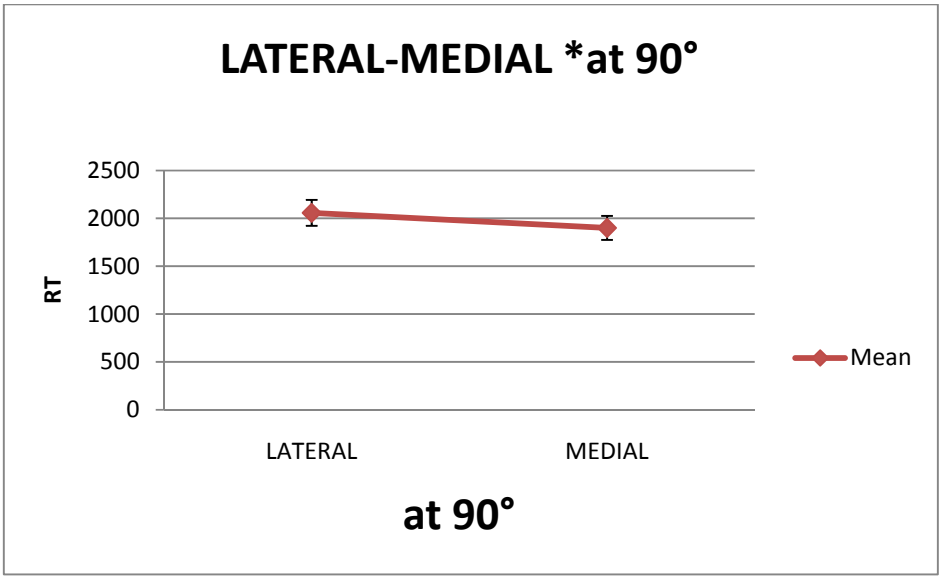

Figure 54: Mean Reaction Times and Standard Errors for LATERAL-MEDIAL *Orientation at 90°

LATERAL-MEDIAL *Orientation at 90°

Moreover, the effect of lateral–medial gradient was significant at 135° ($F(1, 19) = 36.228$, $p < .000$) with significantly longer RTs for the Lateral than for the Medial .See details in table 142 and 143. Mean Reaction Times and Standard Errors are represented in Fig.54

LAT/MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	2392.356	135.495	2108.761	2675.951
MEDIAL	1908.812	111.345	1675.763	2141.861

Table 142: Mean Reaction Times and Standard Errors for LATERAL-MEDIAL *Orientation at 135°

(I) LAT/MED	(J) LAT/MED	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LATERAL	MEDIAL	483.544(*)	80.337	.000	315.397	651.691
MEDIAL	LATERAL	-483.544(*)	80.337	.000	-651.691	-315.397

Table 143: Pairwise Comparisons for LATERAL-MEDIAL *Orientation at 135°

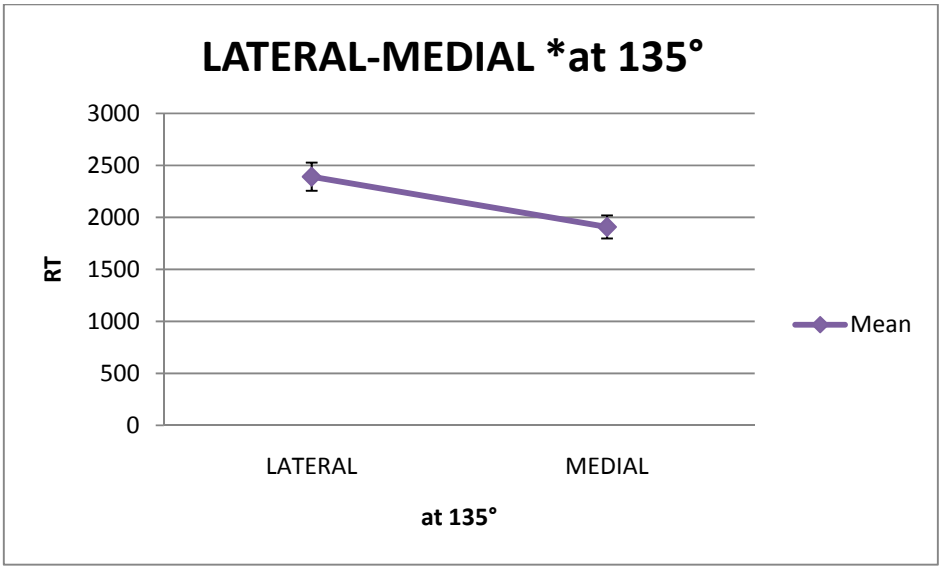

Figure 55: Mean Reaction Times and Standard Errors for LATERAL-MEDIAL *Orientation at 135°

STRATEGY*LETERAL-MEDIAL* ORIENTATION

We found a significant three-way (STRATEGY*LETERAL-MEDIAL* ORIENTATION) interaction (F (2, 38) = 3.302, p=.048).

Post hoc analysis on STRATEGY*LETERAL-MEDIAL* ORIENTATION

Post hoc analysis was performed on the motor and the visual strategy separately.

MOTOR STRATEGY*LETERAL-MEDIAL

For the motor strategy we found a significant main effect of lateral–medial gradient was significant (F (1, 19) =19.093, p = .000), with longer RTs for the Lateral than for the Medial. See details in table 144

			95% Confidence Interval	
LAT_MED	Mean	Std. Error	Lower Bound	Upper Bound
LATERAL	2407.224	99.920	2198.090	2616.359
MEDIAL	2139.034	89.361	1952.000	2326.068

Table 144: Mean Reaction Times and Standard Errors for MOTOR STRATEGY*LETERAL-MEDIAL

MOTOR STRATEGY* ORIENTATION (LAT/MED)

Moreover the effect of Orientation was significant (F (2, 38) = 17.622, p = .000) with significantly longer RTs for the 135° than 45° and 90°**.** See details in table 145

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45 °	2149.592	86.300	1968.965	2330.219
90 °	2225.533	105.222	2005.301	2445.765
135 °	2444.262	90.916	2253.971	2634.552

Table 145: Mean Reaction Times and Standard Errors for MOTOR STRATEGY* ORIENTATION (LAT/MED)

MOTOR STRATEGY* LETERAL-MEDIAL*ORIENTATION

Along with a significant effect of (LETERAL-MEDIAL*ORIENTATION) interaction (F (2, 38) = 22.377, p = .000). See details in table 146. Mean Reaction Times and Standard Errors are represented in Fig.55

LAT_MED	Orientation	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	45 °	2097.614	95.871	1896.954	2298.274
	90 °	2372.700	120.203	2121.112	2624.288
	135 °	2751.359	118.132	2504.105	2998.612
MEDIAL	45 °	2201.570	86.846	2019.800	2383.340
	90 °	2078.366	102.905	1862.984	2293.748
	135 °	2137.165	96.327	1935.550	2338.780

Table 146: Mean Reaction Times and Standard Errors for MOTOR STRATEGY* LETERAL-MEDIAL*ORIENTATION

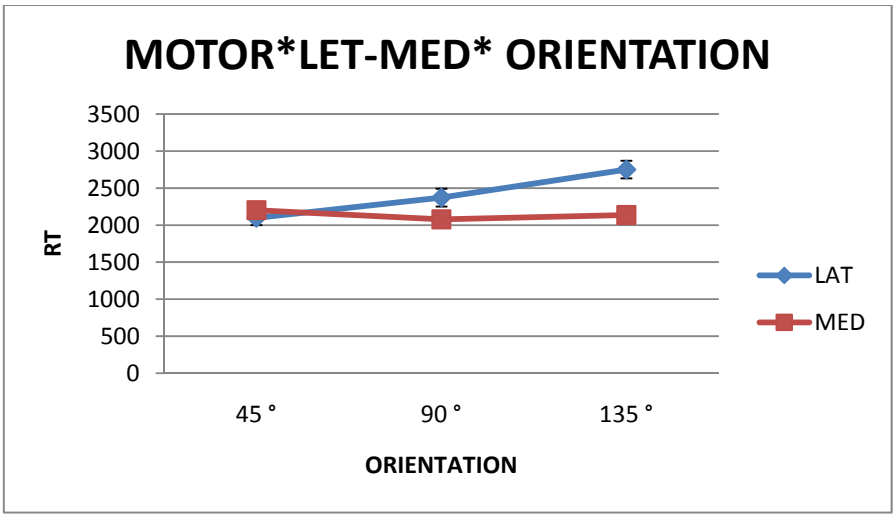

Figure 56: Mean Reaction Times and Standard Errors for MOTOR STRATEGY* LETERAL-MEDIAL*ORIENTATION

VISUAL STRATEGY*LETERAL-MEDIAL

For the Visual strategy we found a significant main effect of lateral–medial gradient was significant (F (1, 19) =17.995, p = .000), with longer RTs for the Lateral than for the Medial. See details in table 147.

LAT_MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	2157.022	125.990	1893.322	2420.721
MEDIAL	1887.698	163.688	1545.096	2230.301

Table 147: Mean Reaction Times and Standard Errors for VISUAL STRATEGY*LETERAL-MEDIAL

VISUAL STRATEGY* Orientation (LAT/MED)

Moreover the effect of Orientation was significant (F (2, 38) = 21.596, p = .000) with significantly longer RTs for the 135° than 45° and 90°. See details in table 148.

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45 °	1865.933	156.924	1537.488	2194.379
90 °	1894.155	165.602	1547.546	2240.764
135 °	2306.992	120.723	2054.316	2559.667

Table 148: Mean Reaction Times and Standard Errors for VISUAL STRATEGY* Orientation (LAT/MED)

VISUAL STRATEGY*LETERAL-MEDIAL* ORIENTATION

Furthermore, the effect of (LETERAL-MEDIAL*ORIENTATION) interaction was significant (F (2, 38) = 35.212, p = .000). See details in table 149. Mean Reaction Times and Standard Errors are represented in Fig. 56

LAT_MED	Orientation	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	45 °	1808.107	151.468	1491.080	2125.133
	90 °	1911.599	167.089	1561.877	2261.321
	135 °	2751.359	118.132	2504.105	2998.612
MEDIAL	45 °	1923.760	166.366	1575.553	2271.967
	90 °	1876.711	170.213	1520.450	2232.971
	135 °	1862.624	161.736	1524.107	2201.142

Table 149: Mean Reaction Times and Standard Errors for VISUAL STRATEGY*LETERAL-MEDIAL* ORIENTATION

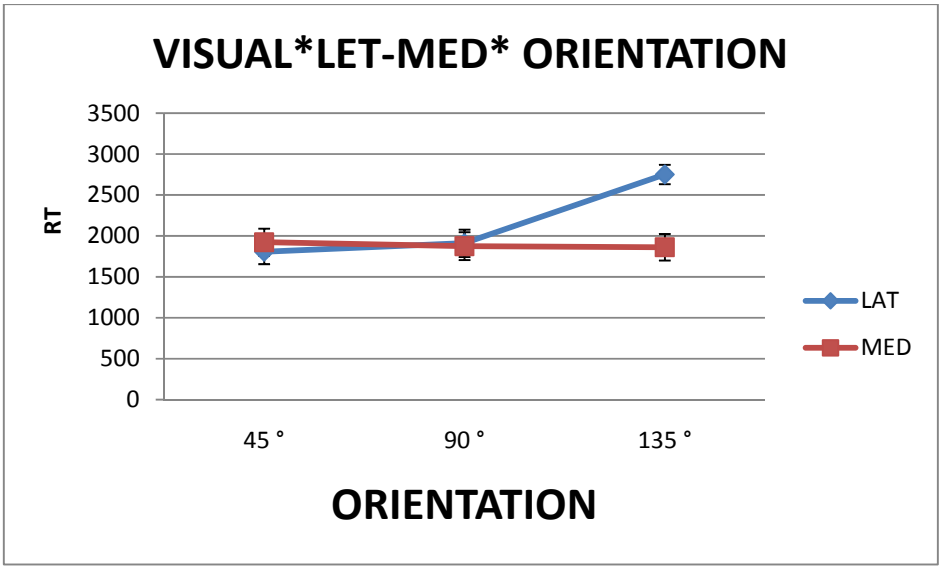

Figure 57: Mean Reaction Times and Standard Errors for VISUAL STRATEGY*LETERAL-MEDIAL* ORIENTATION

*STRATEGY *LETERAL-MEDIAL*ORIENTATION*

To understand the nature of the significant (LETERAL-MEDIAL*ORIENTATION) interactions The ANOVA performed for the motor and the visual strategy with each Orientation separately.

MOTOR STRATEGY *LETERAL-MEDIAL* at 90°

For the motor strategy, the effect of lateral–medial gradient was significant at 90° ($F(1, 19) = 14.963$, $p < .002$), with significantly longer RTs for the Lateral than for the Medial. See details in Table 150 and 151.Mean Reaction Times and Standard Errors are represented in Fig.57

			95% Confidence Interval	
LAT_MED	Mean	Std. Error	Lower Bound	Upper Bound
LATERAL	2372.700	120.203	2121.112	2624.288
MEDIAL	2078.366	102.905	1862.984	2293.748

Table 150: Mean Reaction Times and Standard Errors for MOTOR STRATEGY *LETERAL-MEDIAL* at 90°

(I) LAT_MED	(J) LAT_MED	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LATERAL	MEDIAL	294.334(*)	76.090	.001	135.077	453.591
MEDIAL	LATERAL	-294.334(*)	76.090	.001	-453.591	-135.077

Table 151: Pairwise Comparisons for MOTOR STRATEGY *LETERAL-MEDIAL* at 90°

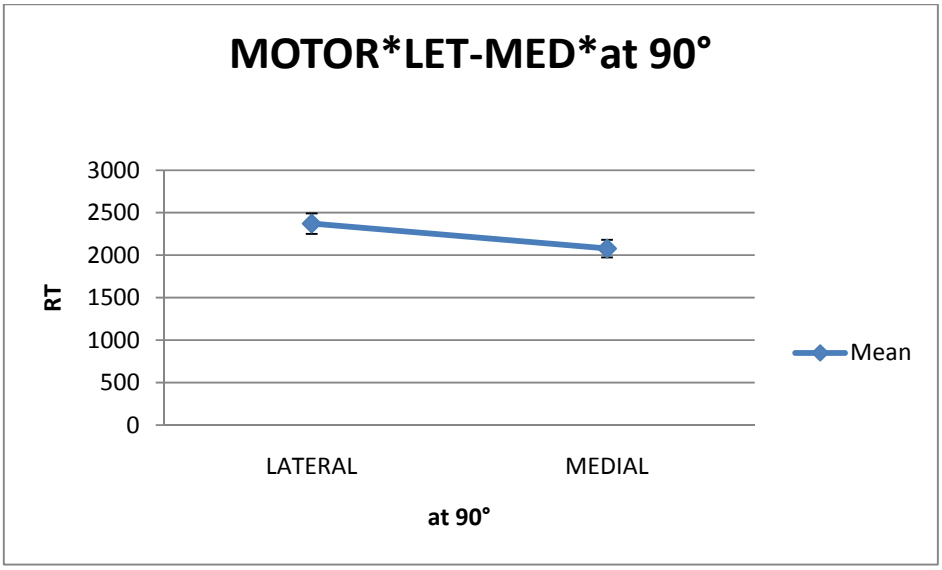

Figure 58: Mean Reaction Times and Standard Errors for MOTOR STRATEGY *LETERAL-MEDIAL* at 90°

MOTOR STRATEGY *LETERAL-MEDIAL* at 135°

Likewise the effect of lateral–medial gradient was significant at 135° (F (1, 19) =28.141, p =.000, with significantly longer RTs for the Lateral than for the Medial. See details in Table 152 and 153. Mean Reaction Times and Standard Errors are represented in Fig. 58

LAT_MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	2751.359	118.132	2504.105	2998.612
MEDIAL	2137.165	96.327	1935.550	2338.780

Table 152: Mean Reaction Times and Standard Errors for MOTOR STRATEGY *LETERAL-MEDIAL* at 135°

(I) LAT_MED	(J) LAT_MED	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LATERAL	MEDIAL	614.194(*)	115.780	.000	371.864	856.525
MEDIAL	LATERAL	-614.194(*)	115.780	.000	-856.525	-371.864

Table 153: Pairwise Comparisons for MOTOR STRATEGY *LETERAL-MEDIAL* at 135°

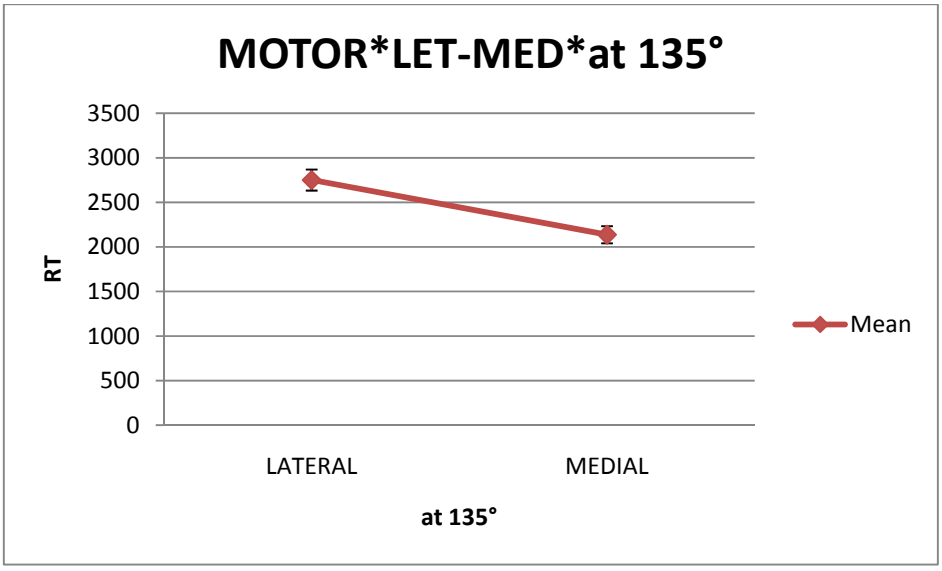

Figure 59: Mean Reaction Times and Standard Errors for MOTOR STRATEGY *LETERAL-MEDIAL* at 135°

MOTOR STRATEGY *LETERAL-MEDIAL* at 90°

By contrast, the effect of lateral–medial gradient was not significant for the other orientations at 45° (F (1, 19) =2.940, p > .05, n.s.) .See details in Table 154.

LAT_MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	2097.614	95.871	1896.954	2298.274
MEDIAL	2201.570	86.846	2019.800	2383.340

Table 154: Mean Reaction Times and Standard Errors for MOTOR STRATEGY *LETERAL-MEDIAL* at 90°

VISUAL STRATEGY *LETERAL-MEDIAL* at 45°

For the Visual Strategy, the effect of lateral–medial gradient was significant at 45° ($F(1, 19) = 4.882$, $p < .05$), with significantly longer RTs for the Medial than for the Lateral. See details in Table 155 and 156. Mean Reaction Times and Standard Errors are represented in Fig. 59

LAT_MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	1808.107	151.468	1491.080	2125.133
MEDIAL	1923.760	166.366	1575.553	2271.967

Table 155: Mean Reaction Times and Standard Errors for VISUAL STRATEGY *LETERAL-MEDIAL* at 45°

(I) LAT_MED	(J) LAT_MED	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LATERAL	MEDIAL	-115.653(*)	52.345	.040	-225.213	-6.094
MEDIAL	LATERAL	115.653(*)	52.345	.040	6.094	225.213

Table 156: Pairwise Comparisons for VISUAL STRATEGY *LETERAL-MEDIAL* at 45°

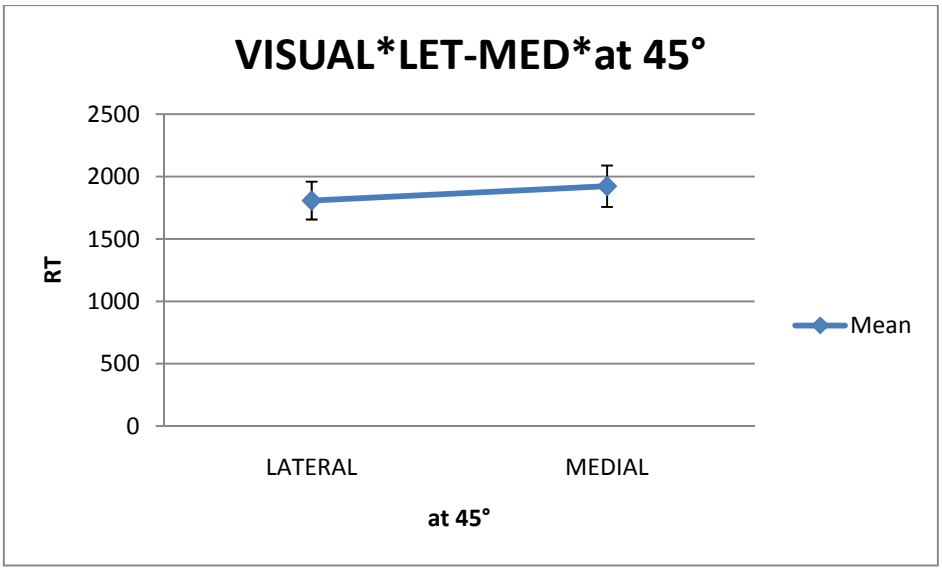

Figure 60: Mean Reaction Times and Standard Errors for VISUAL STRATEGY *LETERAL-MEDIAL* at 45°

VISUAL STRATEGY *LETERAL-MEDIAL* at 135°

Likewise the effect of lateral–medial gradient was significant at 135° (F (1, 19) =32.367, p =.000, with significantly longer RTs for the Lateral than for the Medial. See details in Table 157 and 158. Mean Reaction Times and Standard Errors are represented in Fig. 60

L AT_MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	2639.168	142.523	2340.864	2937.473
MEDIAL	1767.248	150.775	1451.672	2082.824

Table 157: Mean Reaction Times and Standard Errors for VISUAL STRATEGY *LETERAL-MEDIAL* at 135°

(I) LAT_MED	(J) LAT_MED	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LATERAL	MEDIAL	871.920(*)	153.260	.000	551.144	1192.696
MEDIAL	LATERAL	-871.920(*)	153.260	.000	-1192.696	-551.144

Table 158: Pairwise Comparisons for VISUAL STRATEGY *LETERAL-MEDIAL* at 135°

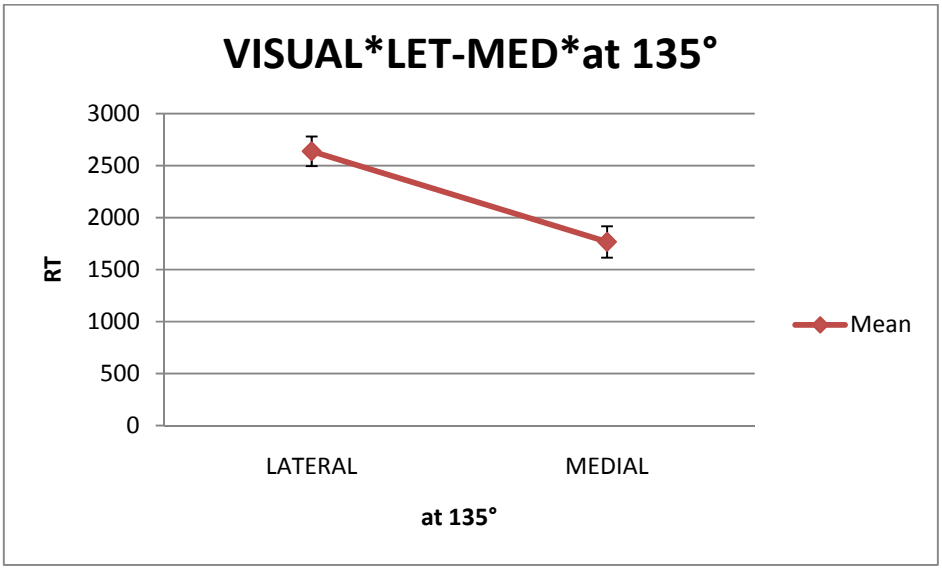

Figure 61: Mean Reaction Times and Standard Errors for VISUAL STRATEGY *LETERAL-MEDIAL* at 135°

VISUAL STRATEGY *LETERAL-MEDIAL* at 90°

By contrast, the effect of lateral–medial gradient was not significant for the orientations at 90° (F (1, 19) =.320, p > .05, n.s.). See details in Table 159.

			95% Confidence Interval	
LAT_MED	Mean	Std. Error	Lower Bound	Upper Bound
LATERAL	1827.445	166.903	1478.113	2176.776
MEDIAL	1791.414	164.274	1447.586	2135.243

Table 159: Mean Reaction Times and Standard Errors for VISUAL STRATEGY *LETERAL-MEDIAL* at 90°

HAND *LETERAL -MEDIAL *ORIENTATION

We found a significant three-way (HAND *LETERAL -MEDIAL *ORIENTATION) interaction (F (2, 38) = 9,677, p=.000).

Post hoc analysis on HAND *LETERAL -MEDIAL *ORIENTATION

A post hoc analysis on (HAND *LETERAL -MEDIAL *ORIENTATION) interactions performed for the Right and the left hand separately.

*RIGHT HAND *LETERAL -MEDIAL*

For the Right hand, the effect of lateral–medial gradient was significant (F (1, 19) = 38.133, p < .000), with significantly longer RTs for the Medial than for the Lateral. See details in Table 160.

			95% Confidence Interval	
LAT_MED	Mean	Std. Error	Lower Bound	Upper Bound
LATERAL	2029.729	119.254	1780.128	2279.330
MEDIAL	2230.434	127.870	1962.798	2498.070

Table 160: Mean Reaction Times and Standard Errors for RIGHT HAND *LETERAL -MEDIAL

*RIGHT HAND *ORIENTATION (LAT/MED)*

By contrast the effect of Orientation was not significant (F (2, 18) = 2.998, p > .05). See details in Table 161 and162

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45 °	2073.052	111.534	1839.608	2306.496
90 °	2127.994	133.156	1849.296	2406.692
135 °	2189.198	128.872	1919.465	2458.930

Table 161: Mean Reaction Times and Standard Errors for RIGHT HAND *ORIENTATION (LAT/MED)

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-54.942	42.043	.621	-165.310	55.426
	135°	-116.145	49.587	.091	-246.315	14.024
90°	45°	54.942	42.043	.621	-55.426	165.310
	135°	-61.204	30.166	.170	-140.393	17.986
135°	45°	116.145	49.587	.091	-14.024	246.315
	90°	61.204	30.166	.170	-17.986	140.393

Table 162: Pairwise Comparisons for RIGHT HAND *ORIENTATION (LAT/MED)

*RIGHT HAND *LETERAL -MEDIAL *ORIENTATION*

Furthermore, the effect of (LETERAL-MEDIAL*ORIENTATION) interaction was significant (F (2, 18) = 26.521, p = .000). See details in Table 163. Mean Reaction Times and Standard Errors are represented in Fig. 61

LAT_MED	Orientation	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	45 °	1921.110	102.876	1705.788	2136.431
	90 °	2228.104	134.148	1947.330	2508.879
	135 °	1939.972	133.900	1659.717	2220.227
MEDIAL	45 °	2224.995	130.003	1952.896	2497.094
	90 °	2027.884	136.703	1741.761	2314.007
	135 °	2438.423	136.162	2153.433	2723.414

Table 163: Mean Reaction Times and Standard Errors for RIGHT HAND *LETERAL -MEDIAL *ORIENTATION

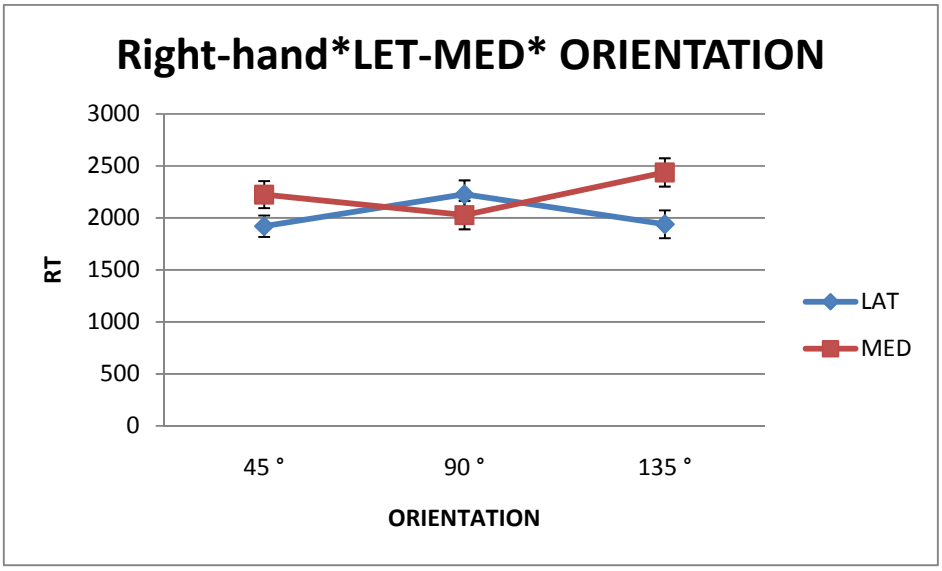

Figure 62: Mean Reaction Times and Standard Errors for RIGHT HAND *LETERAL -MEDIAL *ORIENTATION

*LEFT HAND *LETERAL -MEDIAL*

For the Left hand, the effect of lateral–medial gradient was significant (F (1, 19) = 8.093, p = .01), with significantly longer RTs for the Lateral than for Medial. See details in Table 164

LAT_MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	2183.297	110.648	1951.707	2414.887
MEDIAL	2117.416	114.737	1877.269	2357.563

Table 164: Mean Reaction Times and Standard Errors for LEFT HAND *LETERAL –MEDIAL

LEFT HAND * ORIENTATION (LAT/MED)

Likewise, the effect of Orientation was significant (F (2, 18) = 11.971, p =0.000). See details in Table 165

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45 °	2026.743	122.000	1771.394	2282.093
90 °	2226.877	121.337	1972.917	2480.838
135 °	2197.448	103.293	1981.254	2413.643

Table 165: Mean Reaction Times and Standard Errors for LEFT HAND * ORIENTATION (LAT/MED)

LEFT HAND *LETERAL -MEDIAL *ORIENTATION

Furthermore, the effect of (LETERAL-MEDIAL*ORIENTATION) interaction was significant (F (2, 18) = 44.167, p = .000). See details in Table 146 and 147. Mean Reaction Times and Standard Errors are represented in Fig. 62

LAT_MED	Orientation	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	45 °	1882.407	105.585	1661.416	2103.398
	90 °	2118.841	139.386	1827.102	2410.580
	135 °	2548.644	117.393	2302.939	2794.350
MEDIAL	45 °	2171.080	148.934	1859.358	2482.802
	90 °	2334.914	114.319	2095.641	2574.187
	135 °	1846.253	102.781	1631.128	2061.377

Table 166: Mean Reaction Times and Standard Errors for LEFT HAND *LETERAL -MEDIAL *ORIENTATION

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-200.134(*)	41.875	.000	-310.060	-90.208
	135°	-170.705(*)	64.503	.048	-340.033	-1.376
90°	45°	200.134(*)	41.875	.000	90.208	310.060
	135°	29.429	42.266	1.000	-81.523	140.381
135°	45°	170.705(*)	64.503	.048	1.376	340.033
	90°	-29.429	42.266	1.000	-140.381	81.523

Table 167: Pairwise Comparisons for LEFT HAND *LETERAL -MEDIAL *ORIENTATION

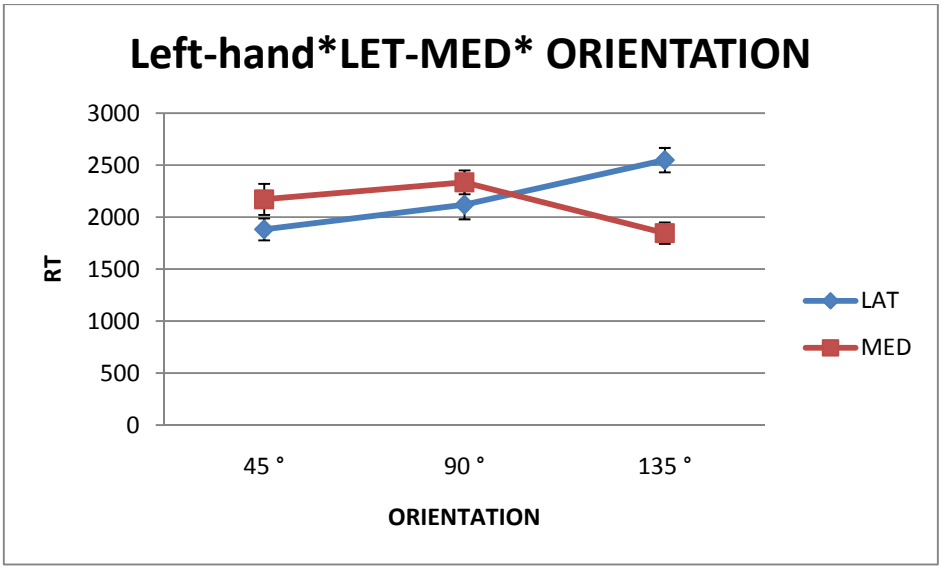

Figure 63: Mean Reaction Times and Standard Errors for LEFT HAND *LETERAL -MEDIAL *ORIENTATION

HAND* LETERAL-MEDIAL*ORIENTATION

To understand the nature of the significant (LETERAL-MEDIAL*ORIENTATION) interactions The ANOVA performed for the Right hand and Left hand with each Orientation separately.

RIGHT HAND* LETERAL-MEDIAL* at 45°

The result showed that for Right hand, the effect of lateral–medial gradient was significant at 45° (F (1, 19) = 17.729, p=.000), with significantly longer RTs for the Medial than for the Lateral. See details in Table 168. Mean Reaction Times and Standard Errors are represented in Fig.63

LAT_MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	1921.110	102.876	1705.788	2136.431
MEDIAL	2224.995	130.003	1952.896	2497.094

Table 168: Mean Reaction Times and Standard Errors for RIGHT HAND* LETERAL-MEDIAL* at 45°

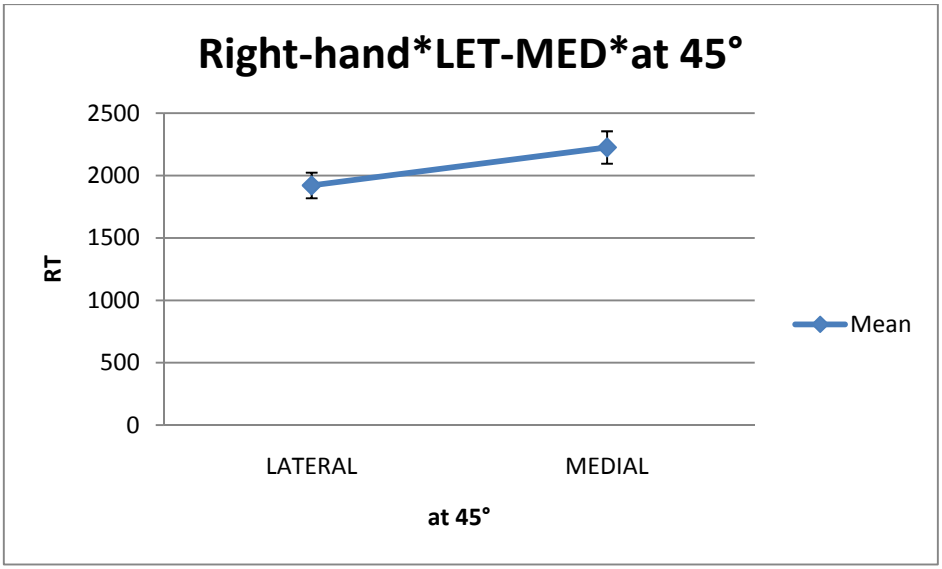

Figure 64: Mean Reaction Times and Standard Errors for RIGHT HAND* LETERAL-MEDIAL* at 45°

RIGHT HAND LETERAL-MEDIAL* at 90°*

Likewise the effect of lateral–medial gradient was significant at 90° (F (1, 19) =16.396, p =.001, with significantly longer RTs for the Lateral than for the Medial. See details in Table 169. Mean Reaction Times and Standard Errors are represented in Fig. 64

LAT_MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	2228.104	134.148	1947.330	2508.879
MEDIAL	2027.884	136.703	1741.761	2314.007

Table 169: Mean Reaction Times and Standard Errors for RIGHT HAND* LETERAL-MEDIAL* at 90°

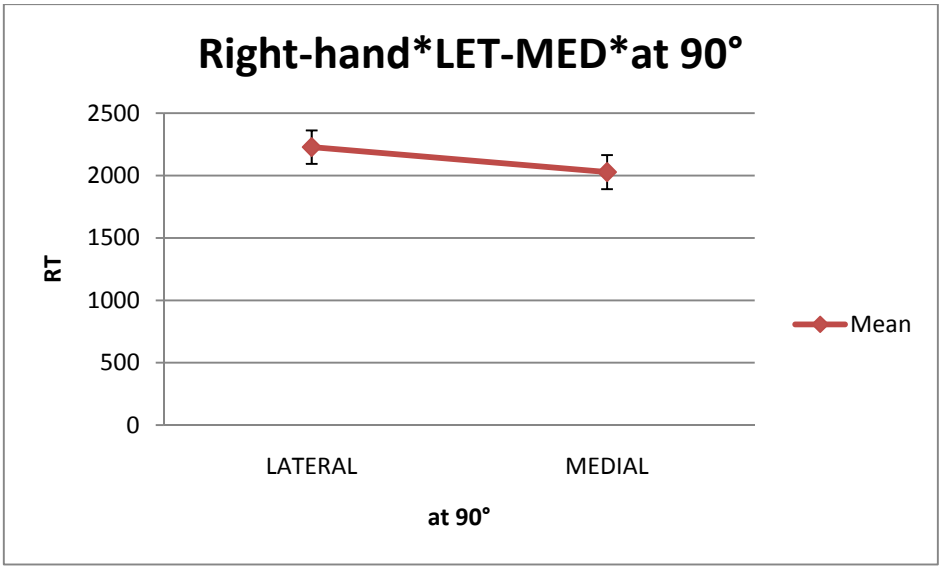

Figure 65: Mean Reaction Times and Standard Errors for RIGHT HAND* LETERAL-MEDIAL* at 90°

RIGHT HAND LETERAL-MEDIAL* at 135°*

Finally, for the Right hand the effect of lateral–medial gradient was significant at 135° (F (1, 19) =38.187, p =.000, with significantly longer RTs for the Medial than for the Lateral. See details in Table 170. Mean Reaction Times and Standard Errors are represented in Fig. 65

			95% Confidence Interval	
LAT_MED	Mean	Std. Error	Lower Bound	Upper Bound
LATERAL	1939.972	133.900	1659.717	2220.227
MEDIAL	2438.423	136.162	2153.433	2723.414

Table 170: Mean Reaction Times and Standard Errors for RIGHT HAND* LETERAL-MEDIAL* at 135°

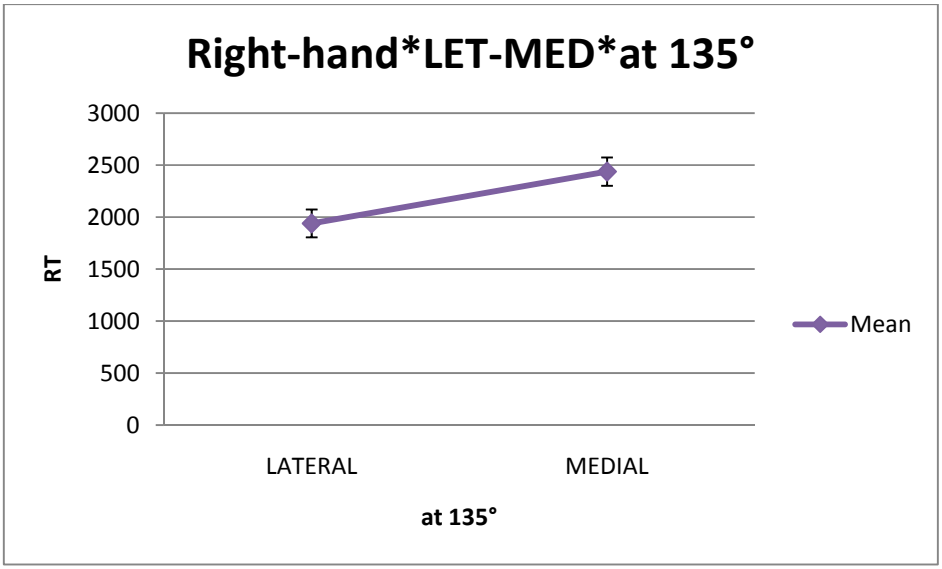

Figure 66: Mean Reaction Times and Standard Errors for RIGHT HAND* LETERAL-MEDIAL* at 135°

LEFT HAND* LETERAL-MEDIAL*ORIENTATION

To understand the nature of the significant (LETERAL-MEDIAL*ORIENTATION) interactions The ANOVA performed for the Right hand and Left hand with each Orientation separately.

LEFT HAND* LETERAL-MEDIAL* at 45°

The result showed that for Left hand, the effect of lateral–medial gradient was significant at 45° (F (1, 19) = 11.700, p=.003), with significantly longer RTs for the Medial than for the Lateral. See details in Table 171 and. Mean Reaction Times and Standard Errors are represented in Fig. 66

LAT_MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	1882.407	105.585	1661.416	2103.398
MEDIAL	2171.080	148.934	1859.358	2482.802

Table 171: Mean Reaction Times and Standard Errors for LEFT HAND* LETERAL-MEDIAL* at 45°

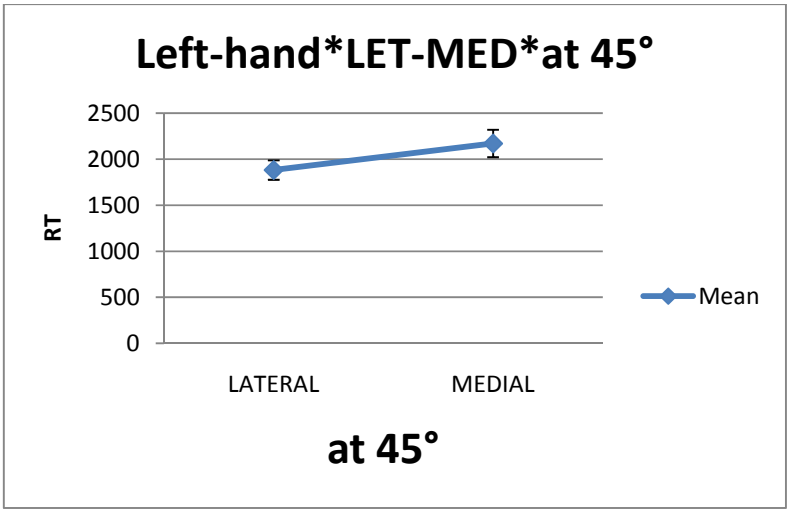

Figure 67: Mean Reaction Times and Standard Errors for LEFT HAND* LETERAL-MEDIAL* at 45°

LEFT HAND LETERAL-MEDIAL* at 90°*

The effect of lateral–medial gradient was significant at 90° (F (1, 19) =7.805, p =.012, with significantly longer RTs for the Medial than for the Lateral. See details in Table 172. Mean Reaction Times and Standard Errors are represented in Fig. 67

LAT_MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	2052.618	134.868	1770.335	2334.901
MEDIAL	2270.243	115.615	2028.258	2512.228

Table 172: Mean Reaction Times and Standard Errors for LEFT HAND* LETERAL-MEDIAL* at 90°

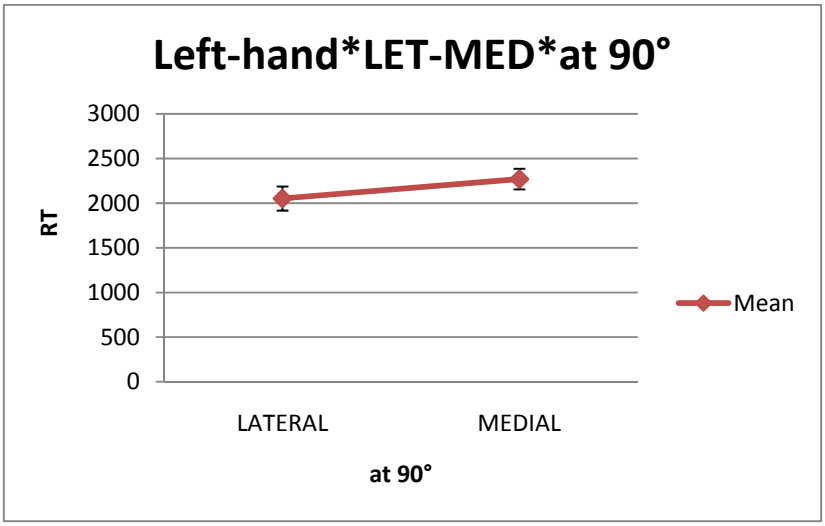

Figure 68: Mean Reaction Times and Standard Errors for LEFT HAND* LETERAL-MEDIAL* at 90°

LEFT HAND LETERAL-MEDIAL* at 135°*

Finally, for the Right hand the effect of lateral–medial gradient was significant at 135° (F (1, 19) =68.970, p =.000, with significantly longer RTs for the Lateral than for Medial. See details in Table173. Mean Reaction Times and Standard Errors are represented in Fig. 68

			95% Confidence Interval	
LAT_MED	Mean	Std. Error	Lower Bound	Upper Bound
LATERAL	2471.964	122.185	2216.227	2727.701
MEDIAL	1783.948	88.370	1598.989	1968.908

Table 173: Mean Reaction Times and Standard Errors for LEFT HAND* LETERAL-MEDIAL* at 135°

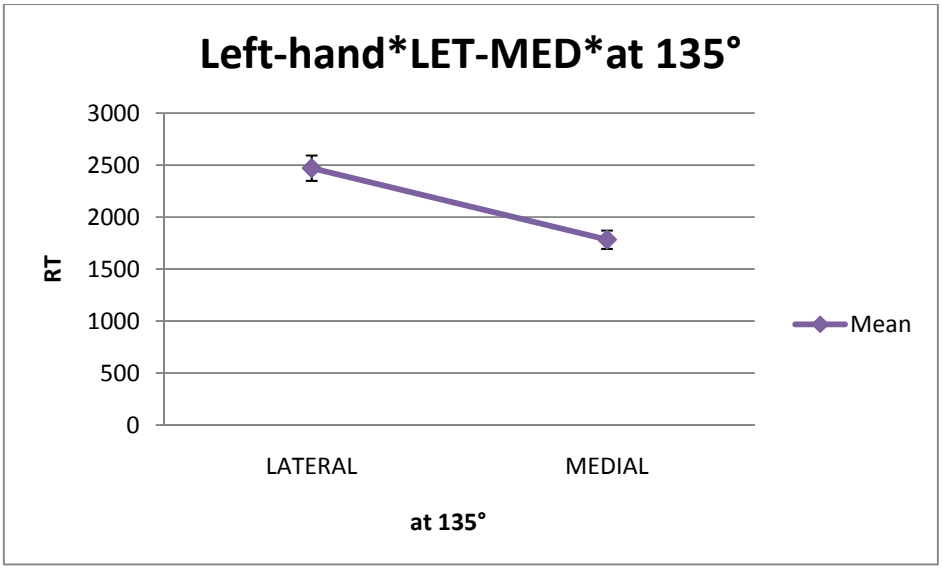

Figure 69: Mean Reaction Times and Standard Errors for LEFT HAND* LETERAL-MEDIAL* at 135°

STRATEGY * LETERAL-MEDIAL* ORIENTATION* POSITION

We found a significant four-way (STRATEGY * LETERAL-MEDIAL* ORIENTATION* POSITION) interaction F (4, 76) = 2,691, p=.037).

Post hoc on STRATEGY * LETERAL-MEDIAL* ORIENTATION* POSITION

Post hoc analysis was performed on the motor and the visual strategy separately.

*MOTOR STRATEGY * LETERAL-MEDIAL*

For the motor strategy we found a significant main effect of lateral–medial gradient (F (1, 19) =6.721, p = .018), with longer RTs for the Medial than for the Lateral. See details in Table 174

LAT_MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	2223.962	93.374	2028.527	2419.397
MEDIAL	2322.297	89.924	2134.083	2510.510

Table 174: Mean Reaction Times and Standard Errors for MOTOR STRATEGY * LETERAL-MEDIAL

*MOTOR STRATEGY * ORIENTATION (LAT/MED)*

Moreover the effect of Orientation was significant (F (2, 18) = 40.310, p = .000) with significantly longer RTs for the 90° than 45° and 135 °. See details in Table 175

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45 °	2087.990	93.495	1892.304	2283.677
90 °	2476.464	87.423	2293.487	2659.442
135 °	2254.932	101.418	2042.662	2467.203

Table 175: Mean Reaction Times and Standard Errors for MOTOR STRATEGY * ORIENTATION (LAT/MED)

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-388.474(*)	50.146	.000	-520.114	-256.834
	135°	-166.942(*)	35.179	.000	-259.290	-74.594
90°	45°	388.474(*)	50.146	.000	256.834	520.114
	135°	221.532(*)	62.215	.006	58.210	384.854
135°	45°	166.942(*)	35.179	.000	74.594	259.290
	90°	-221.532(*)	62.215	.006	-384.854	-58.210

Table 176: Pairwise Comparisons for MOTOR STRATEGY * ORIENTATION (LAT/MED)

*MOTOR STRATEGY * POSITION (LAT/MED)*

By contrast, the effect of Position was not significant (F (2, 18) = 1.759, p > 0.05). See details in Table 177 and 178.

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2308.735	94.889	2110.130	2507.340
C	2254.391	95.286	2054.956	2453.827
LVF	2256.261	85.277	2077.775	2434.747

Table 177: Mean Reaction Times and Standard Errors for MOTOR STRATEGY * POSITION (LAT/MED)

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	54.344	31.773	.310	-29.065	137.752
	LVF	52.474	35.550	.469	-40.848	145.796
C	RVF	-54.344	31.773	.310	-137.752	29.065
	LVF	-1.870	37.509	1.000	-100.335	96.596
LVF	RVF	-52.474	35.550	.469	-145.796	40.848
	C	1.870	37.509	1.000	-96.596	100.335

Table 178: Pairwise Comparisons for MOTOR STRATEGY * POSITION (LAT/MED)

*MOTOR STRATEGY * LETERAL-MEDIAL* ORIENTATION*

Furthermore, the effect of (LETERAL-MEDIAL*ORIENTATION) interaction was significant (F (2, 18) = 11.194, p = .001). See details in Table 179. Mean Reaction Times and Standard Errors are represented in Fig.69

LAT.MED	Orientation	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	45 °	2097.614	95.871	1896.954	2298.274
	90 °	2201.570	86.846	2019.800	2383.340
	135 °	2372.700	120.203	2121.112	2624.288
MEDIAL	45 °	2078.366	102.905	1862.984	2293.748
	90 °	2751.359	118.132	2504.105	2998.612
	135 °	2137.165	96.327	1935.550	2338.780

Table 179: Mean Reaction Times and Standard Errors for MOTOR STRATEGY * LETERAL-MEDIAL* ORIENTATION

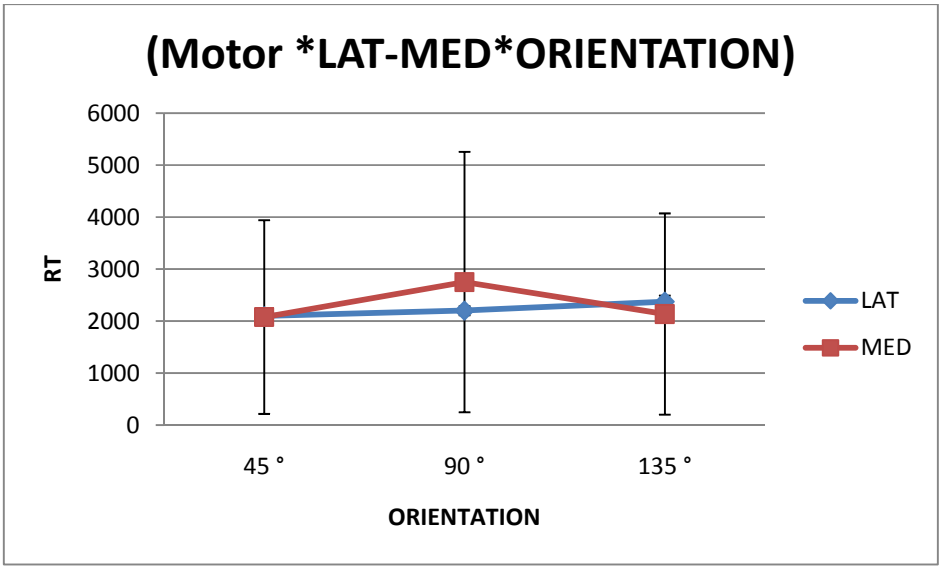

Figure 70: Mean Reaction Times and Standard Errors for MOTOR STRATEGY * LETERAL-MEDIAL* ORIENTATION

*MOTOR STRATEGY * ORIENTATION* POSITION (LAT/MED)*

By contrast, the effect of (LAT.MED * POSITION) and (ORIENTATION*POSITION) were not significant. Respectively [(f (2, 18) = .085, p>0.05) and (f (4, 16) = 1.837, p>0.05). See details in Table 180 and 181. Mean Reaction Times and Standard Errors are represented in Fig.70 and 71

LAT.MED	POSITION	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	RVF	2261.937	94.130	2064.921	2458.953
	C	2197.797	109.961	1967.646	2427.949
	LVF	2212.150	87.194	2029.650	2394.650
MEDIAL	RVF	2355.533	103.795	2138.286	2572.779
	C	2310.985	87.638	2127.558	2494.413
	LVF	2300.372	89.268	2113.531	2487.212

Table 180: Mean Reaction Times and Standard Errors for MOTOR STRATEGY * LETERAL-MEDIAL * POSITION

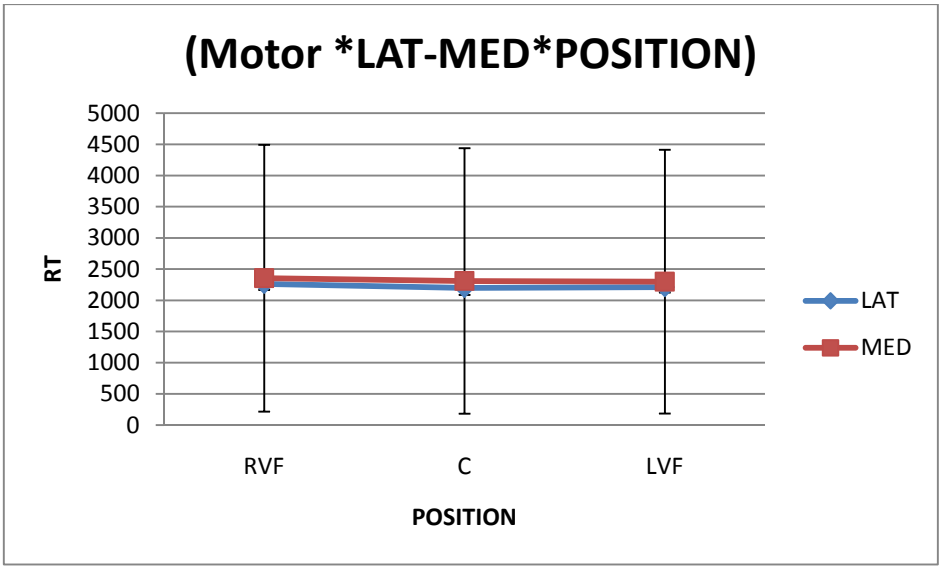

Figure 71: Mean Reaction Times and Standard Errors for MOTOR STRATEGY * LETERAL-MEDIAL * POSITION

ORIENTATION* POSITION

ORIENTATION	POSITION	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
45°	RVF	2079.263	99.257	1871.516	2287.010
	C	2108.438	109.062	1880.167	2336.708
	LVF	2076.271	92.606	1882.444	2270.097
90°	RVF	2501.523	96.893	2298.723	2704.323
	C	2423.115	96.635	2220.854	2625.375
	LVF	2504.755	86.186	2324.366	2685.144
135°	RVF	2345.418	111.481	2112.086	2578.750
	C	2231.621	109.943	2001.509	2461.734
	LVF	2187.757	104.696	1968.625	2406.889

Table 181: Mean Reaction Times and Standard Errors for MOTOR STRATEGY * ORIENTATION* POSITION (LAT/MED)

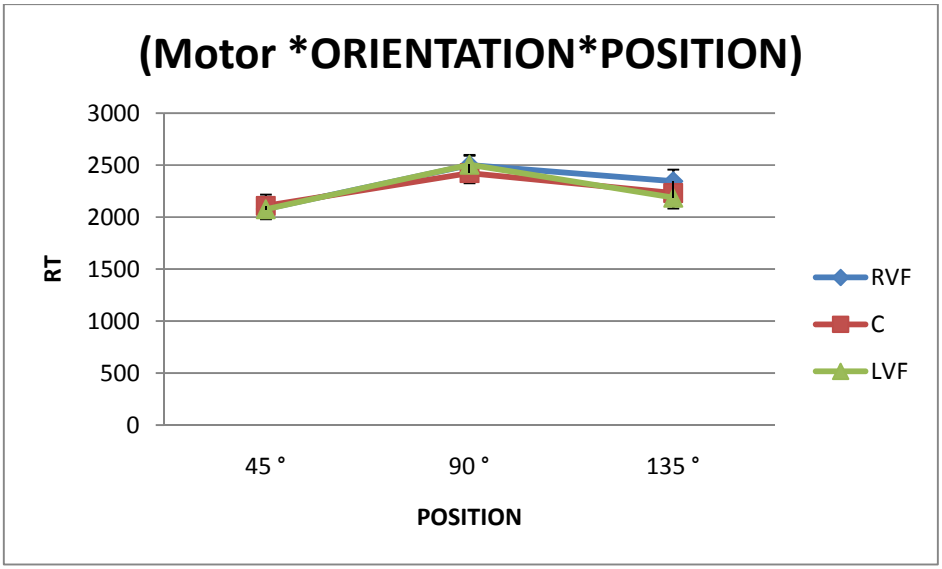

Figure 72: Mean Reaction Times and Standard Errors for MOTOR STRATEGY * ORIENTATION* POSITION (LAT/MED)

*MOTOR STRATEGY * LETERAL-MEDIAL* ORIENTATION* POSITION*

Finally, the effect of (LAT.MED * ORIENTATION * POSITION) was not significant (f(4,16)= 2.612, p>0.05)

*VISUAL STRATEGY * LETERAL-MEDIAL*

For the VISUAL strategy we found a significant main effect of lateral–medial gradient (F (1, 19) =7.495, p = .013), with longer RTs for the Medial than for the Lateral. See details in Table 182

			95% Confidence Interval	
LAT.MED	Mean	Std. Error	Lower Bound	Upper Bound
LATERAL	1912.043	149.234	1599.694	2224.393
MEDIAL	1991.681	160.585	1655.573	2327.789

Table 182: Mean Reaction Times and Standard Errors for VISUAL STRATEGY * LETERAL-MEDIAL

*VISUAL STRATEGY * ORIENTATION (LAT/MED)*

Moreover the effect of Orientation was significant (F (2, 18) = 29.100, p = .000) with significantly longer RTs for the 90° than 45° and 135 °. See details in Table 183 and184.

ORIENTATION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45 °	1842.409	159.180	1509.240	2175.577
90 °	2126.066	147.664	1817.001	2435.131
135 °	1887.112	161.132	1549.860	2224.364

Table 183: Mean Reaction Times and Standard Errors for VISUAL STRATEGY * ORIENTATION (LAT/MED)

(I) ORIENTATION	(J) ORIENTATION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-283.657(*)	39.829	.000	-388.212	-179.103
	135°	-44.703	42.429	.916	-156.084	66.678
90°	45°	283.657(*)	39.829	.000	179.103	388.212
	135°	238.954(*)	39.690	.000	134.765	343.144
135°	45°	44.703	42.429	.916	-66.678	156.084
	90°	-238.954(*)	39.690	.000	-343.144	-134.765

Table 184: Pairwise Comparisons for VISUAL STRATEGY * ORIENTATION (LAT/MED)

*VISUAL STRATEGY * POSITION (LAT/MED)*

By contrast, the effect of Position was not significant (F (2, 18) = 1.600, p > 0.05). See details in Table 185

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	1989.250	143.321	1689.275	2289.225
C	1920.644	164.322	1576.714	2264.575
LVF	1945.692	158.509	1613.928	2277.456

Table 185: Mean Reaction Times and Standard Errors for VISUAL STRATEGY * POSITION (LAT/MED)

*(VISUAL STRATEGY * LETERAL-MEDIAL* ORIENTATION)(VISUAL STRATEGY * LETERAL-MEDIAL * POSITION)(VISUAL STRATEGY * ORIENTATION* POSITION)*

By contrast, the effect of (LETERAL-MEDIAL*ORIENTATION), (LAT.MED * POSITION) and (ORIENTATION*POSITION) were not significant. Respectively[(F(2,18)= 3.123, p > .05) (f(2,18)= 1.130,p>0.05) and (f(4,16)= 1.468>0.05)

LAT.MED	ORIENTATION	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	45 °	1808.107	151.468	1491.080	2125.133
	90 °	2016.424	139.843	1723.728	2309.119
	135 °	1911.599	167.089	1561.877	2261.321
MEDIAL	45 °	1876.711	170.213	1520.450	2232.971
	90 °	2235.709	160.788	1899.175	2572.242
	135 °	1862.624	161.736	1524.107	2201.142

Table 186: Mean Reaction Times and Standard Errors for VISUAL STRATEGY * LETERAL-MEDIAL* ORIENTATION

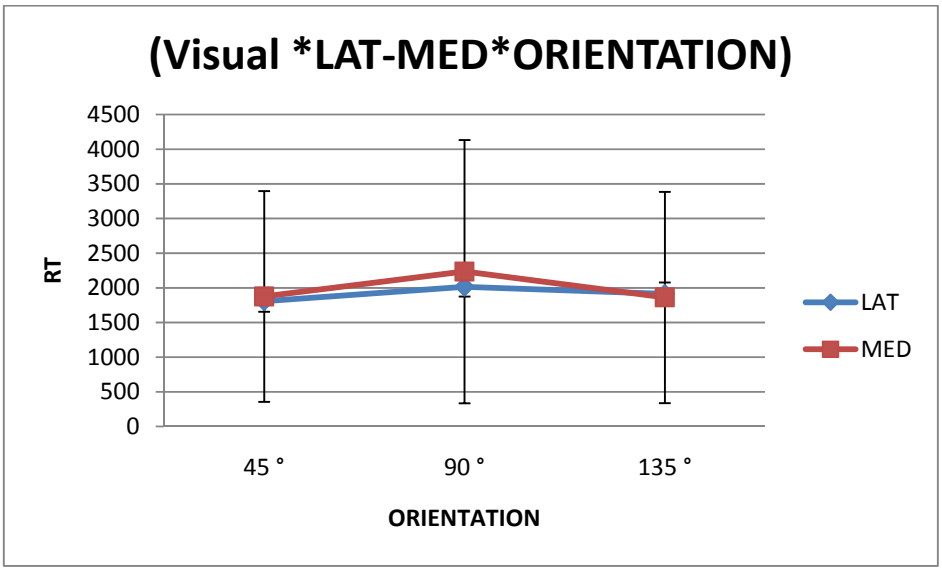

Figure 73: Mean Reaction Times and Standard Errors for VISUAL STRATEGY * LETERAL-MEDIAL* ORIENTATION

LAT.MED	POSITION	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	RVF	1985.251	123.478	1726.809	2243.693
	C	1866.990	163.410	1524.969	2209.011
	LVF	1883.888	165.556	1537.375	2230.401
MEDIAL	RVF	1993.249	165.874	1646.070	2340.428
	C	1974.299	168.420	1621.792	2326.806
	LVF	2007.496	153.691	1685.817	2329.176

Table 187: Mean Reaction Times and Standard Errors for VISUAL STRATEGY * LETERAL-MEDIAL * POSITION

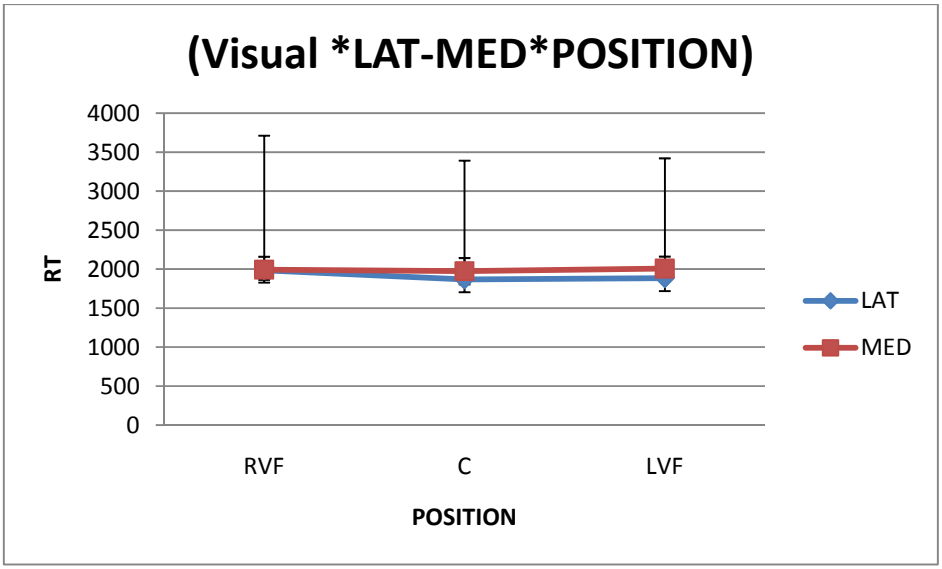

Figure 74: Mean Reaction Times and Standard Errors for VISUAL STRATEGY * LETERAL-MEDIAL * POSITION

ORIENTATION	POSITION	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
45°	RVF	1864.346	161.805	1525.685	2203.007
	C	1817.171	161.126	1479.932	2154.411
	LVF	1845.709	162.905	1504.744	2186.673
90°	RVF	2213.603	130.655	1940.138	2487.067
	C	2110.235	170.705	1752.944	2467.525
	LVF	2054.361	151.814	1736.610	2372.112
135°	RVF	1889.802	151.062	1573.625	2205.978
	C	1834.527	169.413	1479.941	2189.113
	LVF	1937.007	171.780	1577.467	2296.547

Table 188: Mean Reaction Times and Standard Errors for VISUAL STRATEGY * ORIENTATION* POSITION

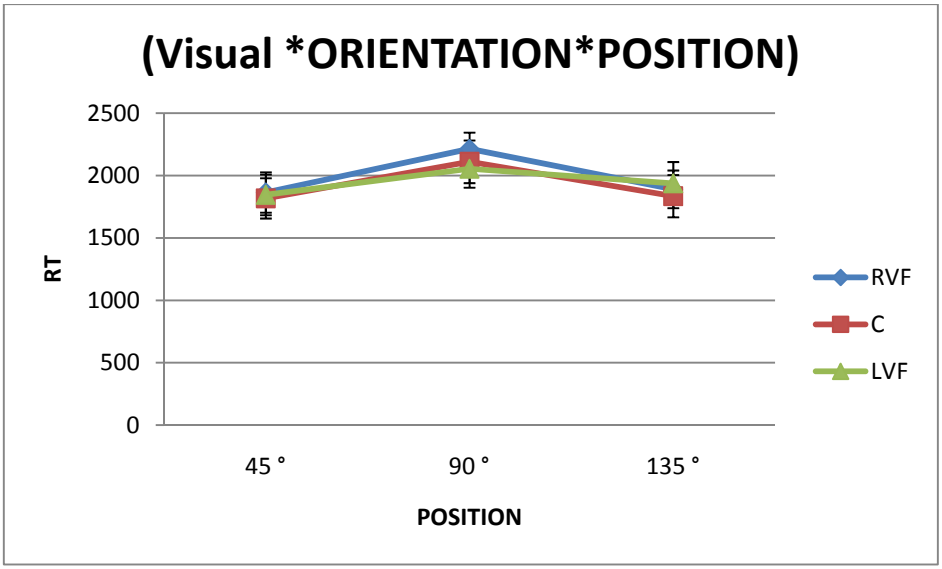

Figure 75: Mean Reaction Times and Standard Errors for VISUAL STRATEGY * ORIENTATION* POSITION

LETERAL-MEDIAL* ORIENTATION* POSITION

Finally, the effect of (LAT.MED * ORIENTATION * POSITION) was significant (f (4, 16) = 6.905, p=0.002)

Post hoc analysis on LETERAL-MEDIAL* ORIENTATION* POSITION

Post hoc analysis was performed for both lateral and medial separately, for each of the stimulus position (RVF, centre, LVF) for the motor and the visual strategy respectively.

*MOTOR*RVF*LATERAL*at (45°,90° , 135°)*

For stimuli presented in the RVF at LATERAL orientations, the hand laterality (R vs. L hand) was significant at 45° [(F(1,19)=14,322, p =.001] with significantly higher RTs for the Left than for the Right hand . and was not at all the other orientations: 90° [(F(1,19)=,067, p > .05., n.s.)], 135 [(F(1,19)=,486, p > .05., n.s.)]. For those at MEDIAL orientations the hand laterality was significant at 135 [(F(1,19)=7,05, p =.013] with significantly higher RTs for the Right than for the Left hand was not at: 45° [(F(1,19)=4,25, p = .053, n.s.)], 90 [(F(1,19)=3,38, p = .82., n.s.)].See details in Table 189,190,191,192,193 and 194 .Mean Reaction Times and Standard Errors are represented in Fig. 75 and 76

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1937.712	102.019	1724.185	2151.240
Left	2339.814	100.816	2128.802	2550.825

Table 189: Mean Reaction Times and Standard Errors for MOTOR*RVF*LATERAL*45°

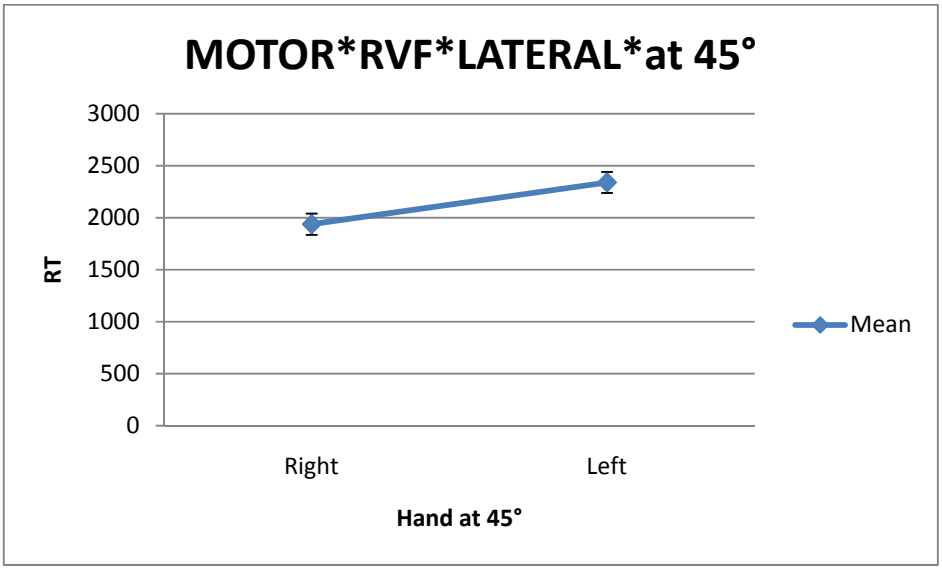

Figure 76: Mean Reaction Times and Standard Errors for MOTOR*RVF*LATERAL*45°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2476.835	102.892	2261.480	2692.191
Left	2439.432	179.522	2063.688	2815.175

Table 190: Mean Reaction Times and Standard Errors for MOTOR*RVF*LATERAL*90°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2859.657	154.807	2535.642	3183.673
Left	2768.607	149.015	2456.714	3080.499

Table 191: Mean Reaction Times and Standard Errors for MOTOR*RVF*LATERAL*135°

*MOTOR*RVF*MEDIAL *(45°, 90°, 135°)*

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2075.699	131.743	1799.958	2351.440
Left	2302.130	109.477	2072.993	2531.267

Table 192: Mean Reaction Times and Standard Errors for MOTOR*RVF*MEDIAL *45°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1907.515	146.095	1601.735	2213.295
Left	2132.011	140.986	1836.924	2427.098

Table 193: Mean Reaction Times and Standard Errors for MOTOR*RVF*MEDIAL *90°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2354.142	129.174	2083.777	2624.507
Left	2111.264	117.999	1864.290	2358.238

Table 194: Mean Reaction Times and Standard Errors for MOTOR*RVF*MEDIAL *135°

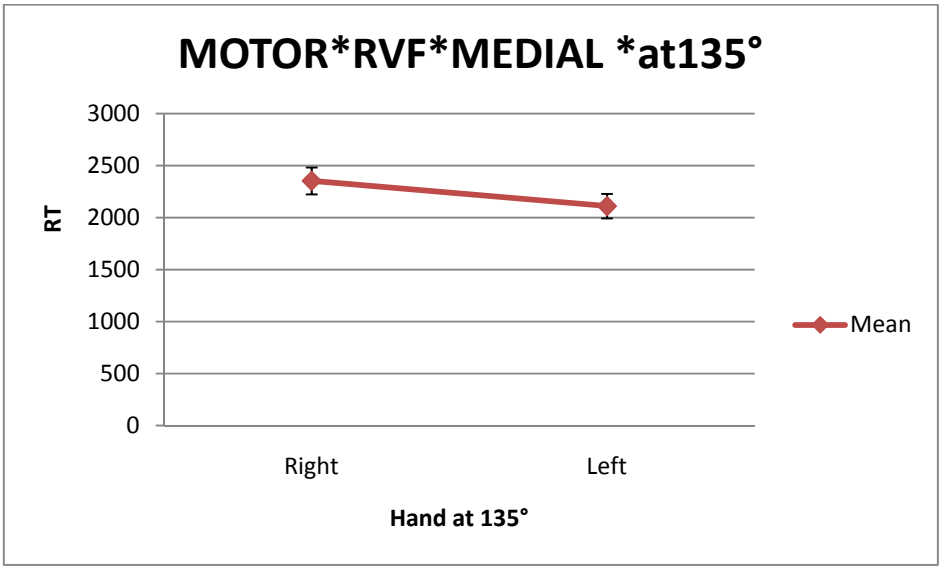

Figure 77: Mean Reaction Times and Standard Errors for MOTOR*RVF*MEDIAL *135°

*MOTOR*C *LATERAL-MEDIAL* (45°, 90°, 135°)*

For stimuli presented in the CENTRE at LATERAL orientations the hand laterality was significant at 45° [(F (1, 19) =5, 64, p =.028] with significantly higher RTs for the Left than for the Right hand. For the 90 [(F (1, 19) =6,109, p =.023] with significantly higher RTs for the Left than for the Right hand; and was not at 135 [(F(1,19)=,033, p > .05., n.s.)]. For those at MEDIAL orientations the hand laterality (Right vs Left hand) was significant at 45° [(F(1,19)=33,79, p =.000] with significantly higher RTs for the Left than for the Right hand, and 135 [(F(1,19)=6,92, p =.016], with significantly higher RTs for the Right than for the Left hand, and was not significant at 90° [(F(1,19)=,468, p > .05., n.s.)]. See details in Table195-200.Mean Reaction Times and Standard Errors are represented in Fig. 77-80

Table 195: Mean Reaction Times and Standard Errors for MOTOR*C *LATERAL*45°

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	1959.677	128.181	1691.390	2227.964
Left	2224.757	136.948	1938.123	2511.392

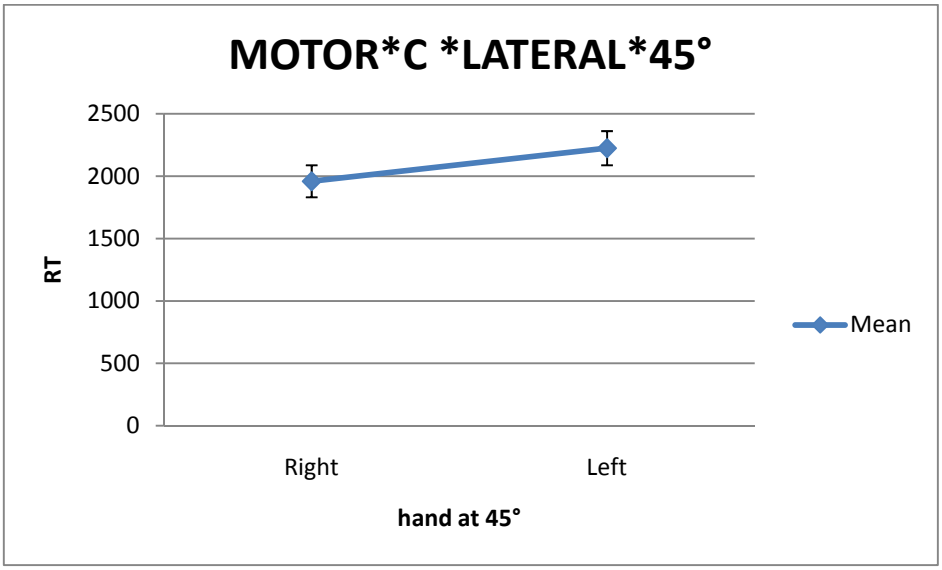

Figure 78: Mean Reaction Times and Standard Errors for MOTOR*C *LATERAL*45°

Table 196: Mean Reaction Times and Standard Errors for MOTOR*C *LATERAL*90°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2108.767	113.340	1871.543	2345.990
Left	2470.030	174.783	2104.205	2835.855

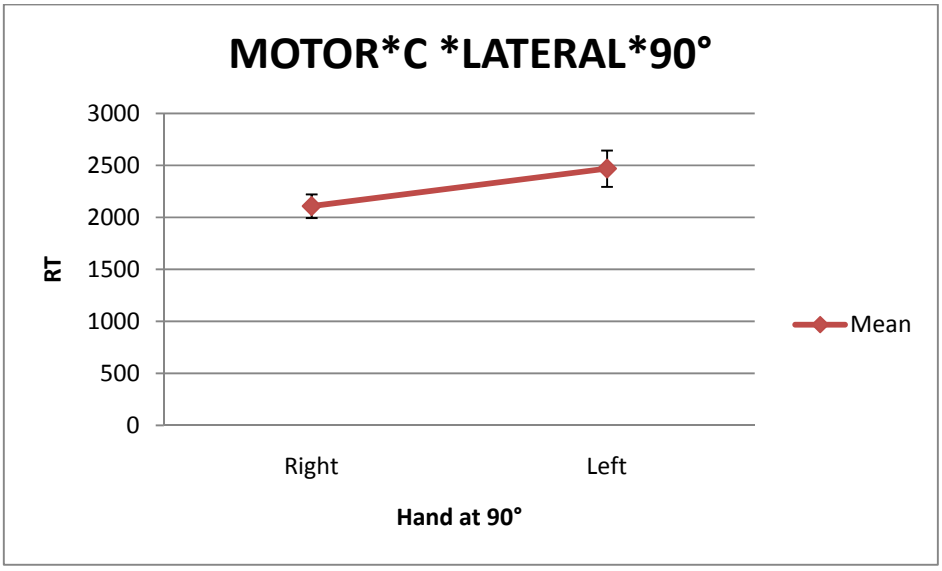

Figure 79: Mean Reaction Times and Standard Errors for MOTOR*C *LATERAL*90°

Table 197: Mean Reaction Times and Standard Errors for MOTOR*C *LATERAL*135°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2651.344	130.901	2377.365	2925.323
Left	2617.563	164.109	2274.079	2961.048

*MOTOR*C*MEDIAL *45°*

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1904.872	123.539	1646.303	2163.442
Left	2518.679	133.201	2239.887	2797.471

Table 198: Mean Reaction Times and Standard Errors for MOTOR*C*MEDIAL *45°

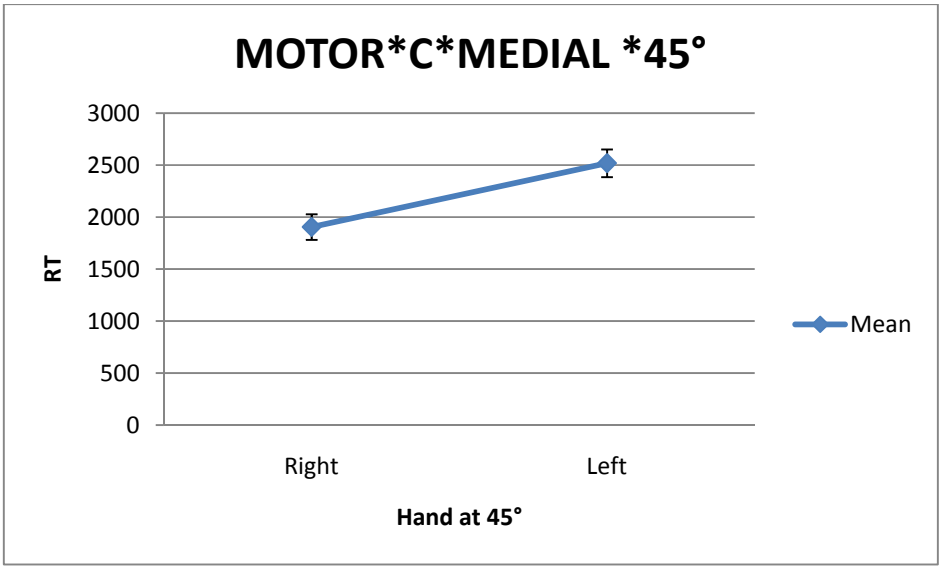

Figure 80: Mean Reaction Times and Standard Errors for MOTOR*C*MEDIAL *45°

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	2162.583	126.507	1897.800	2427.366
Left	2086.733	132.141	1810.158	2363.308

Table 199: Mean Reaction Times and Standard Errors for MOTOR*C*MEDIAL *90°

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	2389.119	156.378	2061.817	2716.422
Left	1958.570	111.034	1726.172	2190.968

Table 200: Mean Reaction Times and Standard Errors for MOTOR*C*MEDIAL *135°

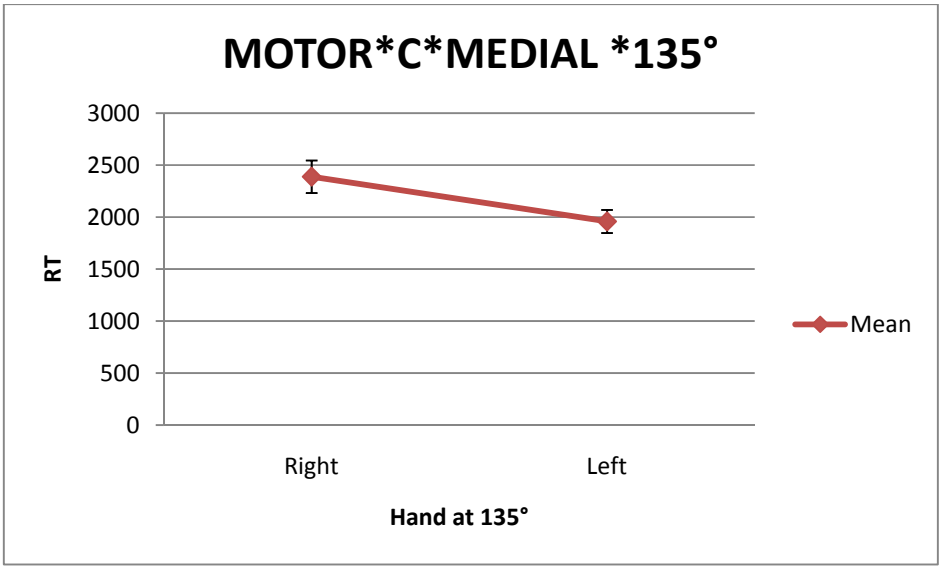

Figure 81: Mean Reaction Times and Standard Errors for MOTOR*C*MEDIAL *135°

*MOTOR*LVF *LATERAL-MEDIAL*(45°, 90°, 135°)*

For stimuli presented in the LVF at LATERAL orientations the hand laterality was not significant at all the orientations: 45° [(F(1,19)=,925, p > .05., n.s.)], 90 [(F(1,19)=,121, p > .05., n.s.)], 135 [(F(1,19)=,023, p > .05., n.s.)], whereas at MEDIAL orientations it was significant at 135 [(F(1,19)=5,714, p =.027, with significantly higher RTs for the Right than for the Left hand; but not at 45° [(F(1,19)=4,19, p = .055., n.s.)], and 90 [(F(1,19)=1,755, p > .05., n.s.)]. See details in Table201-206.Mean Reaction Times and Standard Errors are represented in Fig. 81

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	2111.264	117.999	1864.290	2358.238
Left	2012.462	123.686	1753.583	2271.340

Table 201: Mean Reaction Times and Standard Errors for MOTOR*LVF *LATERAL*45°

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	2350.476	149.713	2037.122	2663.830
Left	2390.661	142.017	2093.416	2687.906

Table 202: Mean Reaction Times and Standard Errors for MOTOR*LVF *LATERAL*90°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2816.221	160.386	2480.529	3151.913
Left	2794.760	134.109	2514.066	3075.453

Table 203: Mean Reaction Times and Standard Errors for MOTOR*LVF *LATERAL*135°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2051.334	93.937	1854.722	2247.946
Left	2356.706	117.247	2111.305	2602.107

Table 204: Mean Reaction Times and Standard Errors for MOTOR*LVF *MEDIAL *45°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2003.742	92.228	1810.707	2196.778
Left	2177.614	139.201	1886.262	2468.965

Table 205: Mean Reaction Times and Standard Errors for MOTOR*LVF *MEDIAL *90°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2178.178	149.253	1865.788	2490.568
Left	1831.715	86.020	1651.672	2011.757

Table 206: Mean Reaction Times and Standard Errors for MOTOR*LVF *MEDIAL *135°

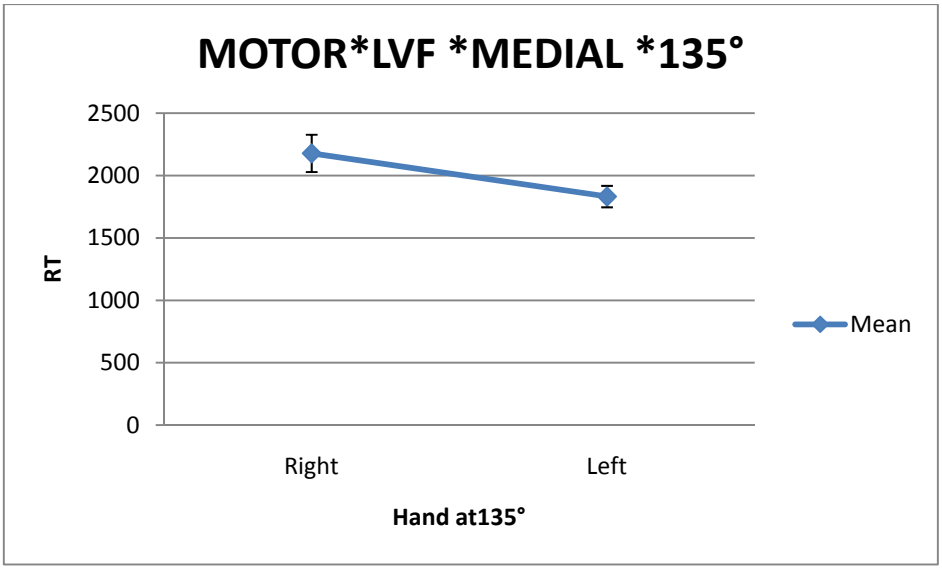

Figure 82: Mean Reaction Times and Standard Errors for MOTOR*LVF *MEDIAL *135°

VISUAL STRATEGY*LETERAL-MEDIAL* ORIENTATION* POSITION

For stimuli presented in the RVF at LATERAL orientations the hand laterality (R vs. L hand) was not significant: 45 [(F(1,19)=,558, p > .05., n.s.)], 90 [(F(1,19)=,037, p > .05., n.s.)], 135 [(F(1,19)=,045, p > .05., n.s.)]. For those presented at MEDIAL orientations it was significant at 45 [(F(1,19)=8,28, p =.010, with significantly higher Rts for the Left than for the Right hand; and was not at 90 [(F(1,19)=1,114, p > .05., n.s.)] and 135 [(F(1,19)=1,75, p > .05., n.s.)]. See details in Table207-212.Mean Reaction Times and Standard Errors are represented in Fig. 82

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	1838.157	164.937	1492.940	2183.375
Left	1931.188	185.511	1542.910	2319.467

Table 207: Mean Reaction Times and Standard Errors for VISUAL*RVF *LATERAL*45°

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	1876.892	138.269	1587.491	2166.293
Left	1851.875	174.544	1486.550	2217.200

Table 208: Mean Reaction Times and Standard Errors for VISUAL*RVF *LATERAL*90°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2233.325	177.890	1860.997	2605.653
Left	2207.691	202.041	1784.815	2630.568

Table 209: Mean Reaction Times and Standard Errors for VISUAL*RVF *LATERAL*135°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1756.578	155.771	1430.544	2082.611
Left	2100.835	183.676	1716.397	2485.273

Table 210: Mean Reaction Times and Standard Errors for VISUAL*RVF *MEDIAL *45°

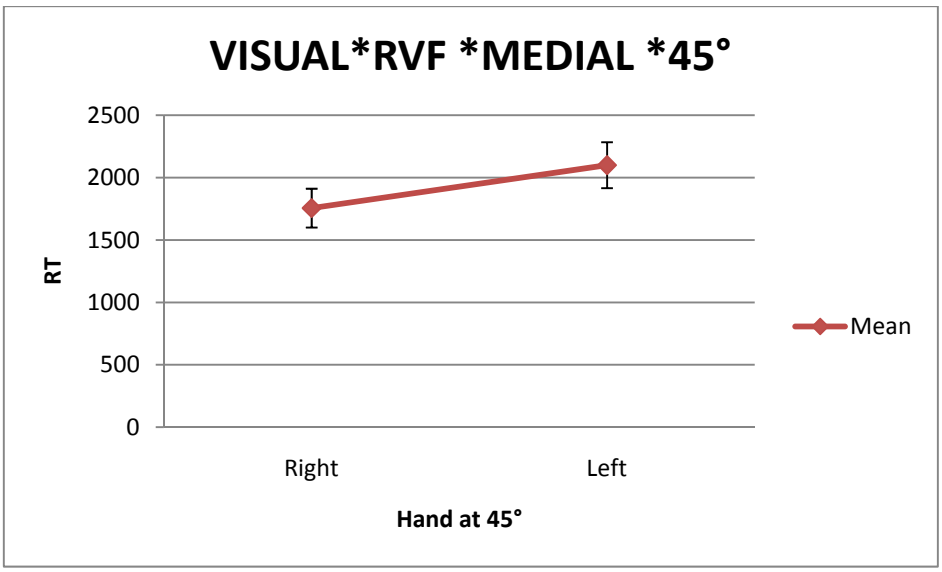

Figure 83: Mean Reaction Times and Standard Errors for VISUAL*RVF *MEDIAL *45°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1779.201	173.396	1416.279	2142.122
Left	1908.838	178.947	1534.298	2283.378

Table 211: Mean Reaction Times and Standard Errors for VISUAL*RVF *MEDIAL *90°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1992.936	181.200	1613.679	2372.192
Left	1837.503	177.757	1465.453	2209.554

Table 212: Mean Reaction Times and Standard Errors for VISUAL*RVF *MEDIAL *135°

*VISUAL*C *LATERAL-MEDIAL*(45°, 90°, 135°)*

For stimuli presented in the CENTRE at LATERAL orientations the hand laterality was not significant: 45 [(F(1,19)=1,121, p > .05., n.s.)], 90 [(F(1,19)=,429, p > .05., n.s.)], 135 [(F(1,19)=2,41, p > .05., n.s.)],. For those presented at MEDIAL orientations the hand laterality was significant at 45 [(F(1,19)=6,36, p =.021, with significantly higher Rts for the Left than for the Right; and 135 [(F(1,19)=11,387, p =.003, with significantly higher Rts for the Right than for the Left hand, and was not at 90 [(F(1,19)=,182, p > .05., n.s.)]. See details in Table213-218.Mean Reaction Times and Standard Errors are represented in Fig. 83 and 84

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	1808.397	138.046	1519.462	2097.331
Left	1705.560	160.607	1369.405	2041.714

Table 213: Mean Reaction Times and Standard Errors for VISUAL*C *LATERAL*45°

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	1868.996	167.209	1519.023	2218.969
Left	1933.553	215.042	1483.466	2383.641

Table 214: Mean Reaction Times and Standard Errors for VISUAL*C *LATERAL*90°

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	2381.828	171.416	2023.049	2740.606
Left	2173.677	194.087	1767.447	2579.906

Table 215: Mean Reaction Times and Standard Errors for VISUAL*C *LATERAL*135°

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	1795.940	160.072	1460.904	2130.975
Left	2089.495	211.285	1647.269	2531.720

Table 216: Mean Reaction Times and Standard Errors for VISUAL*C *MEDIAL *45°

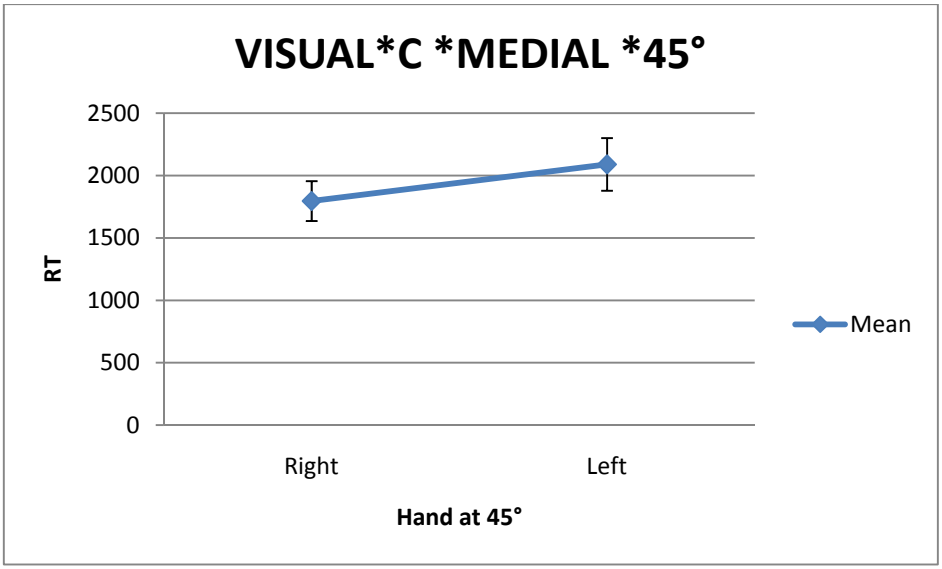

Figure 84: Mean Reaction Times and Standard Errors for VISUAL*C *MEDIAL *45°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1907.203	221.603	1443.384	2371.023
Left	1847.526	179.710	1471.390	2223.663

Table 217: Mean Reaction Times and Standard Errors for VISUAL*C *MEDIAL *90°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1956.206	201.298	1534.886	2377.527
Left	1579.353	141.398	1283.403	1875.302

Table 218: Mean Reaction Times and Standard Errors for VISUAL*C *MEDIAL *135°

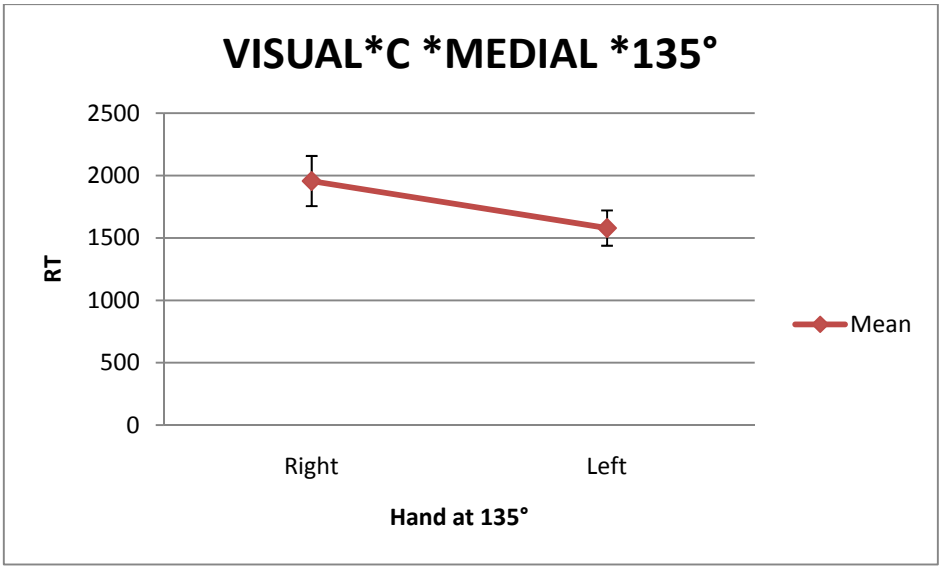

Figure 85: Mean Reaction Times and Standard Errors for VISUAL*C *MEDIAL *135°

*VISUAL*LVF *LATERAL-MEDIAL*(45°, 90°, 135°)*

For stimuli presented in the LVF at LATERAL orientations the hand laterality was not significant: 45 [(F(1,19)=,07, p > .05., n.s.)], 90 [(F(1,19)=2,06, p > .05., n.s.)], 135 [(F(1,19)=2,602, p > .05., n.s.)]. For those presented at MEDIAL orientations it was significant at 45 [(F(1,19)=10,486, p =.004, with significantly higher RTs for the Left than for the Right hand, and 135 [(F(1,19)=9,977, p =.005, with significantly higher RTs for the Right than for the Left hand, but it was not at 90 [(F(1,19)=,151, p > .05., n.s.)]. See details in Table219-224.Mean Reaction Times and Standard Errors are represented in Fig. 85and 86

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	1770.328	160.467	1434.467	2106.189
Left	1795.010	172.317	1434.345	2155.674

Table 219: Mean Reaction Times and Standard Errors for VISUAL*LVF *LATERAL*45°

			95% Confidence Interval	
HAND	Mean	Std. Error	Lower Bound	Upper Bound
Right	2060.327	192.576	1657.261	2463.394
Left	1877.951	200.967	1457.322	2298.581

Table 220: Mean Reaction Times and Standard Errors for VISUAL*LVF *LATERAL*90°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	2290.048	173.649	1926.596	2653.499
Left	1951.439	178.208	1578.444	2324.433

Table 221: Mean Reaction Times and Standard Errors for VISUAL*LVF *LATERAL*135°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1645.707	164.561	1301.277	1990.137
Left	1971.596	191.228	1571.350	2371.842

Table 222: Mean Reaction Times and Standard Errors for VISUAL*LVF *MEDIAL *45°

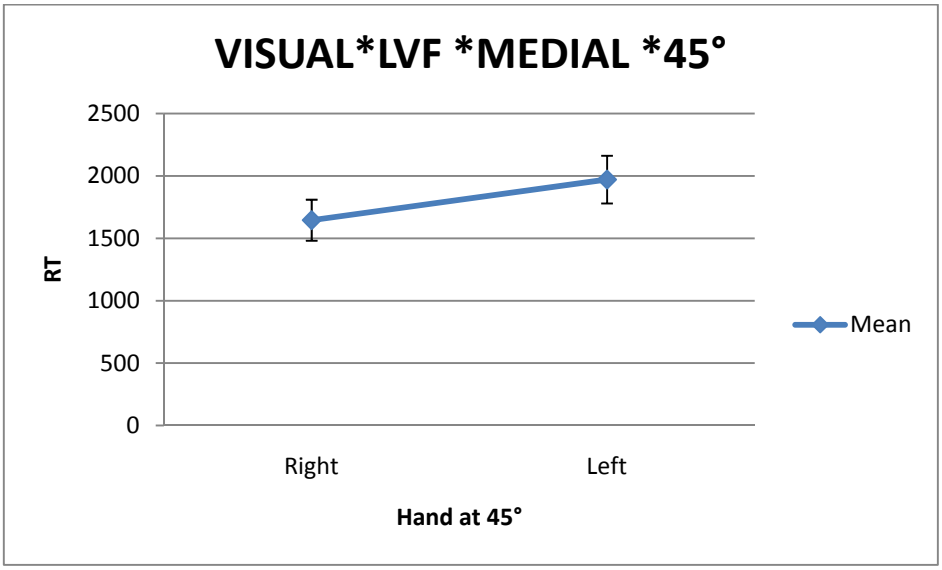

Figure 86: Mean Reaction Times and Standard Errors for VISUAL*LVF *MEDIAL *45°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1799.988	195.531	1390.738	2209.239
Left	1838.355	166.673	1489.504	2187.206

Table 223: Mean Reaction Times and Standard Errors for VISUAL*LVF *MEDIAL *90°

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	1974.572	181.584	1594.513	2354.631
Left	1658.310	156.913	1329.887	1986.732

Table 224: Mean Reaction Times and Standard Errors for VISUAL*LVF *MEDIAL *135°

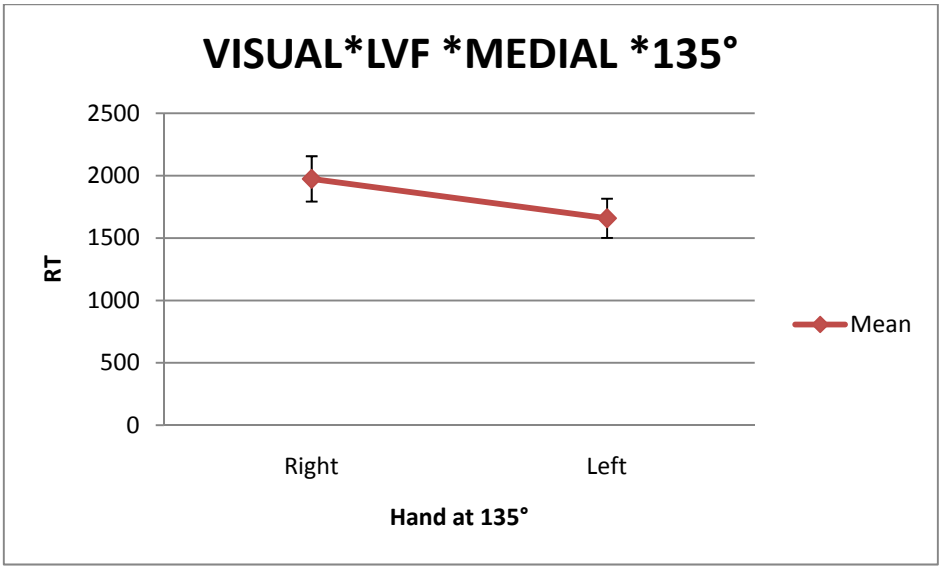

Figure 87: Mean Reaction Times and Standard Errors for VISUAL*LVF *MEDIAL *135°

HAND* LETERAL-MEDIAL* ORIENTATION* POSITION

Lastly, we found a significant four-way (HAND* LETERAL-MEDIAL* ORIENTATION* POSITION) interaction F (4, 76) = 3,667, p=.009).

Post hoc analysis on HAND* LETERAL-MEDIAL* ORIENTATION* POSITION

A further post hoc analysis performed on (HAND* LETERAL-MEDIAL* ORIENTATION* POSITION) interaction, in order to better clarified the direction of the interaction,

*RIGHT HAND * LETERAL-MEDIAL*

For the Right hand we found a significant main effect of lateral–medial gradient (F (1, 19) =19.397, p = .000), with longer RTs for the Medial than for the Lateral. See details in Table 225

LAT.MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	1965.021	107.635	1739.739	2190.303
MEDIAL	2140.096	121.913	1884.929	2395.262

Table 225: Mean Reaction Times and Standard Errors for RIGHT HAND * LETERAL-MEDIAL

*(RIGHT HAND * ORIENTATION)AND (RIGHT HAND * POSITION)*

By contrast, the effect of Orientation (F (2, 18) = 1.576, p >0.05) and Position (F (2, 18) = 3.785, p = 0.042) were not significant. See details in Table 226 and 227.

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45 °	2052.573	107.378	1827.828	2277.318
90 °	2020.181	117.152	1774.979	2265.384
135 °	2084.921	122.366	1828.806	2341.036

Table 226: Mean Reaction Times and Standard Errors for RIGHT HAND * ORIENTATION

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2075.329	115.895	1832.758	2317.900
C	2083.023	115.476	1841.329	2324.717
LVF	1999.323	113.512	1761.740	2236.907

Table 227: Mean Reaction Times and Standard Errors for RIGHT HAND * POSITION

*RIGHT HAND *LETERAL-MEDIAL*ORIENTATION*

The effect of (LETERAL-MEDIAL*ORIENTATION) interaction was not significant (F (2, 18) = 0.033, p > .05). See details in Table 228 .Mean Reaction Times and Standard Errors are represented in Fig. 87

LAT.MED	Orientation	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	45 °	1969.158	103.552	1752.421	2185.894
	90 °	1936.563	120.468	1684.421	2188.705
	135 °	1989.342	111.876	1755.184	2223.500
MEDIAL	45 °	2135.988	117.540	1889.973	2382.003
	90 °	2103.799	119.421	1853.849	2353.750
	135 °	2180.500	146.925	1872.983	2488.016

Table 228: Mean Reaction Times and Standard Errors for RIGHT HAND * LETERAL-MEDIAL*ORIENTATION

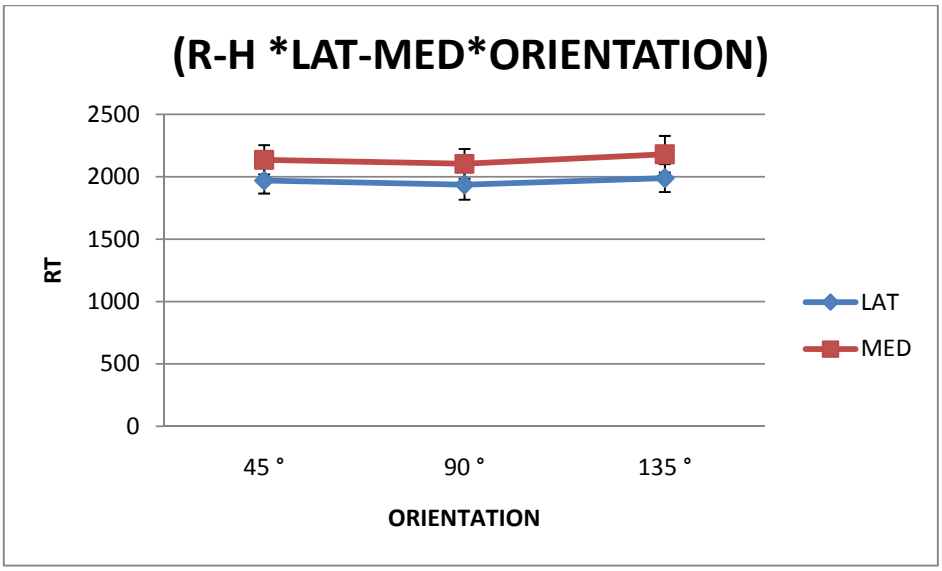

Figure 88: Mean Reaction Times and Standard Errors for RIGHT HAND * LETERAL-MEDIAL*ORIENTATION

*RIGHT HAND *LETERAL-MEDIAL*POSITION*

The effect of (LETERAL-MEDIAL*POSITION) interaction was significant (F (2, 18) = 10.802, p= 0.001). See details in Table 229. Mean Reaction Times and Standard Errors are represented in Fig. 88

LAT.MED	POSITION	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	RVF	1923.077	103.699	1706.032	2140.122
	C	2092.593	115.385	1851.089	2334.097
	LVF	1879.393	114.045	1640.694	2118.092
MEDIAL	RVF	2227.581	134.158	1946.785	2508.377
	C	2073.453	123.282	1815.420	2331.486
	LVF	2119.253	116.801	1874.786	2363.720

Table 229: Mean Reaction Times and Standard Errors for RIGHT HAND *LETERAL-MEDIAL*POSITION

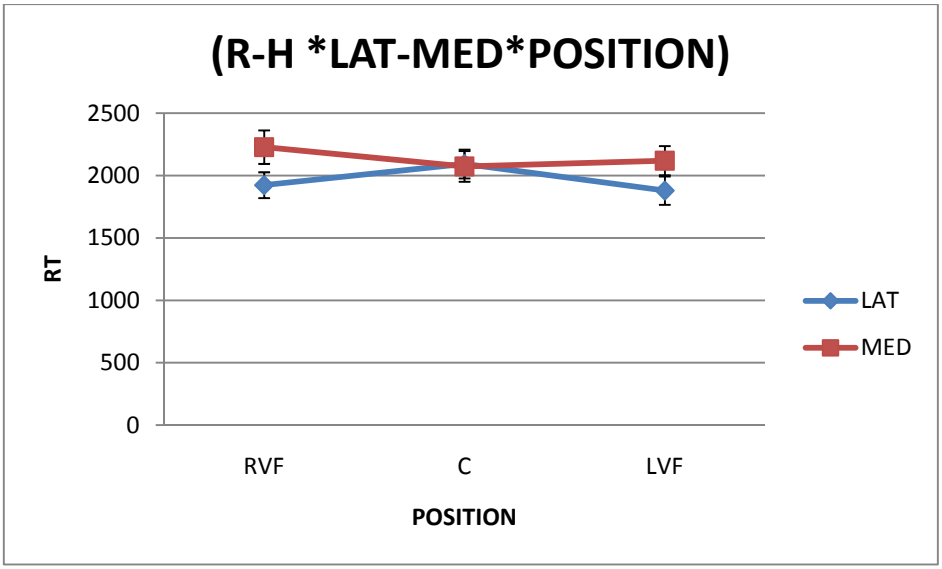

Figure 89: Mean Reaction Times and Standard Errors for RIGHT HAND *LETERAL-MEDIAL*POSITION

*RIGHT HAND *ORIENTATION*POSITION*

The effect of (ORIENTATION*POSITION) interaction was significant (F (4, 16) = 3.333, p= .036). See details in Table 230. Mean Reaction Times and Standard Errors are represented in Fig. 89

Orientation	POSITION	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
45°	RVF	2096.011	119.847	1845.169	2346.853
	C	2002.403	108.883	1774.507	2230.298
	LVF	2059.305	106.932	1835.494	2283.115
90°	RVF	2071.011	101.993	1857.537	2284.485
	C	2043.225	132.874	1765.116	2321.333
	LVF	1946.308	126.530	1681.478	2211.139
135°	RVF	2058.965	138.196	1769.717	2348.213
	C	2203.442	122.479	1947.090	2459.794
	LVF	1992.356	122.487	1735.987	2248.725

Table 230: Mean Reaction Times and Standard Errors for RIGHT HAND * ORIENTATION * POSITION

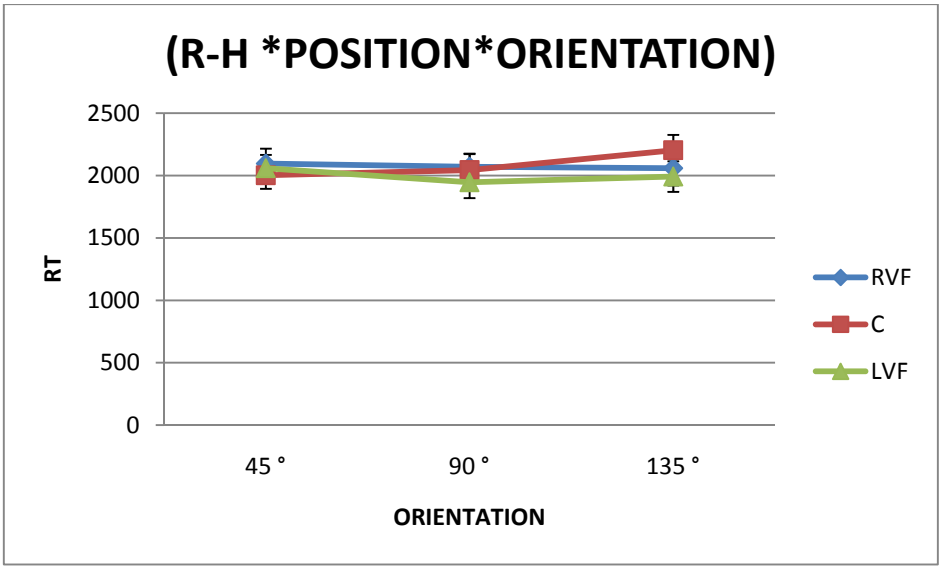

Figure 90: Mean Reaction Times and Standard Errors for RIGHT HAND *ORIENTATION * POSITION

*RIGHT HAND *LAT.MED * ORIENTATION * POSITION*

Finally, the effect of (LAT.MED * ORIENTATION * POSITION) was significant (f (4, 16) = .000, p=0.031)

LEFT HAND* LETERAL-MEDIAL* ORIENTATION* POSITION

For the Left hand we found non-significant effect of lateral–medial gradient (F (1, 19) =.000, p = .984).See details in Table 231

LAT.MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LATERAL	2157.384	120.861	1904.420	2410.349
MEDIAL	2156.594	114.798	1916.318	2396.869

Table 231: Mean Reaction Times and Standard Errors for LEFT HAND* LETERAL-MEDIAL

LEFT HAND ORIENTATION*

By contrast, the effect of Orientation (F (2, 18) = 4.612, p= 0.024) was significant with significantly longer RTs for the 90° than 45° and 135 °. See details in Table 232 and 233

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45 °	2218.109	126.349	1953.657	2482.560
90 °	2047.857	124.145	1788.019	2307.695
135 °	2205.001	108.086	1978.774	2431.229

Table 232: Mean Reaction Times and Standard Errors for LEFT HAND* ORIENTATION

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	170.252(*)	59.839	.031	13.169	327.335
	135°	13.107	35.938	1.000	-81.234	107.448
90°	45°	-170.252(*)	59.839	.031	-327.335	-13.169
	135°	-157.144(*)	51.577	.020	-292.539	-21.749
135°	45°	-13.107	35.938	1.000	-107.448	81.234
	90°	157.144(*)	51.577	.020	21.749	292.539

Table 233: Pairwise Comparisons for LEFT HAND* ORIENTATION

*LEFT HAND * POSITION*

The effect of Position (F (2, 18) = 3.794, p = 0.042) were significant with significantly longer RTs for the Center than RVF. See details in Table 234 and 235

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2115.850	122.646	1859.149	2372.550
C	2186.981	116.456	1943.236	2430.726
LVF	2168.136	114.687	1928.093	2408.180

Table 234: Mean Reaction Times and Standard Errors for LEFT HAND * POSITION

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	-71.131(*)	25.245	.033	-137.402	-4.860
	LVF	-52.286	39.480	.603	-155.926	51.353
C	RVF	71.131(*)	25.245	.033	4.860	137.402
	LVF	18.845	37.839	1.000	-80.487	118.177
LVF	RVF	52.286	39.480	.603	-51.353	155.926
	C	-18.845	37.839	1.000	-118.177	80.487

Table 235: Pairwise Comparisons for LEFT HAND * POSITION

LEFT HAND LETERAL-MEDIAL* ORIENTATION*

The effect of (LETERAL-MEDIAL*ORIENTATION) interaction was significant (F (2, 18) = 45.190, p=0.000). See details in Table 236.Mean Reaction Times and Standard Errors are represented in Fig. 90

LAT.MED	Orientation	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	45 °	1966.225	135.665	1682.276	2250.174
	90 °	1988.852	120.559	1736.519	2241.185
	135 °	2517.075	124.087	2257.357	2776.793
MEDIAL	45 °	2469.992	129.524	2198.895	2741.089
	90 °	2106.862	134.047	1826.299	2387.424
	135 °	1892.927	103.962	1675.332	2110.522

Table 236: Mean Reaction Times and Standard Errors for LEFT HAND* LETERAL-MEDIAL* ORIENTATION

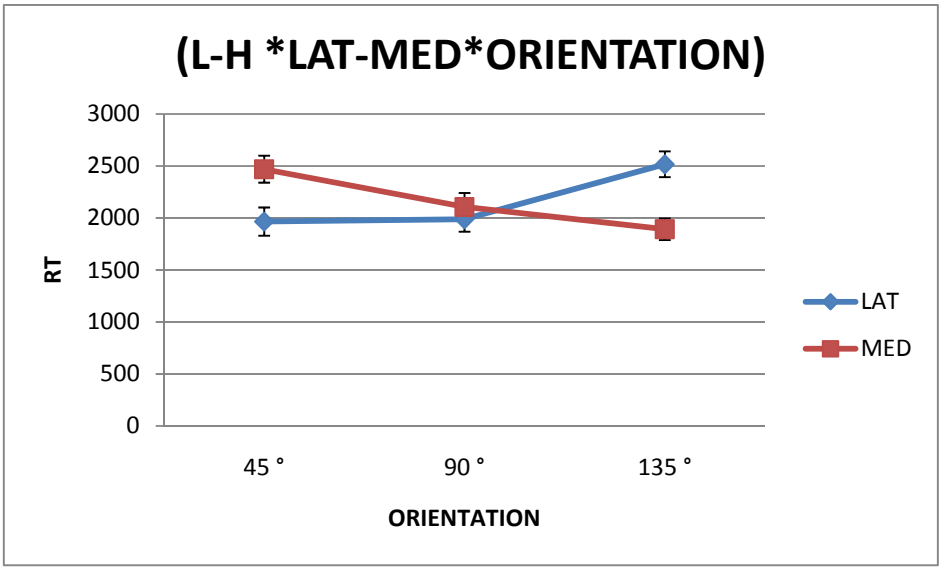

Figure 91: Mean Reaction Times and Standard Errors for LEFT HAND* LETERAL-MEDIAL* ORIENTATION

LEFT HAND LETERAL-MEDIAL * POSITION*

The effect of (LETERAL-MEDIAL*POSITION) interaction was not significant (F (2, 18) = 1.722, p=0.207). See details in Table 237. Mean Reaction Times and Standard Errors are represented in Fig. 91

LAT.MED	POSITION	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
LATERAL	RVF	2118.993	128.441	1850.164	2387.822
	C	2150.080	122.001	1894.729	2405.430
	LVF	2203.080	120.128	1951.649	2454.512
MEDIAL	RVF	2112.707	123.985	1853.203	2372.210
	C	2223.882	116.994	1979.012	2468.753
	LVF	2133.192	117.910	1886.405	2379.980

Table 237: Mean Reaction Times and Standard Errors for LEFT HAND* LETERAL-MEDIAL * POSITION

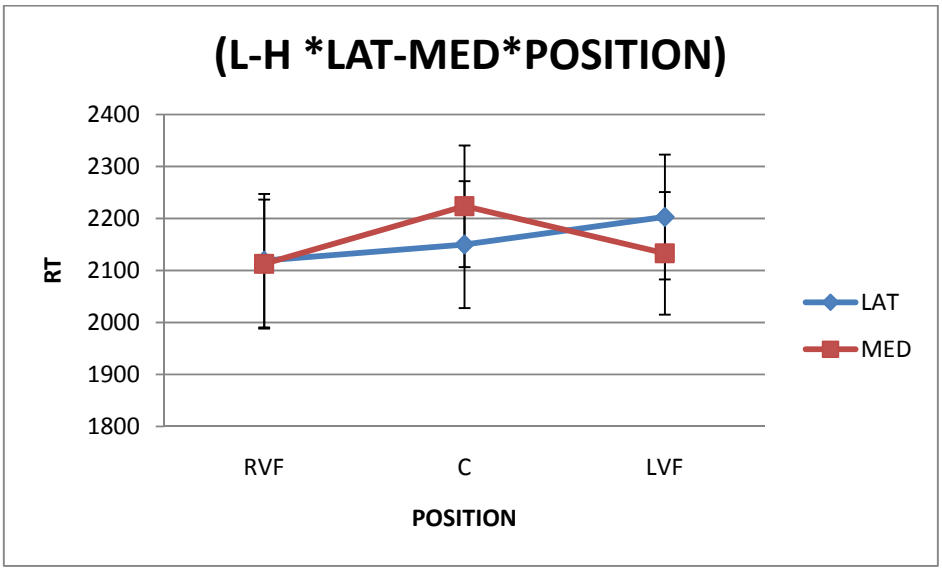

Figure 92: Mean Reaction Times and Standard Errors for LEFT HAND* LETERAL-MEDIAL * POSITION

LEFT HAND ORIENTATION* POSITION*

The effect of (ORIENTATION*POSITION) interaction was significant (F (4, 16) = 10.438, p= 0.000). See details in Table 238. Mean Reaction Times and Standard Errors are represented in Fig. 92

Orientation	POSITION	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
45°	RVF	2119.489	137.137	1832.457	2406.521
	C	2301.640	118.416	2053.791	2549.488
	LVF	2233.197	136.450	1947.605	2518.789
90°	RVF	2070.334	133.435	1791.051	2349.617
	C	1958.025	117.223	1712.674	2203.375
	LVF	2115.212	135.696	1831.198	2399.226
135°	RVF	2157.726	114.756	1917.540	2397.913
	C	2301.279	129.462	2030.311	2572.246
	LVF	2155.999	94.990	1957.183	2354.815

Table 238: Mean Reaction Times and Standard Errors for LEFT HAND* ORIENTATION* POSITION

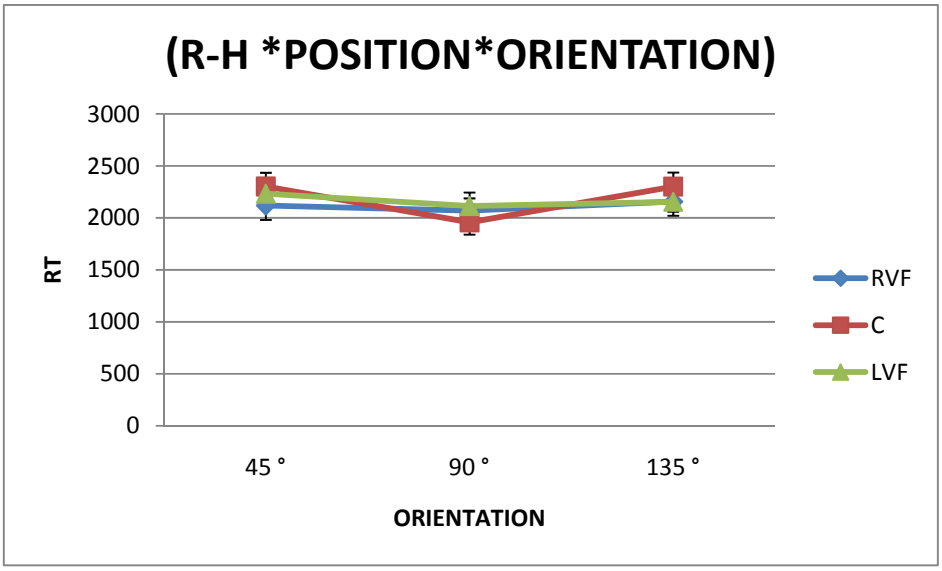

Figure 93: Mean Reaction Times and Standard Errors for LEFT HAND* ORIENTATION* POSITION

LEFT HAND LETERAL-MEDIAL* ORIENTATION* POSITION*

Finally, the effect of (LAT.MED * ORIENTATION * POSITION) was significant (F (4, 16) = 3.609, p=0.028)

Post hoc analysis on HAND* LETERAL-MEDIAL* ORIENTATION* POSITION

Post hoc analyses were performed for lateral and medial and all orientation separately, for each of the stimulus position (RVF, centre, LVF) for the Right and Left hand respectively.

*Right Hand*Lateral* Position *at 45°*

For Right hand stimuli presented at 45° and LATERAL orientation, the Position (RVF vs C vs LVF) was significant [(F(2,18)= 5.663, p =.012] with significantly higher RTs for the C than for the RVF and LVF positions. See details in Table 239 and 240. Mean Reaction Times and Standard Errors are represented in Fig. 93

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	1887.935	104.665	1668.868	2107.002
C	2135.501	123.704	1876.586	2394.416
LVF	1884.037	103.129	1668.185	2099.889

Table 239: Mean Reaction Times and Standard Errors for Right Hand*Lateral* Position *at 45°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	-247.566(*)	77.221	.014	-450.279	-44.853
	LVF	3.898	49.831	1.000	-126.914	134.710
C	RVF	247.566(*)	77.221	.014	44.853	450.279
	LVF	251.464(*)	75.674	.011	52.813	450.116
LVF	RVF	-3.898	49.831	1.000	-134.710	126.914
	C	-251.464(*)	75.674	.011	-450.116	-52.813

Table 240: Pairwise Comparisons for Right Hand*Lateral* Position *at 45°

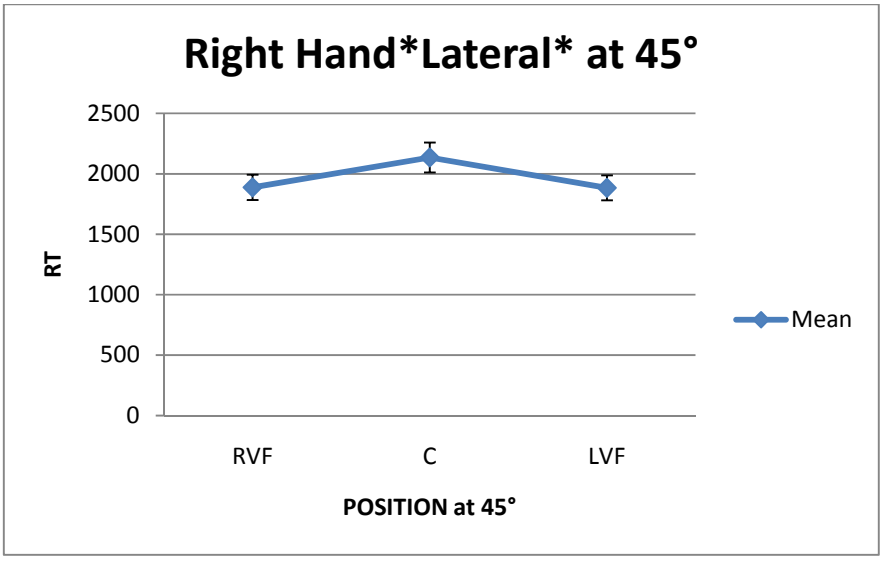

Figure 94: Mean Reaction Times and Standard Errors for Right Hand*Lateral* Position *at 45°

*Right Hand*Medial * Position *at 45°*

For Right hand stimuli presented at 45° and MEDIAL orientation, the Position (RVF vs. C vs. LVF) was not significant [(F(2,18)= .350, p > .05., n.s.)]. See details in Table 241 and 242. Mean Reaction Times and Standard Errors are represented in Fig. 94

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	1965.159	123.680	1706.293	2224.024
C	1940.796	125.304	1678.532	2203.060
LVF	1903.736	137.966	1614.969	2192.502

Table 241: Mean Reaction Times and Standard Errors for Right Hand*Medial * Position *at 45°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	24.362	87.637	1.000	-205.693	254.418
	LVF	61.423	72.990	1.000	-130.184	253.029
C	RVF	-24.362	87.637	1.000	-254.418	205.693
	LVF	37.060	80.482	1.000	-174.214	248.335
LVF	RVF	-61.423	72.990	1.000	-253.029	130.184
	C	-37.060	80.482	1.000	-248.335	174.214

Table 242: Pairwise Comparisons for Right Hand*Medial * Position *at 45°

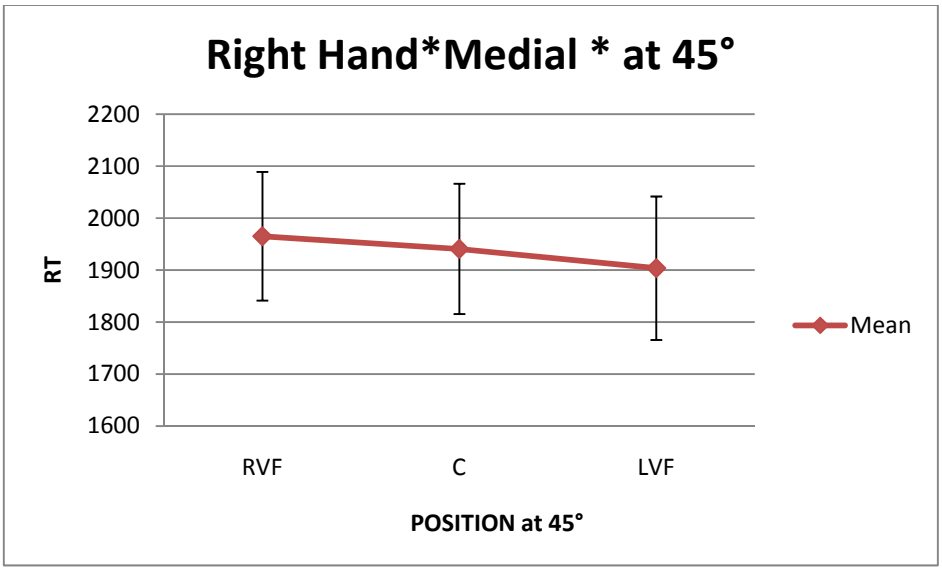

Figure 95: Mean Reaction Times and Standard Errors for Right Hand*Medial * Position *at 45°

*Right Hand*Lateral* Position *at 90°*

For Right hand stimuli presented at 90° and Lateral orientation, the Position (RVF vs. C vs. LVF) was significant [(F(2,18)= 10.623, p =0.001] with significantly higher RTs for the C than for the RVF and LVF positions. See details in Table 243 and 244. Mean Reaction Times and Standard Errors are represented in Fig. 95

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	1916.138	118.098	1668.957	2163.320
C	2201.482	126.631	1936.442	2466.523
LVF	1850.406	121.610	1595.874	2104.938

Table 243: Mean Reaction Times and Standard Errors for Right Hand*Lateral* Position *at 90°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	-285.344(*)	84.797	.010	-507.944	-62.744
	LVF	65.732	90.109	1.000	-170.814	302.278
C	RVF	285.344(*)	84.797	.010	62.744	507.944
	LVF	351.076(*)	79.741	.001	141.748	560.405
LVF	RVF	-65.732	90.109	1.000	-302.278	170.814
	C	-351.076(*)	79.741	.001	-560.405	-141.748

Table 244: Pairwise Comparisons Right Hand*Lateral* Position *at 90°

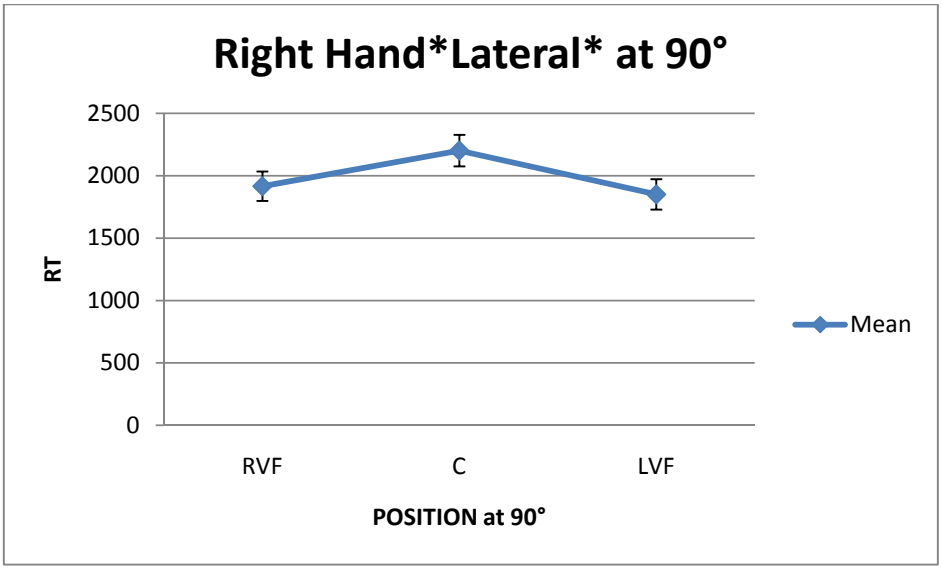

Figure 96: Mean Reaction Times and Standard Errors for Right Hand*Lateral* Position *at 90°

*Right Hand*Medial * Position * at 90°*

For Right hand stimuli presented at 90° and MEDIAL orientation, the Position (RVF vs. C vs. LVF) was significant [(F(2,18)= 10.321, p=0.001)] with significantly higher RTs for the RVF than for the C position. See details in Table 245 and 256. Mean Reaction Times and Standard Errors are represented in Fig. 96

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2304.087	147.769	1994.803	2613.371
C	1869.304	111.929	1635.035	2103.574
LVF	2234.572	125.194	1972.538	2496.607

Table 245: Mean Reaction Times and Standard Errors for Right Hand*Medial * Position * at 90°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	434.782(*)	96.826	.001	181.374	688.191
	LVF	69.514	84.197	.804	-150.842	289.870
C	RVF	-434.782(*)	96.826	.001	-688.191	-181.374
	LVF	-365.268(*)	96.468	.004	-617.740	-112.796
LVF	RVF	-69.514	84.197	.804	-289.870	150.842
	C	365.268(*)	96.468	.004	112.796	617.740

Table 246: Pairwise Comparisons Right Hand*Medial * Position * at 90°

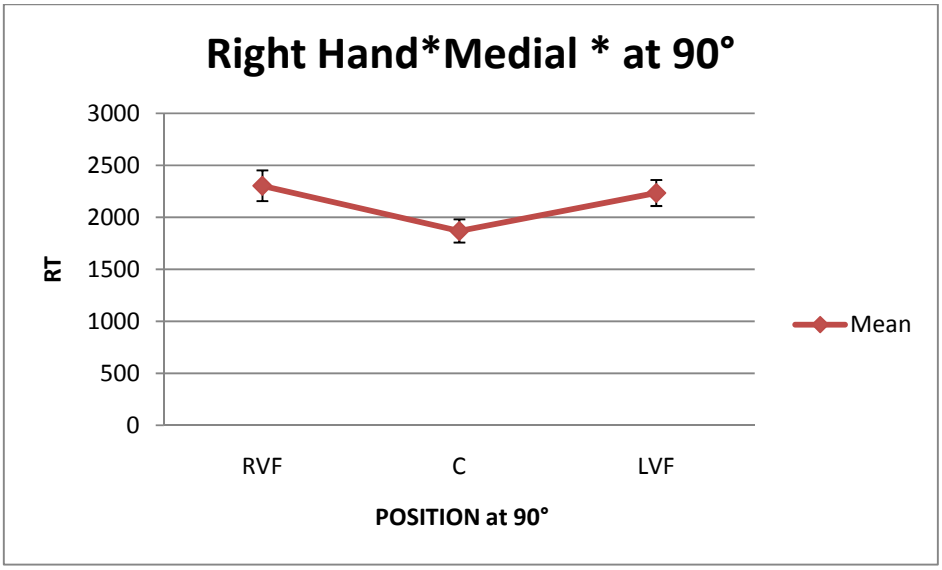

Figure 97: Mean Reaction Times and Standard Errors for Right Hand*Medial * Position * at 90°

*Right Hand*Lateral* Position * at 135°*

For Right hand stimuli presented at 135° and LATERAL orientation, the Position (RVF vs. C vs. LVF) was significant [(F(2,18)= 5.106, p =0.018] with significantly higher RTs for the RVF than for the LVF positions. See details in Table 247 and 248. Mean Reaction Times and Standard Errors are represented in Fig. 97

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2176.864	103.151	1960.966	2392.762
C	2145.653	155.513	1820.160	2471.146
LVF	1988.881	121.564	1734.444	2243.318

Table 247: Mean Reaction Times and Standard Errors for Right Hand*Lateral* Position * at 135°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	31.210	97.182	1.000	-223.902	286.322
	LVF	187.982(*)	64.032	.025	19.892	356.073
C	RVF	-31.210	97.182	1.000	-286.322	223.902
	LVF	156.772	83.134	.224	-61.464	375.008
LVF	RVF	-187.982(*)	64.032	.025	-356.073	-19.892
	C	-156.772	83.134	.224	-375.008	61.464

Table 248: Pairwise Comparisons Right Hand*Lateral* Position * at 135°

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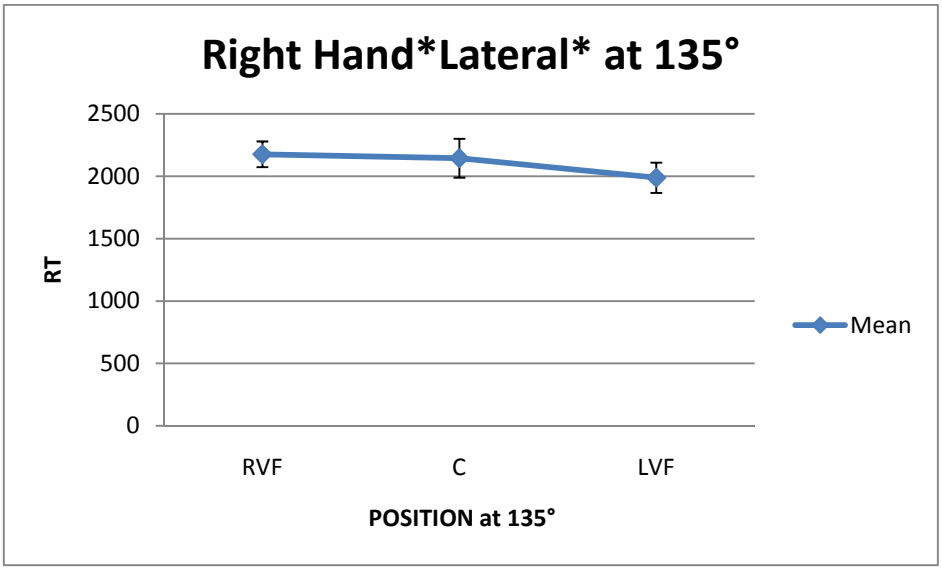

Figure 98: Mean Reaction Times and Standard Errors for Right Hand*Lateral* Position * at 135°

*Right Hand*Medial * Position * at 135°*

For Right hand stimuli presented at 135° and MEDIAL orientation, the Position (RVF vs. C vs. LVF) was not significant [(F(2,18)= .371, p>0.05] .see details in Table 249 and 250. Mean Reaction Times and Standard Errors are represented in Fig. 98

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2201.792	176.017	1833.385	2570.199
C	2205.402	148.790	1893.980	2516.823
LVF	2134.306	143.542	1833.869	2434.743

Table 249: Mean Reaction Times and Standard Errors for Right Hand*Medial * Position * at 135°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	-3.610	98.281	1.000	-261.609	254.389
	LVF	67.486	86.228	1.000	-158.871	293.842
C	RVF	3.610	98.281	1.000	-254.389	261.609
	LVF	71.096	98.987	1.000	-188.755	330.946
LVF	RVF	-67.486	86.228	1.000	-293.842	158.871
	C	-71.096	98.987	1.000	-330.946	188.755

Table 250: Pairwise Comparisons Right Hand*Medial * Position * at 135°

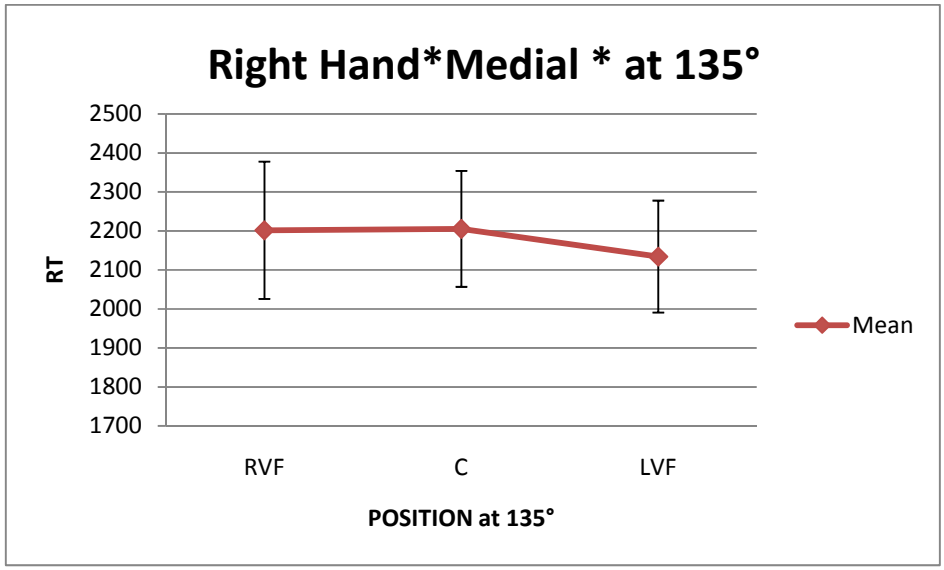

Figure 99: Mean Reaction Times and Standard Errors for Right Hand*Medial * Position * at 135°

*Left Hand*Lateral* Position * at 45°*

For Left hand stimuli presented at 45° and LATERAL orientation, the Position (RVF vs. C vs. LVF) was significant [(F(2,18)= 3.988, p =.037] with not significantly higher RTs for any of the positions. See details in Table 251 and 252. Mean Reaction Times and Standard Errors are represented in Fig.99

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	1843.358	140.551	1549.181	2137.535
C	2020.424	128.787	1750.870	2289.979
LVF	2034.893	159.783	1700.464	2369.322

Table 251: Mean Reaction Times and Standard Errors for Left Hand*Lateral* Position * at 45°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	-177.066	68.363	.054	-356.526	2.393
	LVF	-191.535	87.115	.121	-420.221	37.151
C	RVF	177.066	68.363	.054	-2.393	356.526
	LVF	-14.469	87.792	1.000	-244.931	215.994
LVF	RVF	191.535	87.115	.121	-37.151	420.221
	C	14.469	87.792	1.000	-215.994	244.931

Table 252: Pairwise Comparisons Left Hand*Lateral* Position * at 45°

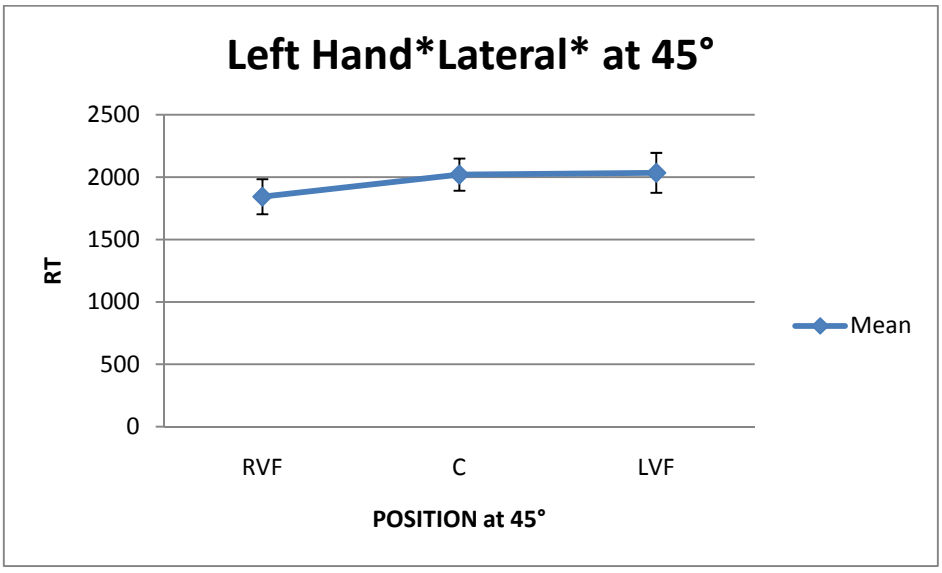

Figure 100: Mean Reaction Times and Standard Errors for Left Hand*Lateral* Position * at 45°

*Left Hand*Medial* Position * at 45°*

For Left hand stimuli presented at 45° and MEDIAL orientation, the Position (RVF vs. C vs. LVF) was not significant [(F(2,18)= .746, p = 0.488., n.s.)]. See details in Table 253 and 254. Mean Reaction Times and Standard Errors are represented in Fig. 100

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	1967.130	132.349	1690.119	2244.140
C	1941.665	121.938	1686.446	2196.885
LVF	2057.761	133.547	1778.244	2337.278

Table 253: Mean Reaction Times and Standard Errors for Left Hand*Medial* Position * at 45°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	25.464	58.187	1.000	-127.283	178.211
	LVF	-90.632	88.852	.962	-323.878	142.615
C	RVF	-25.464	58.187	1.000	-178.211	127.283
	LVF	-116.096	92.569	.675	-359.100	126.908
LVF	RVF	90.632	88.852	.962	-142.615	323.878
	C	116.096	92.569	.675	-126.908	359.100

Table 254: Pairwise Comparisons Left Hand*Medial* Position * at 45°

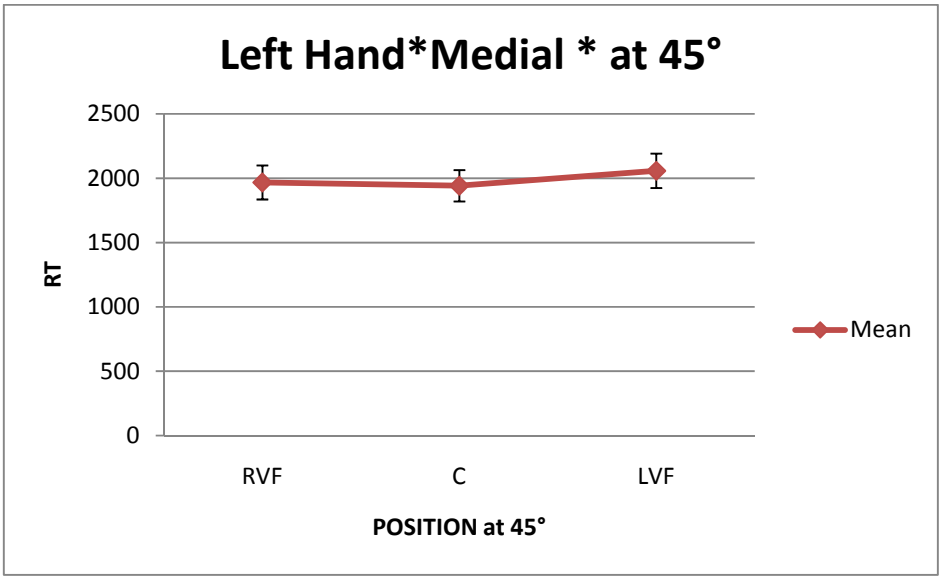

Figure 101: Mean Reaction Times and Standard Errors for Left Hand*Medial* Position * at 45°

*Left Hand*Lateral* Position * at 90°*

For Left hand stimuli presented at 90° and Lateral orientation, the Position (RVF vs. C vs. LVF) was not significant [(F(2,18)= .285, p >0.05].See details in Table 255and 256. Mean Reaction Times and Standard Errors are represented in Fig. 101

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2546.491	139.488	2254.539	2838.443
C	2488.149	145.898	2182.781	2793.517
LVF	2516.586	127.476	2249.777	2783.395

Table 255: Mean Reaction Times and Standard Errors for Left Hand*Lateral* Position * at 90°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	58.342	76.037	1.000	-141.264	257.949
	LVF	29.905	110.321	1.000	-259.700	319.511
C	RVF	-58.342	76.037	1.000	-257.949	141.264
	LVF	-28.437	120.199	1.000	-343.973	287.099
LVF	RVF	-29.905	110.321	1.000	-319.511	259.700
	C	28.437	120.199	1.000	-287.099	343.973

Table 256: Pairwise Comparisons Left Hand*Lateral* Position * at 90°

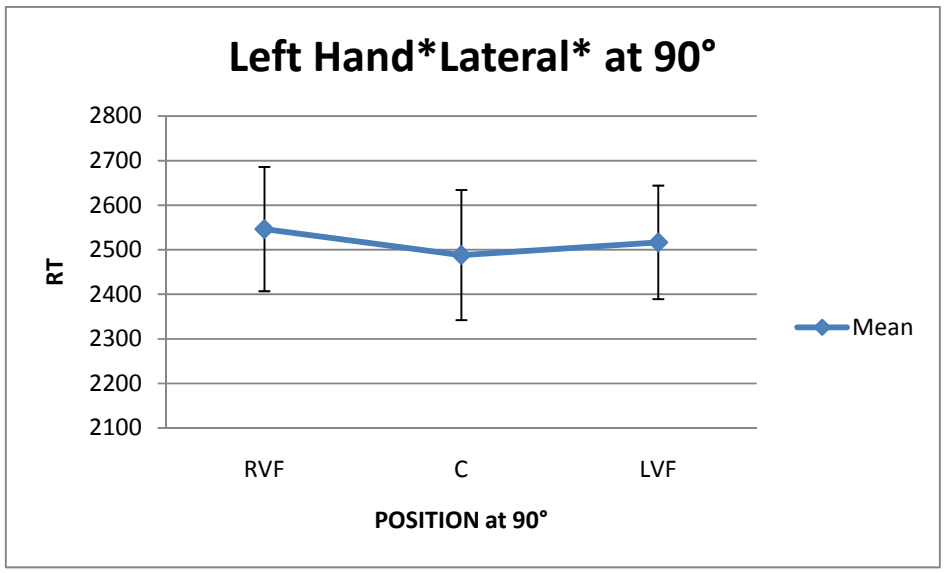

Figure 102: Mean Reaction Times and Standard Errors for Left Hand*Lateral* Position * at 90°

*Left Hand*Medial* Position * at 90°*

For Left hand stimuli presented at 90° and MEDIAL orientation, the Position (RVF vs. C vs. LVF) was not significant [(F(2,18)= 3.004 , p>0.05)]. See details in Table 257 and 258. Mean Reaction Times and Standard Errors are represented in Fig. 102

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2395.620	153.135	2075.105	2716.135
C	2582.855	128.561	2313.773	2851.937
LVF	2431.501	134.687	2149.598	2713.404

Table 257: Mean Reaction Times and Standard Errors for Left Hand*Medial* Position * at 90°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	-187.235	76.302	.072	-387.535	13.065
	LVF	-35.881	92.081	1.000	-277.602	205.840
C	RVF	187.235	76.302	.072	-13.065	387.535
	LVF	151.354	95.220	.385	-98.608	401.316
LVF	RVF	35.881	92.081	1.000	-205.840	277.602
	C	-151.354	95.220	.385	-401.316	98.608

Table 258: Pairwise Comparisons Left Hand*Medial* Position * at 90°

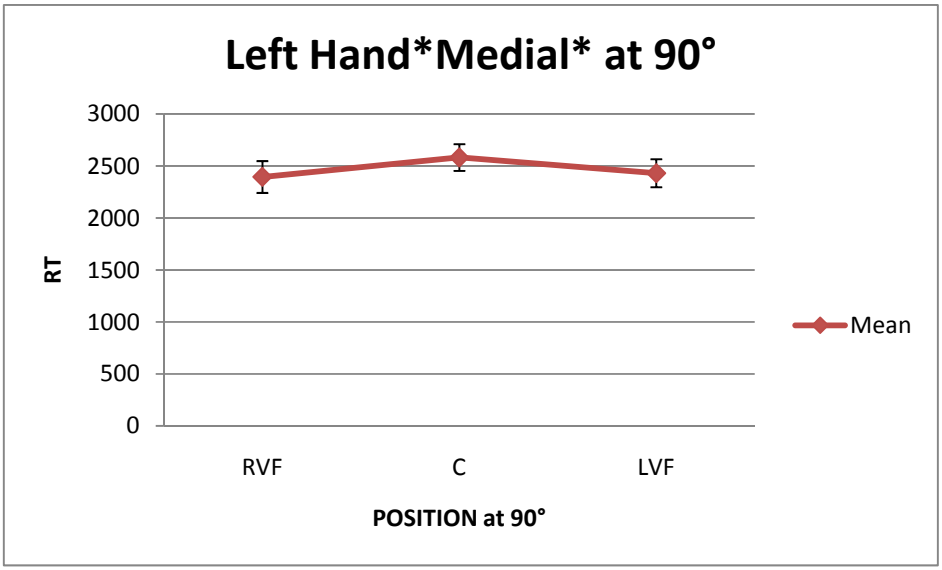

Figure 103: Mean Reaction Times and Standard Errors for Left Hand*Medial* Position * at 90°

*Left Hand*Lateral* Position * at 135°*

For Left hand stimuli presented at 135° and LATERAL orientation, the Position (RVF vs. C vs. LVF) was not significant [(F(2,18)= 2.744, p >0.05].See details in Table 259 and 260. Mean Reaction Times and Standard Errors are represented in Fig.103

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	2173.539	147.916	1863.947	2483.130
C	1974.384	131.642	1698.853	2249.914
LVF	2172.663	153.071	1852.282	2493.044

Table 259: Mean Reaction Times and Standard Errors for Left Hand*Lateral* Position * at 135°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	199.155	84.171	.086	-21.802	420.112
	LVF	.876	85.841	1.000	-224.466	226.218
C	RVF	-199.155	84.171	.086	-420.112	21.802
	LVF	-198.279	108.393	.249	-482.821	86.263
LVF	RVF	-.876	85.841	1.000	-226.218	224.466
	C	198.279	108.393	.249	-86.263	482.821

Table 260: Pairwise Comparisons Left Hand*Lateral* Position * at 135°

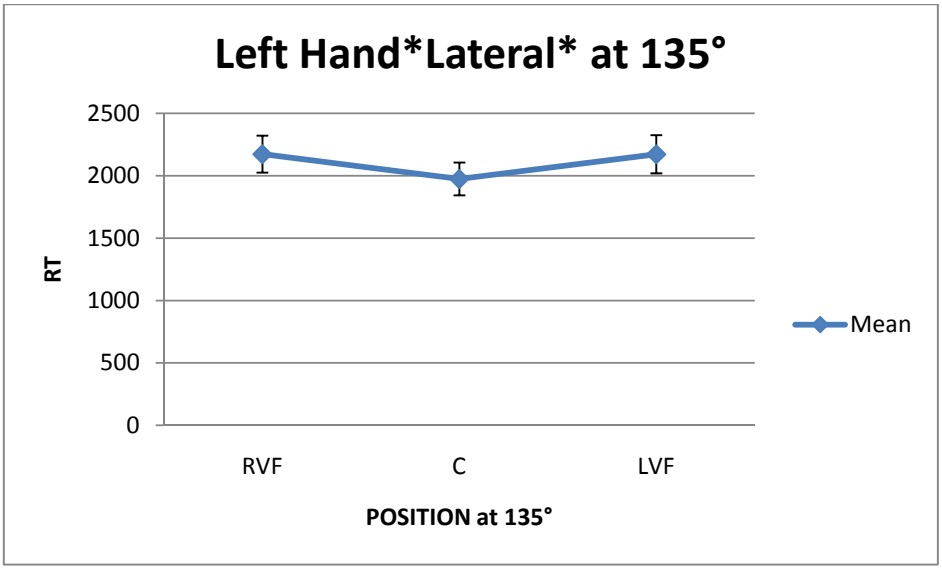

Figure 104: Mean Reaction Times and Standard Errors for Left Hand*Lateral* Position * at 135°

*Left Hand*Medial* Position * at 135°*

For Left hand stimuli presented at 135° and MEDIAL orientation, the Position (RVF vs. C vs. LVF) was not significant [(F(2,18)= 9.380, p=0.002] with significantly higher RTs for the C than for the RVF and LVF positions. see details in Table 261 and 262. Mean Reaction Times and Standard Errors are represented in Fig. 104

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	1768.961	108.205	1542.486	1995.436
C	2114.408	132.643	1836.783	2392.033
LVF	1795.413	105.511	1574.576	2016.250

Table 261: Mean Reaction Times and Standard Errors for Left Hand*Medial* Position * at 135°

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	-345.447(*)	87.779	.003	-575.877	-115.017
	LVF	-26.451	92.488	1.000	-269.243	216.340
C	RVF	345.447(*)	87.779	.003	115.017	575.877
	LVF	318.995(*)	88.163	.005	87.557	550.433
LVF	RVF	26.451	92.488	1.000	-216.340	269.243
	C	-318.995(*)	88.163	.005	-550.433	-87.557

Table 262: Pairwise Comparisons Left Hand*Medial* Position * at 135°

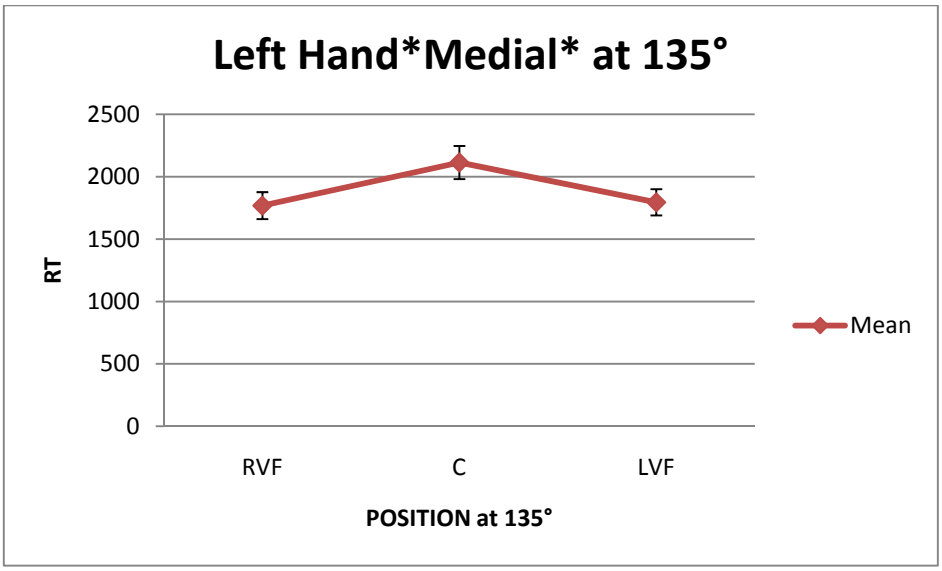

Figure 105: Mean Reaction Times and Standard Errors for Left Hand*Medial* Position * at 135°

Accuracy

In Experiment with Normal subjects, I analyzed subject's accuracy by means of analyses of variance (ANOVAs) with repeated measures. Each ANOVA had four within-subjects factors, rotation Orientation of the hand (45, 90, 135, 225, 270, and 315), hand (Right, Left), Strategy (Motor, Visual) and Position of the stimuli: Right Visual Field (RVF), Central Visual Field (C) and Left Visual Field (LVF). After I did the repeated measure ANOVA with four within-subjects factors, I ran future ANOVA and post hoc test for significant interactions all over again.

STRATEGY

Results showed the main effects of the type of STRATEGY was not significant [(F1, 19) = .088, p =0.770]. Percentage error (%) and standard errors for both strategies are reported in detail in Table 1 and represented in Table 263 and 264. Percentage error (%) and standard errors are represented in Fig. 105

STRATEGY	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Motor	19.444%	2.973%	13.222	25.667
Visual	20.868%	5.361%	9.648	32.088

Table 263: Percentage error (%) and standard errors for STRATEGY

(I) STRATEGY	(J) STRATEGY	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Motor	Visual	-1.424	4.810%	.770	-11.492	8.645
Visual	Motor	1.424	4.810%	.770	-8.645	11.492

Table 264: Pairwise Comparisons for STRATEGY

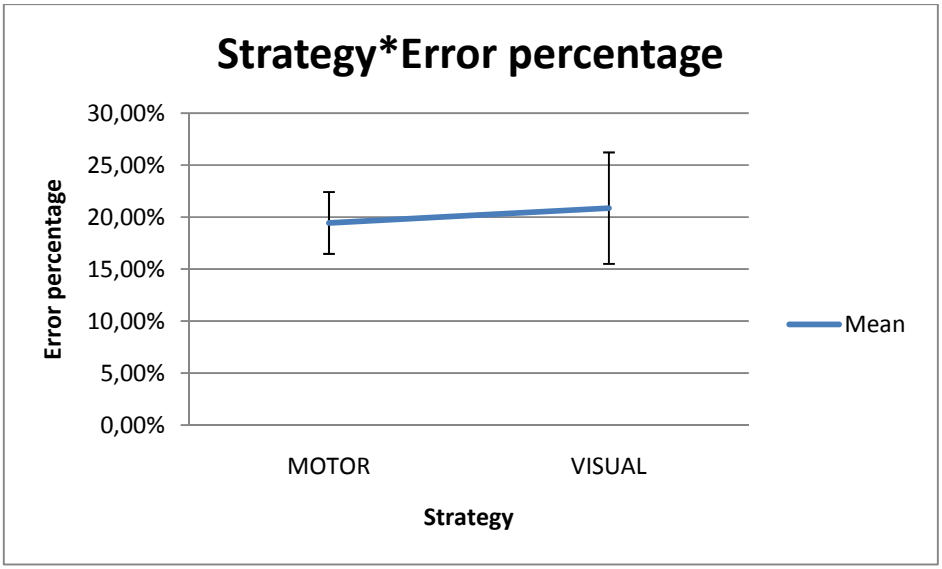

Figure 106: Percentage error (%) and standard errors for STRATEGY

Hand Stimulus side

The factor Hand Stimulus side was not significant (F (1, 19) = 0.382; p = 0.544). This effect was due to fact that subjects were not more Accurate in mentally rotating the right Hand stimuli than the left Hand stimuli. Percentage error (%) and standard errors for both strategies are reported in detail in Table 1 and represented in Table 265 and 266. Percentage error (%) and standard errors are represented in Fig. 106

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	20.486%	3.715%	12.710%	28.262%
Left	19.826%	3.574%	12.346%	27.307%

Table 265: Percentage error (%) and standard errors for Hand Stimulus side

(I) HAND	(J) HAND	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	.660	1.067	.544	-1.573	2.893
Left	Hand	-.660	1.067	.544	-2.893	1.573

Table 266: Pairwise Comparisons for Hand Stimulus side

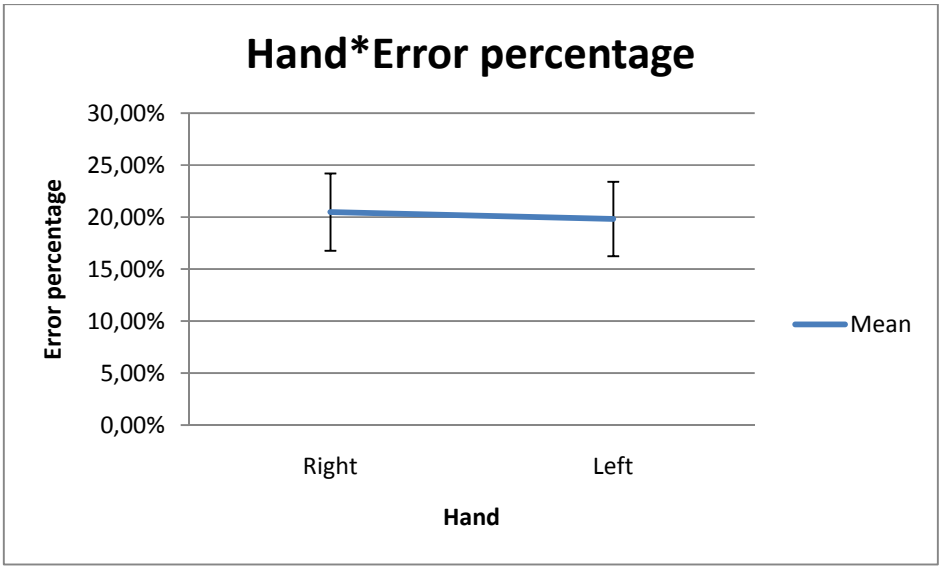

Figure 107: Percentage error (%) and standard errors for Hand Stimulus side

Stimulus orientation

The factor Stimulus orientation was significant [F (5, 95) = 3.597, p=0.024], insofar as Percentage error were higher when stimuli had an orientation of 135° than in other five orientations. Percentage error (%) and standard errors for both strategies are reported in detail in Table 1 and represented in Table 267 and 268. Percentage error (%) and standard errors are represented in Fig. 107

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	17.344%	3.767%	9.460	25.227
90°	22.188%	4.237%	13.319	31.056
135°	25.938%	4.426%	16.674	35.201
225°	22.552%	4.091%	13.989	31.116
270°	17.396%	3.493%	10.086	24.706
315°	15.521%	3.156%	8.916	22.126

Table 267: Percentage error (%) and standard errors for Stimulus orientation

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-4.844	1.604	.106	-10.222	.535
	135°	-8.594	2.790	.092	-17.951	.763
	225°	-5.208	1.818	.149	-11.307	.891
	270°	-.052	2.523	1.000	-8.514	8.410
	315°	1.823	1.963	1.000	-4.762	8.408
90°	45°	4.844	1.604	.106	-.535	10.222
	135°	-3.750	2.117	1.000	-10.849	3.349
	225°	-.365	1.912	1.000	-6.778	6.049
	270°	4.792	2.369	.861	-3.153	12.736
	315°	6.667	2.088	.072	-.337	13.670
135°	45°	8.594	2.790	.092	-.763	17.951
	90°	3.750	2.117	1.000	-3.349	10.849
	225°	3.385	2.474	1.000	-4.913	11.684
	270°	8.542	2.979	.148	-1.449	18.532
	315°	10.417(*)	3.001	.038	.351	20.482
225°	45°	5.208	1.818	.149	-.891	11.307
	90°	.365	1.912	1.000	-6.049	6.778
	135°	-3.385	2.474	1.000	-11.684	4.913
	270°	5.156	2.040	.307	-1.685	11.997
	315°	7.031(*)	1.901	.023	.655	13.408
270°	45°	.052	2.523	1.000	-8.410	8.514
	90°	-4.792	2.369	.861	-12.736	3.153
	135°	-8.542	2.979	.148	-18.532	1.449
	225°	-5.156	2.040	.307	-11.997	1.685
	315°	1.875	1.372	1.000	-2.727	6.477
315°	45°	-1.823	1.963	1.000	-8.408	4.762
	90°	-6.667	2.088	.072	-13.670	.337
	135°	-10.417(*)	3.001	.038	-20.482	-.351
	225°	-7.031(*)	1.901	.023	-13.408	-.655
	270°	-1.875	1.372	1.000	-6.477	2.727

Table 268: Pairwise Comparisons for Stimulus orientation

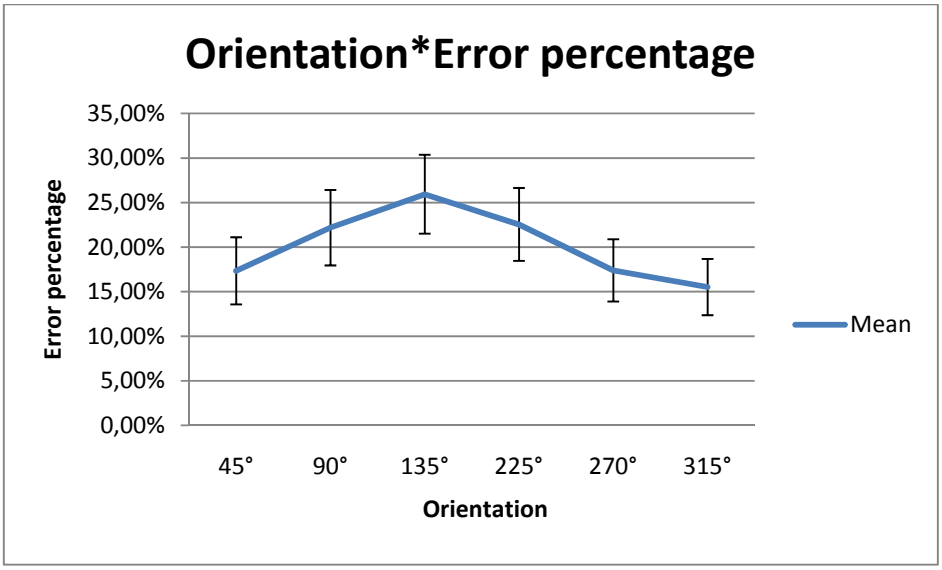

Figure 108: Percentage error (%) and standard errors for Stimulus orientation

POSITION

The factor Hand Stimulus side was not significant (F (1, 19) = 0.611; p = 0.544). This effect was due to fact that there were no significantly different in accuracy for mentally rotate hand stimuli in different visual field in the screen. Percentage error (%) and standard errors for all position are reported in detail in Table 1 and represented in Table 269 and 270. Percentage error (%) and standard errors are represented in Fig.108

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	20.729%	3.641%	13.108	28.350
C	20.234%	3.774%	12.334	28.134
LVF	19.505%	3.585%	12.001	27.009

Table 269: Percentage error (%) and standard errors for POSITION

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	.495	1.091	1.000	-2.369	3.358
	LVF	1.224	1.085	.820	-1.624	4.072
C	RVF	-.495	1.091	1.000	-3.358	2.369
	LVF	.729	1.295	1.000	-2.671	4.130
LVF	RVF	-1.224	1.085	.820	-4.072	1.624
	C	-.729	1.295	1.000	-4.130	2.671

Table 270: Pairwise Comparisons for POSITION

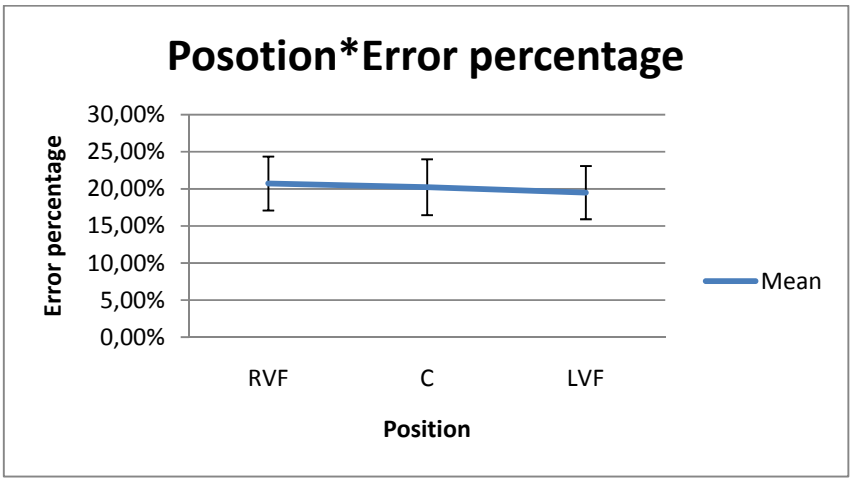

Figure 109: Percentage error (%) and standard errors for POSITION

STRATEGY * HAND

We found a significant two-way Strategy x Hand interaction (F (1, 19) = 6.428, p0.020).

VISUAL STRATEGY * HAND

Post hoc analysis showed that the main effect of Hand was significant for Visual Strategy (F (1, 19) = 10.847, p =0.004) not for Motor Strategy (F (1, 19) = 1.651, p =0.214). For Visual strategy percentage of error was significantly higher for Right hand than the Left hand. Percentage error (%) and standard errors for Visual strategy for both hands are reported in detail in Table 271 and 272. Percentage error (%) and standard errors are represented in Fig.109

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	22.847%	5.703%	10.911	34.783
Left	18.889%	5.067%	8.283	29.495

Table 271: Percentage error (%) and standard errors for VISUAL STRATEGY * HAND

(I) HAND	(J) HAND	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	3.958(*)	1.202	.004	1.443	6.474
Left	Right	-3.958(*)	1.202	.004	-6.474	-1.443

Table 272: Pairwise Comparisons for VISUAL STRATEGY * HAND

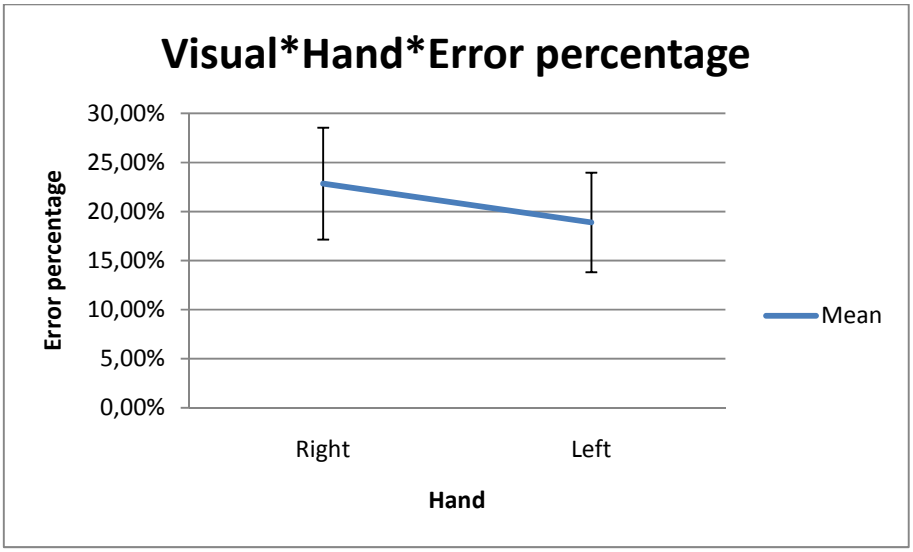

Figure 110: Percentage error (%) and standard errors for VISUAL STRATEGY * HAND

Strategy* Orientation

We found a significant two-way Strategy x Orientation interaction (F (5, 15) = 6.106, p=0.003).

Motor Strategy* Orientation

Post hoc analysis showed that the main effect of ORIENTATION was significant for Motor Strategy (F (5, 15) = 10.719, p =0.003) and not for the Left Hand (F (5, 15) = 1.449, p = 0. 264). In the result that we obtained for the interaction of Motor Strategy with Stimulus orientation, percentage errors were higher when stimuli had an orientation of 135°. Percentage error (%) and

standard errors for Motor strategy for all Orientation are reported in detail in Table 273 and 274. Percentage error (%) and standard errors are represented in Fig. 110

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	13.542%	2.929%	7.412	19.672
90°	19.479%	3.980%	11.150	27.808
135°	25.625%	3.260%	18.803	32.447
225°	25.417%	4.353%	16.305	34.528
270°	18.542%	3.874%	10.434	26.650
315°	14.063%	2.891%	8.012	20.113

Table 273: Percentage error (%) and standard errors for Motor Strategy* Orientation

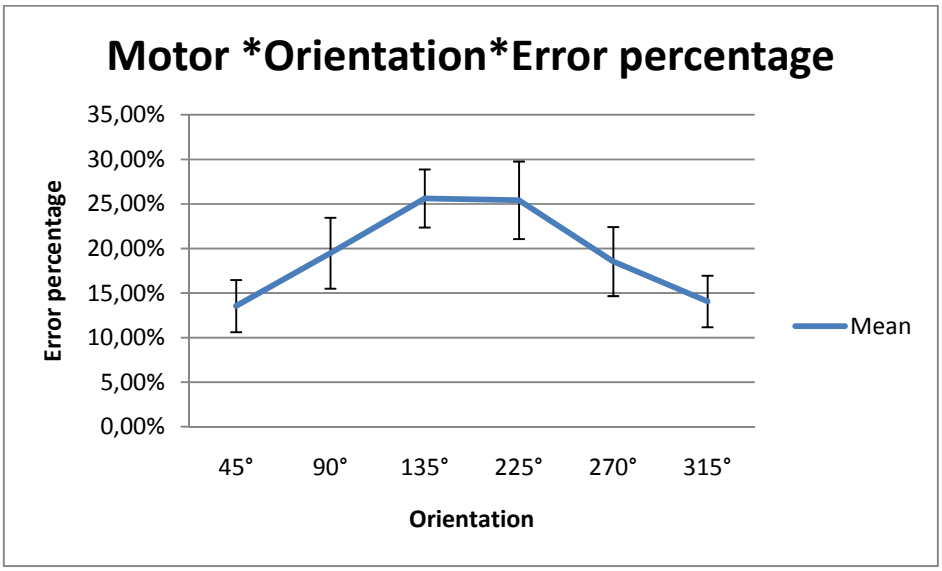

Figure 111: Percentage error (%) and standard errors for Motor Strategy* Orientation

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-5.937	2.623	.533	-14.736	2.861
	135°	-12.083(*)	2.925	.009	-21.895	-2.272
	225°	-11.875(*)	3.315	.030	-22.994	-.756
	270°	-5.000	3.622	1.000	-17.149	7.149
	315°	-.521	2.707	1.000	-9.601	8.560
90°	45°	5.937	2.623	.533	-2.861	14.736
	135°	-6.146	2.929	.742	-15.969	3.677
	225°	-5.938	3.441	1.000	-17.478	5.603
	270°	.937	2.866	1.000	-8.674	10.549
	315°	5.417	2.203	.355	-1.971	12.805
135°	45°	12.083(*)	2.925	.009	2.272	21.895
	90°	6.146	2.929	.742	-3.677	15.969
	225°	.208	4.501	1.000	-14.889	15.305
	270°	7.083	3.654	1.000	-5.171	19.338
	315°	11.563(*)	2.667	.005	2.616	20.509
225°	45°	11.875(*)	3.315	.030	.756	22.994
	90°	5.938	3.441	1.000	-5.603	17.478
	135°	-.208	4.501	1.000	-15.305	14.889
	270°	6.875	3.366	.829	-4.416	18.166
	315°	11.354(*)	3.240	.036	.488	22.220
270°	45°	5.000	3.622	1.000	-7.149	17.149
	90°	-.937	2.866	1.000	-10.549	8.674
	135°	-7.083	3.654	1.000	-19.338	5.171
	225°	-6.875	3.366	.829	-18.166	4.416
	315°	4.479	1.732	.271	-1.329	10.287
315°	45°	.521	2.707	1.000	-8.560	9.601
	90°	-5.417	2.203	.355	-12.805	1.971
	135°	-11.563(*)	2.667	.005	-20.509	-2.616
	225°	-11.354(*)	3.240	.036	-22.220	-.488
	270°	-4.479	1.732	.271	-10.287	1.329

Table 274: Pairwise Comparisons for Motor Strategy* Orientation

Hand * Orientation

We found a significant two-way Hand x Orientation interaction (F (5, 15) = 4.060, p=.016).

Right Hand* Orientation

Post hoc analysis showed that the main effect of ORIENTATION was significant for Right Hand (F (5, 15) = 6.259, p =0.000) and also for the Left Hand (F (5, 15) = 4.677, p = 0.009). In the result that we obtained for the interaction of Right Hand with Stimulus orientation, percentage errors were higher when stimuli had an orientation of 135°. Percentage error (%) and standard errors for Right Hand for all Orientation are reported in detail in Table 275 and 276Percentage error (%) and standard errors are represented in Fig. 111

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	19.167%	4.236%	10.300	28.033
90°	26.979%	5.018%	16.476	37.483
135°	29.375%	5.010%	18.888	39.862
225°	17.500%	4.090%	8.939	26.061
270°	13.854%	3.497%	6.535	21.173
315°	16.042%	3.583%	8.542	23.542

Table 275: Percentage error (%) and standard errors for Right Hand* Orientation

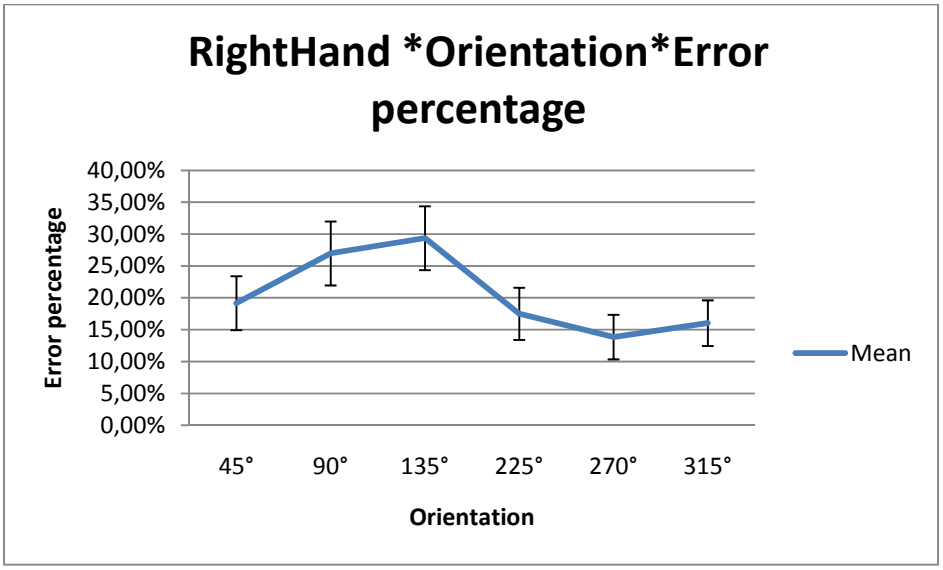

Figure 112: Percentage error (%) and standard errors for Right Hand* Orientation

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-7.813	2.851	.195	-17.376	1.751
	135°	-10.208	4.616	.592	-25.692	5.275
	225°	1.667	3.355	1.000	-9.584	12.918
	270°	5.312	4.444	1.000	-9.592	20.217
	315°	3.125	2.905	1.000	-6.619	12.869
90°	45°	7.813	2.851	.195	-1.751	17.376
	135°	-2.396	3.305	1.000	-13.482	8.691
	225°	9.479(*)	2.314	.009	1.717	17.242
	270°	13.125	3.988	.058	-.250	26.500
	315°	10.938(*)	2.907	.020	1.188	20.687
135°	45°	10.208	4.616	.592	-5.275	25.692
	90°	2.396	3.305	1.000	-8.691	13.482
	225°	11.875(*)	2.511	.002	3.452	20.298
	270°	15.521(*)	3.728	.008	3.016	28.025
	315°	13.333	4.003	.053	-.092	26.759
225°	45°	-1.667	3.355	1.000	-12.918	9.584
	90°	-9.479(*)	2.314	.009	-17.242	-1.717
	135°	-11.875(*)	2.511	.002	-20.298	-3.452
	270°	3.646	2.626	1.000	-5.162	12.454
	315°	1.458	2.222	1.000	-5.994	8.910
270°	45°	-5.312	4.444	1.000	-20.217	9.592
	90°	-13.125	3.988	.058	-26.500	.250
	135°	-15.521(*)	3.728	.008	-28.025	-3.016
	225°	-3.646	2.626	1.000	-12.454	5.162
	315°	-2.187	2.382	1.000	-10.178	5.803
315°	45°	-3.125	2.905	1.000	-12.869	6.619
	90°	-10.938(*)	2.907	.020	-20.687	-1.188
	135°	-13.333	4.003	.053	-26.759	.092
	225°	-1.458	2.222	1.000	-8.910	5.994
	270°	2.187	2.382	1.000	-5.803	10.178

Table 276: Pairwise Comparisons for Right Hand* Orientation

Left Hand Orientation*

In the result that we obtained for the interaction of Left Hand with Stimulus orientation, percentage errors were higher when stimuli had an orientation of 225°. Percentage error (%) and standard errors for Right Hand for all Orientation are reported in detail in Table 277 and 278. Percentage error (%) and standard errors are represented in Fig. 112

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45°	15.521%	4.151%	6.832	24.210
90°	17.396%	4.129%	8.754	26.038
135°	22.500%	4.271%	13.560	31.440
225°	27.500%	4.908%	17.227	37.773
270°	20.937%	4.771%	10.952	30.923
315°	15.000%	3.066%	8.582	21.418

Table 277: Percentage error (%) and standard errors for Left Hand* Orientation

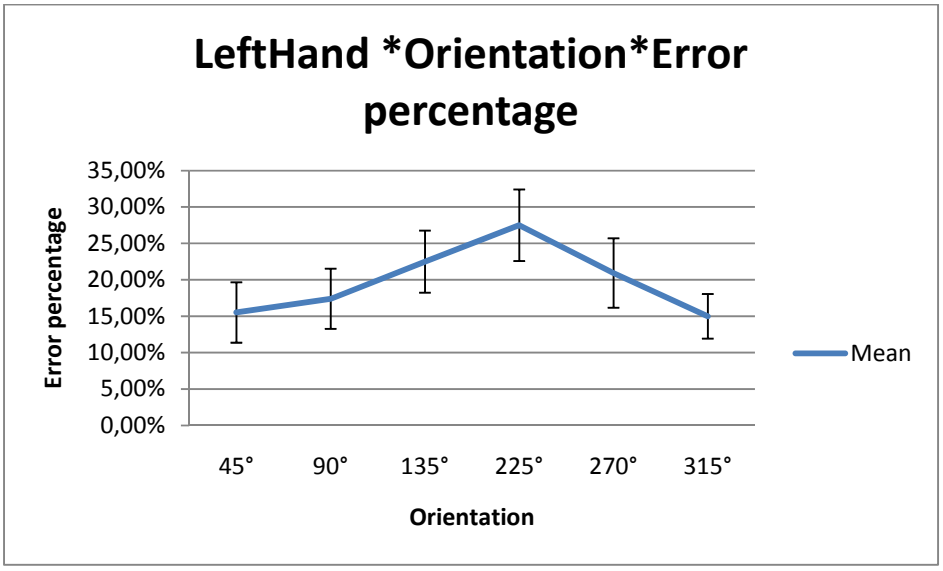

Figure 113: Percentage error (%) and standard errors for Left Hand* Orientation

(I) Orientation	(J) Orientation	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
45°	90°	-1.875	1.669	1.000	-7.472	3.722
	135°	-6.979	2.997	.466	-17.032	3.074
	225°	-11.979	4.534	.241	-27.186	3.228
	270°	-5.417	4.271	1.000	-19.741	8.907
	315°	.521	2.879	1.000	-9.136	10.178
90°	45°	1.875	1.669	1.000	-3.722	7.472
	135°	-5.104	2.964	1.000	-15.044	4.836
	225°	-10.104	5.043	.894	-27.018	6.810
	270°	-3.542	5.065	1.000	-20.530	13.447
	315°	2.396	3.168	1.000	-8.229	13.021
135°	45°	6.979	2.997	.466	-3.074	17.032
	90°	5.104	2.964	1.000	-4.836	15.044
	225°	-5.000	3.610	1.000	-17.107	7.107
	270°	1.563	4.280	1.000	-12.792	15.917
	315°	7.500	3.257	.492	-3.424	18.424
225°	45°	11.979	4.534	.241	-3.228	27.186
	90°	10.104	5.043	.894	-6.810	27.018
	135°	5.000	3.610	1.000	-7.107	17.107
	270°	6.563	2.535	.270	-1.939	15.064
	315°	12.500(*)	2.985	.007	2.489	22.511
270°	45°	5.417	4.271	1.000	-8.907	19.741
	90°	3.542	5.065	1.000	-13.447	20.530
	135°	-1.563	4.280	1.000	-15.917	12.792
	225°	-6.563	2.535	.270	-15.064	1.939
	315°	5.937	2.841	.754	-3.591	15.466
315°	45°	-.521	2.879	1.000	-10.178	9.136
	90°	-2.396	3.168	1.000	-13.021	8.229
	135°	-7.500	3.257	.492	-18.424	3.424
	225°	-12.500(*)	2.985	.007	-22.511	-2.489
	270°	-5.937	2.841	.754	-15.466	3.591

Table 278: Pairwise Comparisons for Left Hand* Orientation

Lateral-Medial

STRATEGY

Results showed the main effects of the type of STRATEGY was not significant [(F (1, 19) = .088, p =0.770]. Percentage error (%) and standard errors for both strategies are reported in detail in Table 1 and represented in Table 279 and 280. Percentage error (%) and standard errors are represented in Fig. 113

STRATEGY	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Motor	19.444%	2.973%	13.222	25.667
Visual	20.868%	5.361%	9.648	32.088

Table 279: Percentage error (%) and standard errors for STRATEGY

(I) STRATEGY	(J) STRATEGY	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Motor	Visual	-1.424	4.810	.770	-11.492	8.645
Visual	Motor	1.424	4.810	.770	-8.645	11.492

Table 280: Pairwise Comparisons for STRATEGY

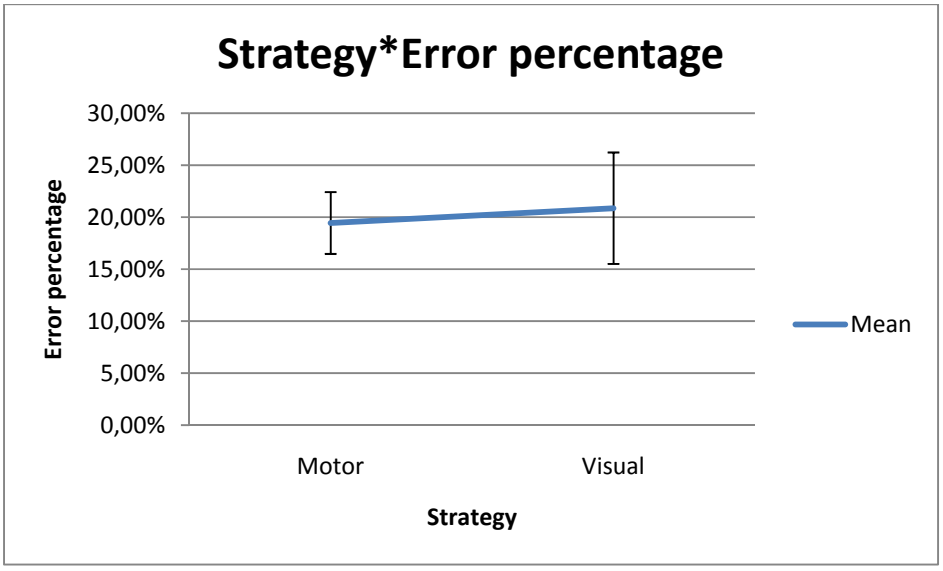

Figure 114: Percentage error (%) and standard errors for STRATEGY

Laterality

Results showed the main effects of the type of Laterality was not significant [(F (1, 19) = 0.382, p =0.544]. Percentage error (%) and standard errors for both Lateral- Medial are reported in detail in Table 1 and represented in Table 281 and 282. Percentage error (%) and standard errors are represented in Fig.114

LAT-MED	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Lateral	20.486%	3.715%	12.710	28.262
Medial	19.826%	3.574%	12.346	27.307

Table 281: Percentage error (%) and standard errors for Laterality

(I) LAT-MED	(J) LAT-MED	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Lateral	Medial	.660	1.067	.544	-1.573	2.893
Medial	Lateral	-.660	1.067	.544	-2.893	1.573

Table 282: Pairwise Comparisons for Laterality

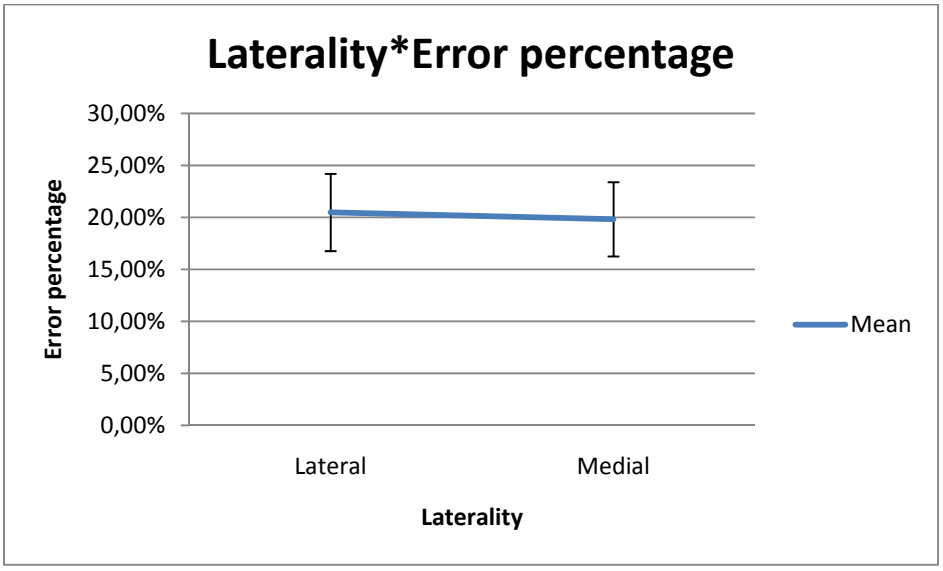

Figure 115: Percentage error (%) and standard errors for Laterality

Hand

Results showed the main effects of the type of Hand was not significant [(F (1, 19) = 3.751, p =0.068]. Percentage error (%) and standard errors for both Hands are reported in detail in Table 1 and represented in Table 283 and 284. Percentage error (%) and standard errors are represented in Fig. 115

HAND	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	21.823%	3.949%	13.557	30.088
Left	18.490%	3.449%	11.271	25.708

Table 283: Percentage error (%) and standard errors for Hand

(I) HAND	(J) HAND	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Right	Left	3.333	1.721	.068	-.269	6.936
Left	Right	-3.333	1.721	.068	-6.936	.269

Table 284: Pairwise Comparisons for Hand

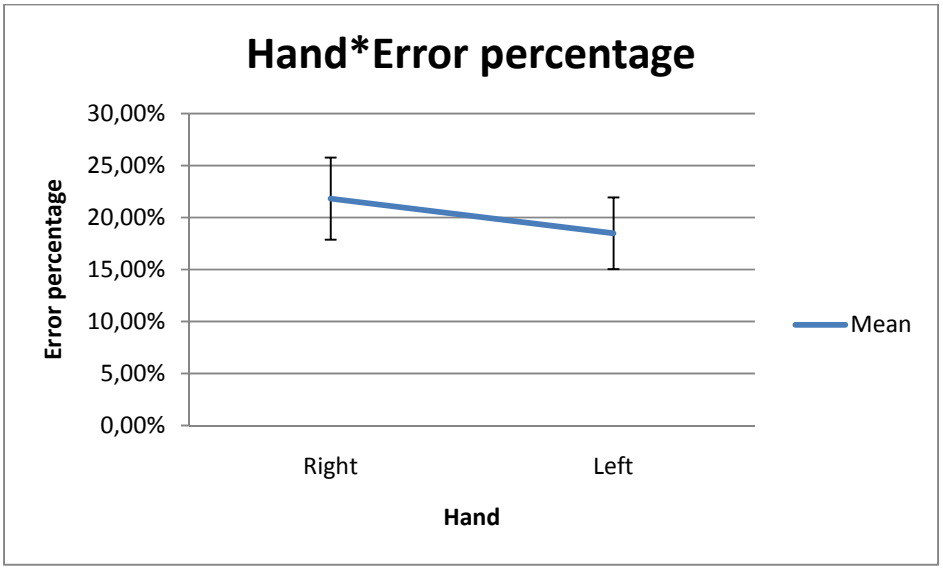

Figure 116: Percentage error (%) and standard errors for Hand

Position

Results showed the main effects of the Position was not significant [(F (1, 19) = 0.611, p =0.554]. Percentage error (%) and standard errors for both Hands are reported in detail in Table 1 and represented in Table 285 and 286. Percentage error (%) and standard errors are represented in Fig. 116

POSITION	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
RVF	20.729%	3.641%	13.108	28.350
C	20.234%	3.774%	12.334	28.134
LVF	19.505%	3.585%	12.001	27.009

Table 285: Percentage error (%) and standard errors for Position

(I) POSITION	(J) POSITION	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
RVF	C	.495	1.091	1.000	-2.369	3.358
	LVF	1.224	1.085	.820	-1.624	4.072
C	RVF	-.495	1.091	1.000	-3.358	2.369
	LVF	.729	1.295	1.000	-2.671	4.130
LVF	RVF	-1.224	1.085	.820	-4.072	1.624
	C	-.729	1.295	1.000	-4.130	2.671

Table 286: Pairwise Comparisons for Position

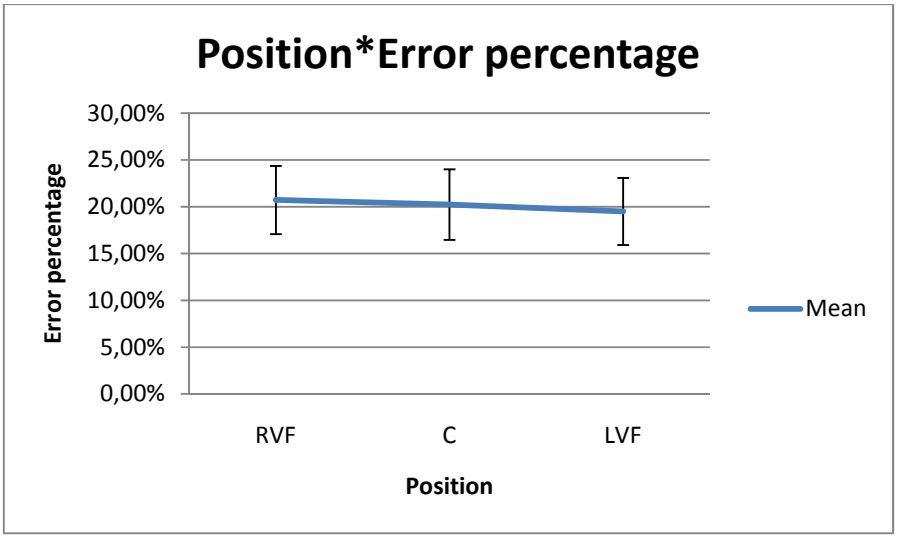

Figure 117: Percentage error (%) and standard errors for Position

Orientation

Results showed the main effects of Orientation was not significant [(F (1, 19) = 0.345, p =0. 713]. Percentage error (%) and standard errors for all Orientations are reported in detail in Table 1 and represented in Table 287. Percentage error (%) and standard errors are represented in Fig.117

Orientation	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
45 °	19.948%	3.826%	11.940	27.956
90 °	19.792%	3.698%	12.052	27.532
135 °	20.729%	3.539%	13.323	28.136

Table 287: Percentage error (%) and standard errors for Orientation

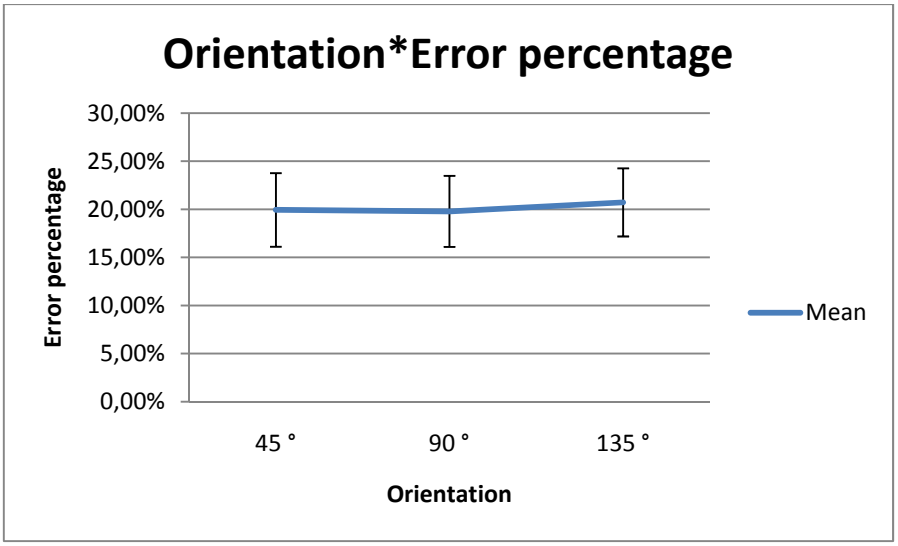

Figure 118: Percentage error (%) and standard errors for Orientation

STRATEGY *LAT MED

We found a significant two-way STRATEGY *LAT MED interaction (F (1, 19) =6.428, p=.02).

Post hoc on STRATEGY *LAT MED

To understand the nature of the significant STRATEGY * LAT MED interactions we performed further Post hoc analysis for Motor and Visual Strategy independently.

MOTOR STRATEGY *LAT MED

For the motor strategy, the effect of Lateral/Medial was not significant (F (1, 19) = 0.008, p=0.929 .See details in Table 288. Percentage error (%) and standard errors are represented in Fig. 118

			95% Confidence Interval	
Laterality	Mean	Std. Error	Lower Bound	Upper Bound
LAT	19.549%	3.002%	13.266	25.832
MED	19.340%	3.368%	12.290	26.390

Table 288: Percentage error (%) and standard errors for MOTOR STRATEGY *LAT MED

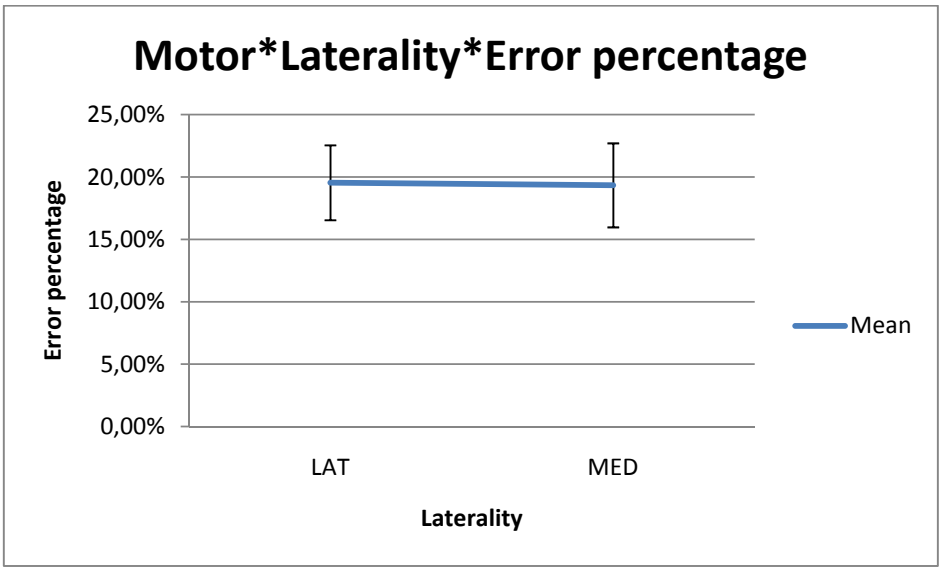

Figure 119: Percentage error (%) and standard errors for MOTOR STRATEGY *LAT MED

VISUAL STRATEGY *LAT MED

For the Visual strategy, the effect of Lateral/Medial was significant (F (1, 19) = 8.123, p=0. 010) with significantly higher error for Lateral than Medial .See details in Table 289 and 290. Percentage error (%) and standard errors are represented in Fig. 119

			95% Confidence Interval	
Laterality	Mean	Std. Error	Lower Bound	Upper Bound
LAT	24.097%	6.043%	11.450	36.744
MED	17.639%	4.851%	7.486	27.792

Table 289 : Percentage error (%) and standard errors for VISUAL STRATEGY *LAT MED

					95% Confidence Interval for Difference(a)	
(I) Laterality	(J) Laterality	Mean Difference (I-J)	Std. Error	Sig.(a)	Lower Bound	Upper Bound
LAT	MED	6.458(*)	2.266	.010	1.715	11.201
MED	LAT	-6.458(*)	2.266	.010	-11.201	-1.715

Table 290: Pairwise Comparisons for VISUAL STRATEGY *LAT MED

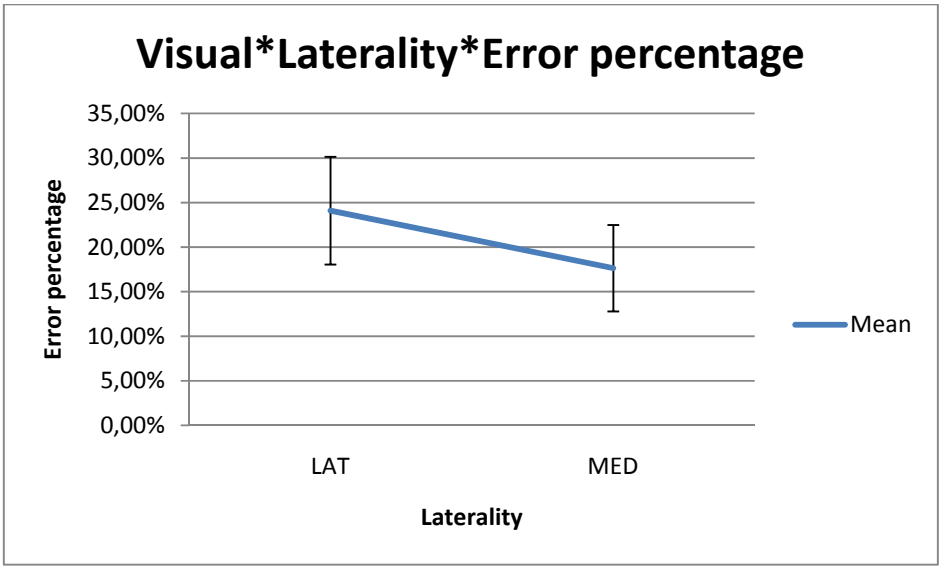

Figure 120: Percentage error (%) and standard errors for VISUAL STRATEGY *LAT MED

HAND *LAT MED

We found a significant two-way Hand *LAT MED interaction (F (1, 19) =7.087, p=0.015).

Post hoc analysis on HAND *LAT MED

To understand the nature of the significant HAND* LAT MED interactions we performed further Post hoc analysis for Right and Left hand independently.

RIGHT HAND *LAT MED

For the Right Hand, the effect of Lateral/Medial was significant (F (1, 19) = 16.602, p=0.001).See details in Table 291 and 292. Percentage error (%) and standard errors are represented in Fig. 120

			95% Confidence Interval	
Laterality	Mean	Std. Error	Lower Bound	Upper Bound
LAT	25.174%	4.273%	16.230	34.117
MED	15.846%	3.448%	8.628	23.063

Table 291: Percentage error (%) and standard errors for RIGHT HAND *LAT MED

(I) Laterality	(J) Laterality	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LAT	MED	9.328(*)	2.289	.001	4.536	14.120
MED	LAT	-9.328(*)	2.289	.001	-14.120	-4.536

Table 292: Pairwise Comparisons for RIGHT HAND *LAT MED

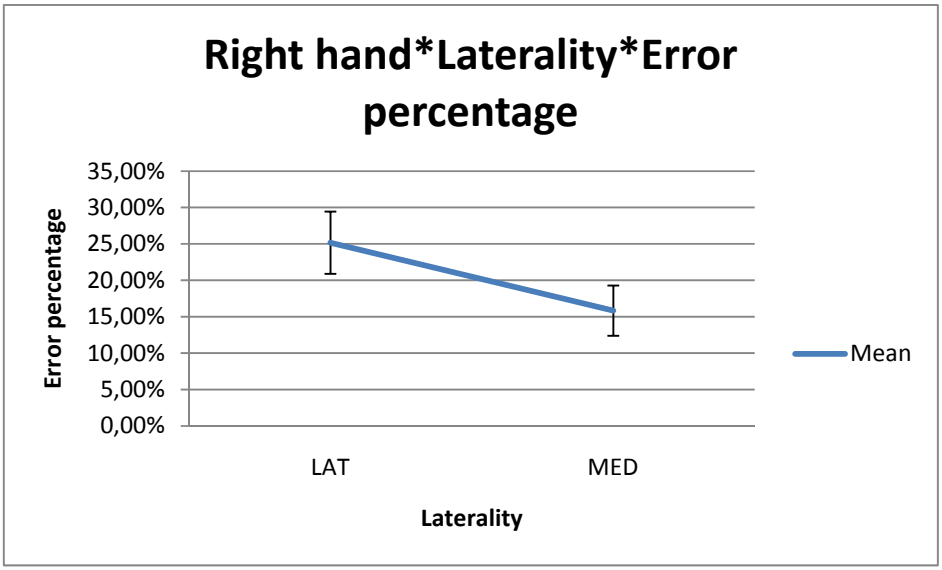

Figure 121: Percentage error (%) and standard errors for RIGHT HAND *LAT MED

LEFT HAND *LAT MED

For the Left Hand, the effect of Lateral/Medial was not significant (F (1, 19) = .670, p=0.423).See details in Table 293 and 294. Percentage error (%) and standard errors are represented in Fig. 121

Laterality	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LAT	18.472%	3.902%	10.305	26.639
MED	21.181%	3.974%	12.863	29.499

Table 293: Percentage error (%) and standard errors for LEFT HAND *LAT MED

(I) Laterality	(J) Laterality	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LAT	MED	-2.708	3.309	.423	-9.633	4.217
MED	LAT	2.708	3.309	.423	-4.217	9.633

Table 294: Pairwise Comparisons for LEFT HAND *LAT MED

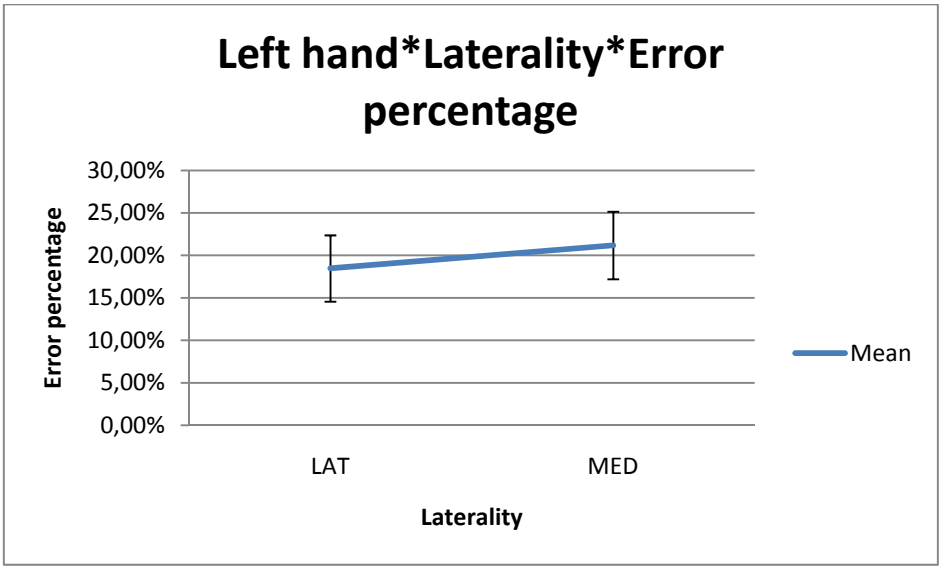

Figure 122: Percentage error (%) and standard errors for LEFT HAND *LAT MED

ORIENTATION*LAT MED

We found a significant two-way Orientation*LAT MED interaction (F (1, 19) =6.061, p=0.010).

Post hoc analysis on ORIENTATION*LAT MED

To understand the nature of the significant Orientation * LAT MED interactions we performed further Post hoc analysis for all Orientation independently.

At 45°*LAT MED

For the 45, the effect of Lateral/Medial was significant (F (1, 19) = 8.204, p=0.01) with significantly higher errors for Medial than Lateral. See details in Table 295 and 296. Percentage error (%) and standard errors are represented in Fig. 122

Laterality	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LAT	17.344%	3.767%	9.460	25.227
MED	22.552%	4.091%	13.989	31.116

Table 295: Percentage error (%) and standard errors for 45°*LAT MED

(I) Laterality	(J) Laterality	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LAT	MED	-5.208(*)	1.818	.010	-9.014	-1.402
MED	LAT	5.208(*)	1.818	.010	1.402	9.014

Table 296: Pairwise Comparisons for 45°*LAT MED

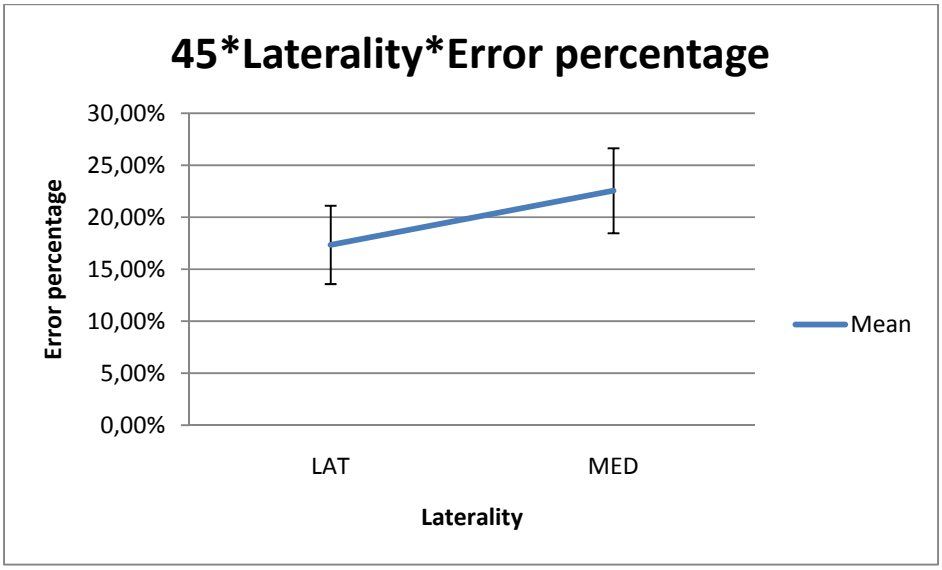

Figure 123: Percentage error (%) and standard errors for 45°*LAT MED

At 90°*LAT MED

For the 90, the effect of Lateral/Medial was not significant (F (1, 19) = 4.092, p=.057).See details in Table 297 and 298. Percentage error (%) and standard errors are represented in Fig. 123

Laterality	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LAT	22.187%	4.237%	13.319	31.056
MED	17.396%	3.493%	10.086	24.706

Table 297: Percentage error (%) and standard errors for 90°*LAT MED

(I) Laterality	(J) Laterality	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LAT	MED	4.792	2.369	.057	-.166	9.749
MED	LAT	-4.792	2.369	.057	-9.749	.166

Table 298: Pairwise Comparisons for 90°*LAT MED

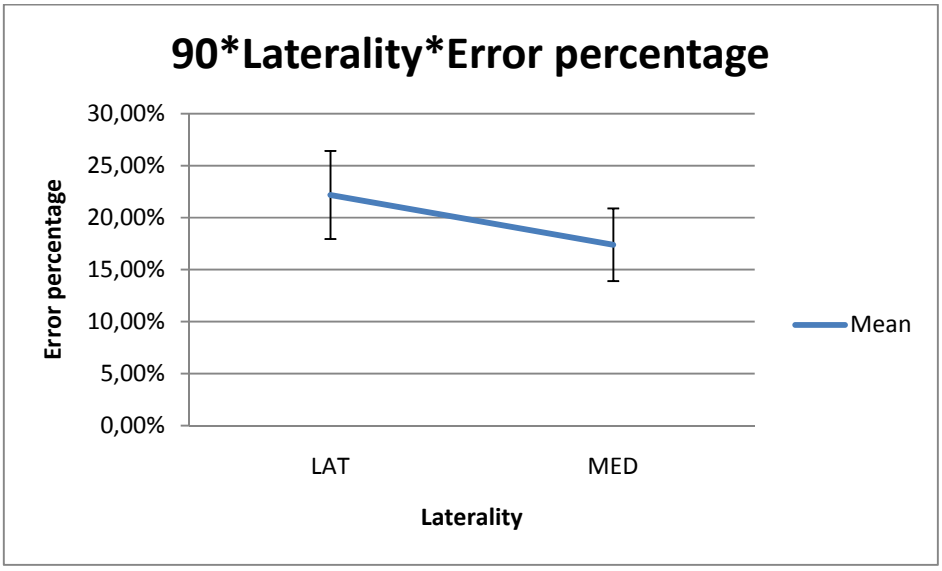

Figure 124: Percentage error (%) and standard errors for 90°*LAT MED

At 135°*LAT MED

For the 135, the effect of Lateral/Medial was significant (F (1, 19) = 12.048, p=0.003) with significantly higher errors for Medial than Lateral .See details in Table 299 and 300. Percentage error (%) and standard errors are represented in Fig. 124

Laterality	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
LAT	25.937%	4.426%	16.674	35.201
MED	15.521%	3.156%	8.916	22.126

Table 299: Percentage error (%) and standard errors for135°*LAT MED

(I) Laterality	(J) Laterality	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
LAT	MED	10.417(*)	3.001	.003	4.135	16.698
MED	LAT	-10.417(*)	3.001	.003	-16.698	-4.135

Table 300: Pairwise Comparisons for135°*LAT MED

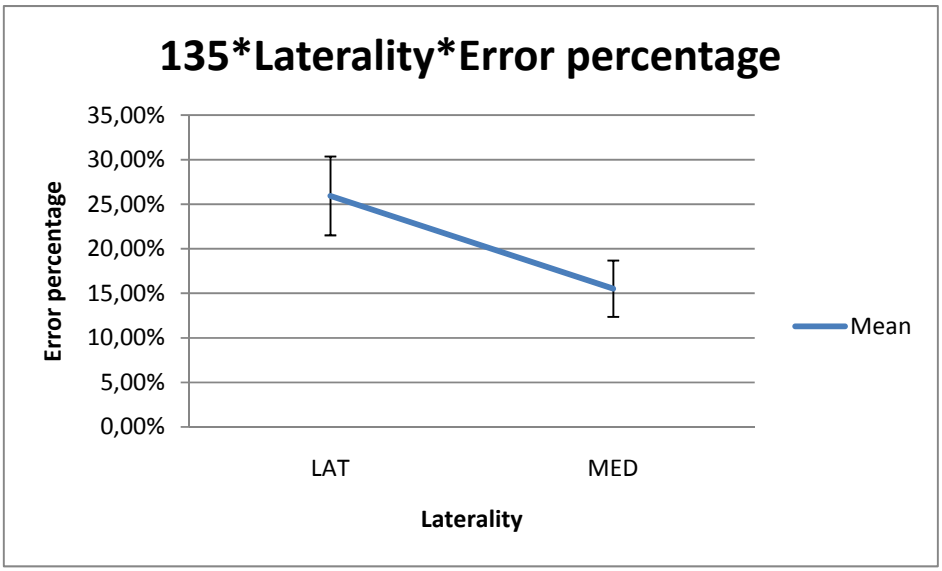

Figure 125: Percentage error (%) and standard errors for 135°*LAT MED

Contralateral Neglect Syndrome Background

Unilateral neglect is a neuropsychological condition in which, after damage to one hemisphere of the brain - most commonly consequence of stroke on right side of brain - patients have difficulties in reporting sensory events occurring in contralateral side of lesion. When the Neglect Patients eat, they often miss to eat from the left side of their dish, they hit into obstacles located on their left, and have a trend to pay attention to right-sided details when the visual cue appear , it seems like if their attention were fascinated by these details[29]. “Ipsilesional neglect” is also a term that has been used for patients who, after injury to right hemisphere of their brain, while performing standard line bisection task they line would be deviated to the left[30]. And notably on the cancellation task, which is the test designed for testing the level of severity in neglect patient, subjects with a lesion in the right hemisphere often fail to see targets on the left side of space[31]. They are frequently not conscious about their deficits, and regularly persistently refuse that they are hemiplegic [32,33]. Patients with left brain damage may possibly confirm the existence of contralesional, right-sided neglect, notwithstanding not often and typically are not so severe [34].

The contralesional side of space might be neglected, theoretically, both because patients fail to perceive and consequently are not capable to report the events happening contralesional side ‘failure to perceive’, or as a consequence of failure to actions in the contralesional part of space ‘failure to reach for’. This difference suggested the existence of two major components of unilateral spatial neglect: ‘perceptual’ vs. ‘premotor’ [35]. This category could also be expressed in terms of the failure of ‘input’ vs. ‘output’ systems [36].The ‘perceptual’ vs. ‘premotor’ distinction suggests that, this distinction is influenced by factors, such as parts of space for example neglect for near of far space[37] , and stimulus type (e.g., neglect ‘dyslexia’ [38]) , and also ‘facial’ neglect 39 .The term ‘premotor’ in general refer to impairments regarding to programming, initiating, and executing of movements in the contralateral side of the lesion, self-determining of the characteristics of the stimulus[40,41]. The term ‘Motor neglect [42], shall refer to the incapability to start and carry out movements, by means of the contralesional limbs. Perceptual neglect is refer to perceiving the sensory events that happen in contrlateral side of the

lesion and therefore patients are unable to report the event, the perceptual neglect is mainly attentional or space representation deficits.

Rivermead Behavioral Inattention Test

The BIT, originally called as Rivermead Behavioral Inattention Test, is tests to estimate the existence and the degree of visual neglect on patients with visual inattention (Wilson, Cockburn, & Halligan, 1987). The BIT first introduced and invented in 1987 by Barbara Wilson, Janet Cockburn and Peter Halligan43.

The BIT is separated into two sections: Conventional and Behavioral. The BIT Conventional subtest (BITC) composed of 6 items: line crossing, letter cancelation, star cancellation, figure and shape copying, line bisection, and representational drawing. The BIT Behavioral subtest (BITB) composed of 9 items: pre-scanning, phone dialing, menu reading, article reading, telling and setting the time, coin sorting, address and sentence copying, map navigation, and card sorting. To minimize practice and learning effects upon re-testing, parallel versions of the test were created (Wilson et al., 1987).

BIT Conventional subtest (BITC):

Line crossing: Patients are asked to identify and cancel all lines on a sheet.
Letter Cancellation: patients are asked to search, locate, and cancel selected targets from a background of other letters.
Star Cancellation: Patients are required to cross out all the small stars among other stars in a page.
Figure and Shape copying: the patients are instructed to copy easy sketch from the left side of the page.
Line Bisection: Patients are asked to determine and mark the midpoint of a horizontal line
Representational Drawing: Patients are required to sketch pictures of a clock as well as the numbers and a setting a simple sketch of a butterfly.

Scoring:

The BIT total score are achieved by adding together the subtests scores .Higher scores are suggestive of severity of visual impairment 44.

Neglect Patient:

TS is a right-handed (100% on the Olfield Test) Italian man born in 1939 with 15 years of education, was admitted to the hospital with ischemic stroke in the right MCA territory. The clinical picture and neuropsychological examination showed that the patient suffering from left hemiparesis and dysarthria, tactile extinction on the left, very mild extra personal visual left neglect and representational left neglect, no personal neglect on the Personal Neglect Test, no other neuropsychological deficit. The BEHAVIOURAL INATTENTION TEST performed by the patient reported below in the table *

BEHAVIOURAL INATTENTION TEST

BEHAVIOURAL INATTENTION TEST (Wilson, 1995)			
Conventional sub-tests	**Patient score**	**Acceptable range**	**Cut off score**
Line crossing	36/36	35-36	34
Letter cancellation	31/40	33-40	32
Star cancellation	48/54	52-54	51
Figure and shape copying	3/4	4	3
Line bisection	1/9	8-9	7
Representational drawing	2/3	3	2
Total	121		129

Table 301: BEHAVIOURAL INATTENTION TEST performed by TS

Experiment

TS performed two tasks, one involving a motor strategy and the other involving a visual strategy. In the motor strategy, TS asked required to decide whether a hand stimulus presented on the screen is left or right, whereas in the visual strategy he had to decide whether a red spot is on the

left or on the right of the hand stimulus. TS sat in front of the PC screen (the size of the screen was the same size as used for normal subjects), at a distance of approximately 30 cm and were told to press a previously assigned response key. He responded with his right hand by using a custom-made button box consist of two pads located one above the other (same used for subjects) corresponding to “left” and “right . The accuracy of button box was 1 millisecond. Two dependent variables collected: RTs and accuracy. During the experiments TS placed his left hand on the table with the palm facing downwards. He first performed the task of Motor strategy before Visual strategy. After performing a first experiment TS had a pause (5 minutes); followed by the second experiment. The total duration of the experiment (including both experiments (Motor/Visual) and 5 minutes pause) was about 20-25 minutes. The Experiment performed at Cattinara Hospital in Trieste, for which TS informed in according to the related laws and institutional guiding principle and were approved by the S.I.S.S.A. Ethical Committee.

Graphs and Tables:

Graphs and tables drawn using Microsoft excel 2007 and SPSS 11.5 software.

Data analyses:

Data analyses were carried out with SPSS 11.5. Data were examined following a single-case approach. The performance of patient was compared with that of the controls using a z test. A further Wilcoxon Signed-Rank Test Performed on data obtained from patient in order to better clarified the difference between performing the Motor and Visual strategy regarding to both Response Time and Accuracy data.

Response Time:

The data obtained from the neglect subject organized and the graphs drawn based on the Response time for all the factors and their interactions.

Strategy

The graph is drawn to clarify the main effect of the type of STRATEGY. Mean Reaction Times and Standard Errors are represented in Table 302 and Fig.125

STRATEGY	Mean	Std. Error
Motor	3561.313	166.698
Visual	4493.113	179.7939

Table 302: Mean Reaction Times and Standard Errors for Strategy

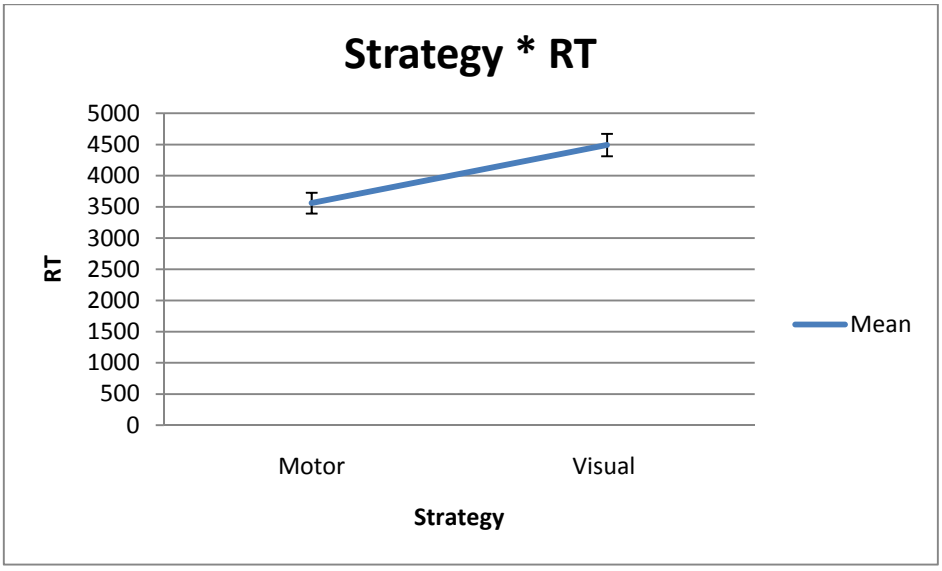

Figure 126: Mean Reaction Times and Standard Errors for Strategy

Hand:

The graph is drawn to clarify the main effect of the Hand Stimulus. Mean Reaction Times and Standard Errors are represented in Table 303 and Fig.126

Hand	Mean	Std. Error
Right	4076.797	194.199
Left	3977.628	186.1824

Table 303: Mean Reaction Times and Standard Errors for Hand

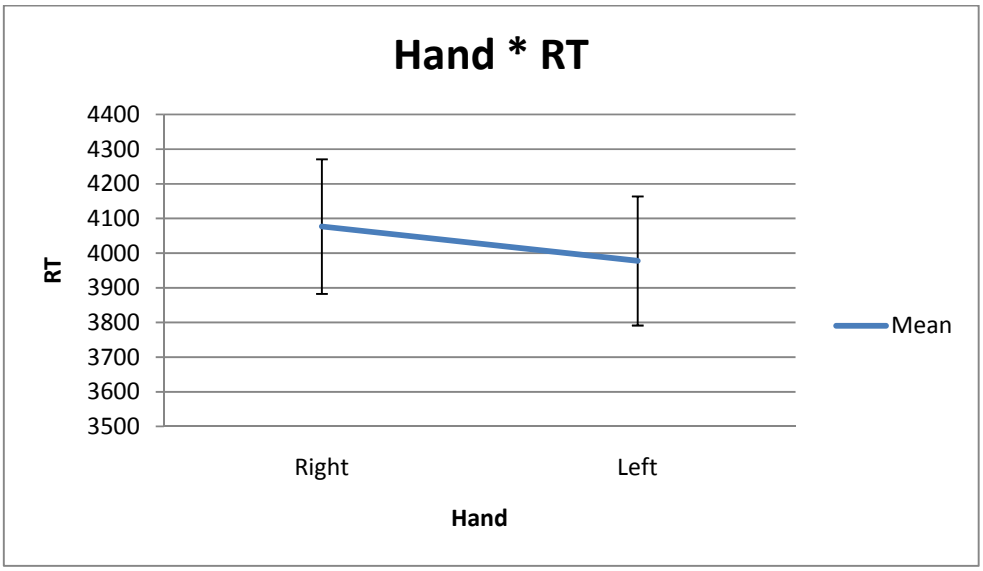

Figure 127: Mean Reaction Times and Standard Errors for Hand

Orientation:

The graph is drawn to clarify the main effect of the Orientation. Mean Reaction Times and Standard Errors are represented in Table 304 and Fig.127

Orientation	Mean	Std. Error
45°	4267.849	367.4043
90°	4019.172	421.8053
135°	3992.466	273.3948
225°	3767.558	341.3403
270°	4211.524	227.3542
315°	3904.708	346.9853

Table 304: Mean Reaction Times and Standard Errors for Orientation

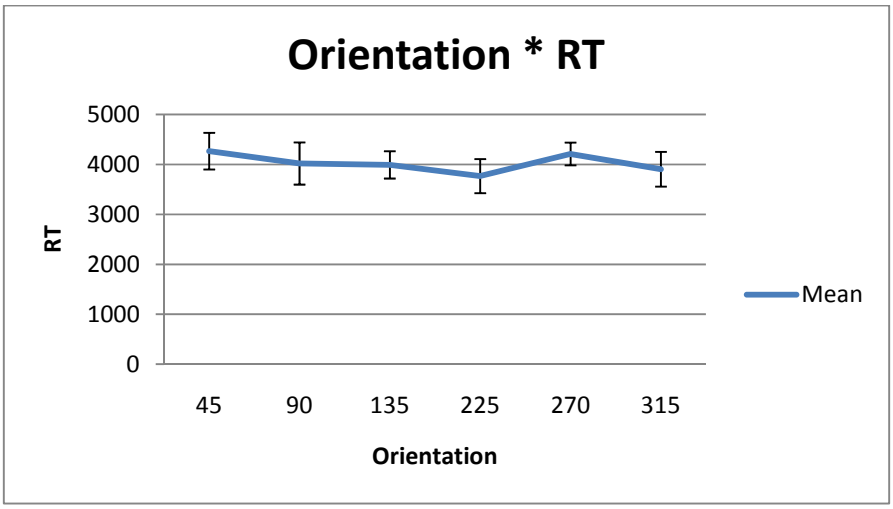

Figure 128: Mean Reaction Times and Standard Errors for Orientation

Position:

The graph is drawn to clarify the main effect of the Position. Mean Reaction Times and Standard Errors are represented in Table and Fig.128

Position	Mean	Std. Error
RVF	3761.641	211.9903171
C	3826.803	254.6235253
LVF	4493.194	203.7224117

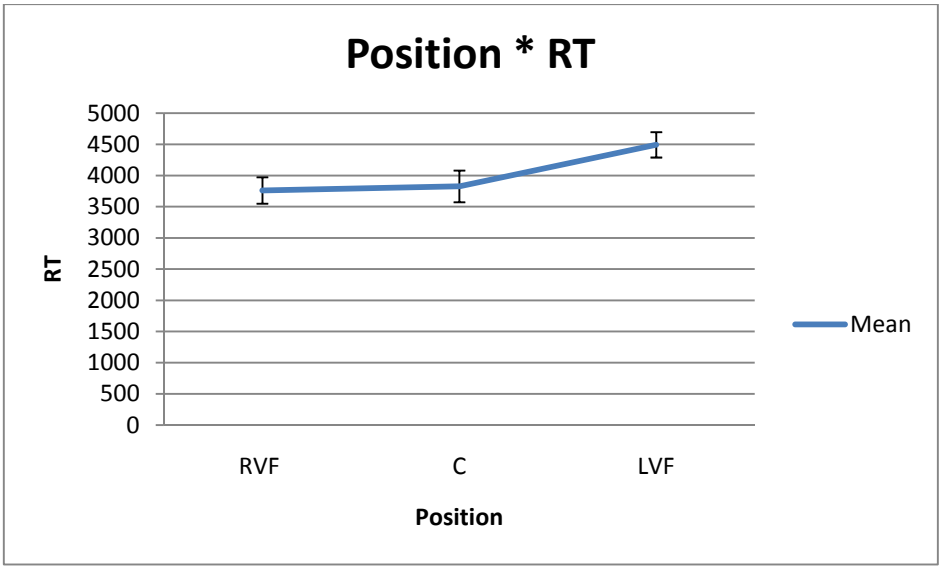

Figure 129: Mean Reaction Times and Standard Errors for Position

Strategy*Orientation:

The graph is drawn to clarify the main effect of the Strategy*Orientation interaction. Mean Reaction Times and Standard Errors are represented in Table 305 and Fig.129

STRATEGY	ANGLE	Mean	Std. Error
Motor	45°	4064.033	486.533
	90°	3656.504	558.7222
	135°	3376.021	309.8465
	225°	2927.813	343.9316
	270°	3741.246	289.4743
	315°	3602.263	416.9313
Visual	45°	4471.665	583.6157
	90°	4381.839	646.5796
	135°	4608.911	284.3765
	225°	4607.304	335.1119
	270°	4681.801	234.8952
	315°	4207.154	565.0961

Table 305: Mean Reaction Times and Standard Errors for Strategy*Orientation:

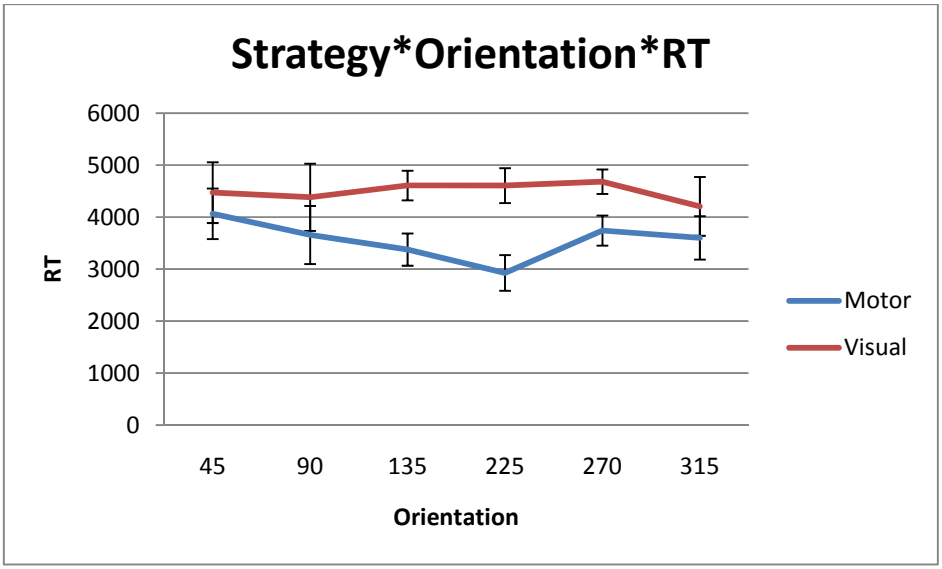

Figure 130: Mean Reaction Times and Standard Errors for Strategy*Orientation:

*Strategy*Hand*

The graph is drawn to clarify the main effect of the Strategy*Hand interaction. Mean Reaction Times and Standard Errors are represented in Table 306 and Fig.130

STRATEGY	HAND	Mean	Std. Error
Motor	Right	3487.214	258.7802
	Left	3635.413	216.3537
Visual	Right	4666.381	217.7787
	Left	4319.844	286.6127

Table 306: Mean Reaction Times and Standard Errors for Strategy*Hand

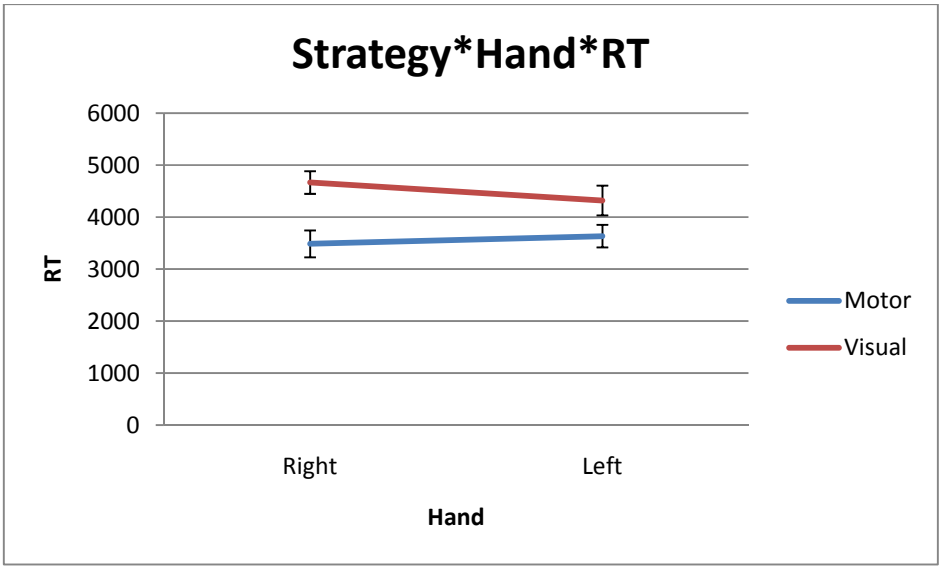

Figure 131: Mean Reaction Times and Standard Errors for Strategy*Hand

Strategy* Position

The graph is drawn to clarify the main effect of the Strategy*Position interaction. Mean Reaction Times and Standard Errors are represented in Table 307 and Fig.131

STRATEGY	POSITION	Mean	Std. Error
Motor	RVF	3397.404	266.9228
	C	3254.192	319.3518
	LVF	4032.344	246.6386
Visual	RVF	4125.878	304.2386
	C	4399.415	330.9373
	LVF	4954.044	272.2344

Table 307: Mean Reaction Times and Standard Errors for Strategy* Position

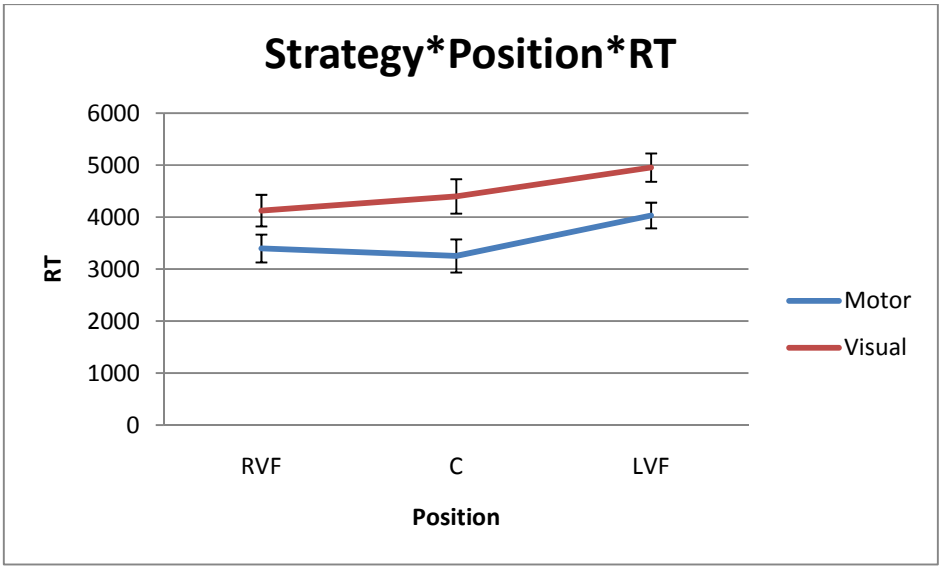

Figure 132: Mean Reaction Times and Standard Errors for Strategy* Position

Hand*Orientation

The graph is drawn to clarify the main effect of the Hand*Orientation interaction. Mean Reaction Times and Standard Errors are represented in Table 308 and Fig.132

HAND	Orientation	Mean	Std. Error
Right	45°	4164.915	425.2538
	90°	4191.513	639.2382
	135°	3813.232	490.7707
	225°	3593.404	409.5026
	270°	4499.033	260.5271
	315°	4198.688	643.9164
Left	45°	4370.783	639.4209
	90°	3846.831	601.9474
	135°	4171.7	274.173
	225°	3941.713	576.9176
	270°	3924.014	355.6635
	315°	3610.729	283.8255

Table 308: Mean Reaction Times and Standard Errors for Hand*Orientation

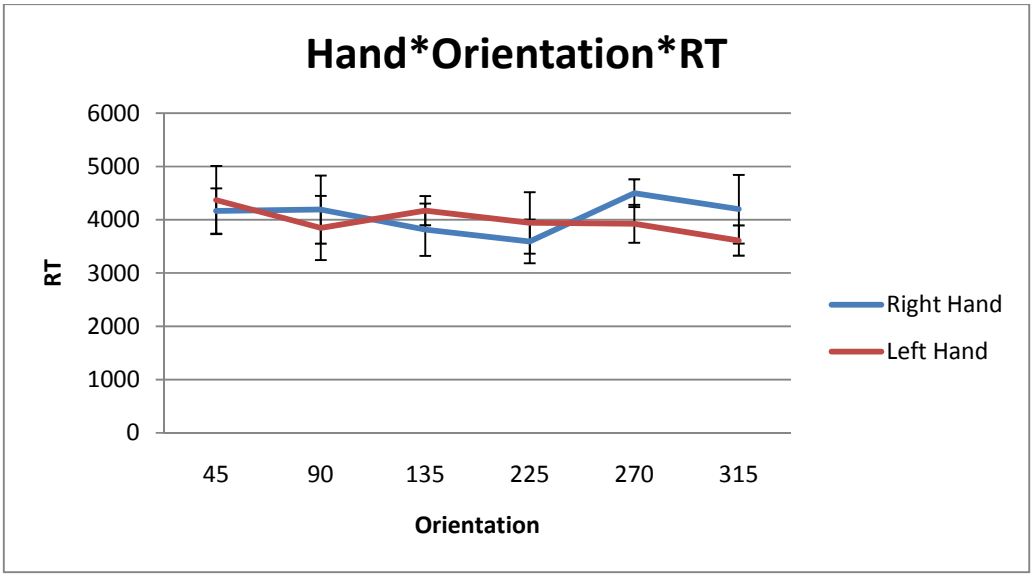

Figure 133: Mean Reaction Times and Standard Errors for Hand*Orientation

Hand*Position

The graph is drawn to clarify the main effect of the Hand*Position interaction. Mean Reaction Times and Standard Errors are represented in Table 309 and Fig.133

HAND	POSITION	Mean	Std. Error
Right	RVF	3633.019	320.7847
	C	4103.403	353.4955
	LVF	4493.97	313.5908
Left	RVF	3890.263	286.3908
	C	3550.203	363.6631
	LVF	4492.418	274.2589

Table 309: Mean Reaction Times and Standard Errors for Hand*Position

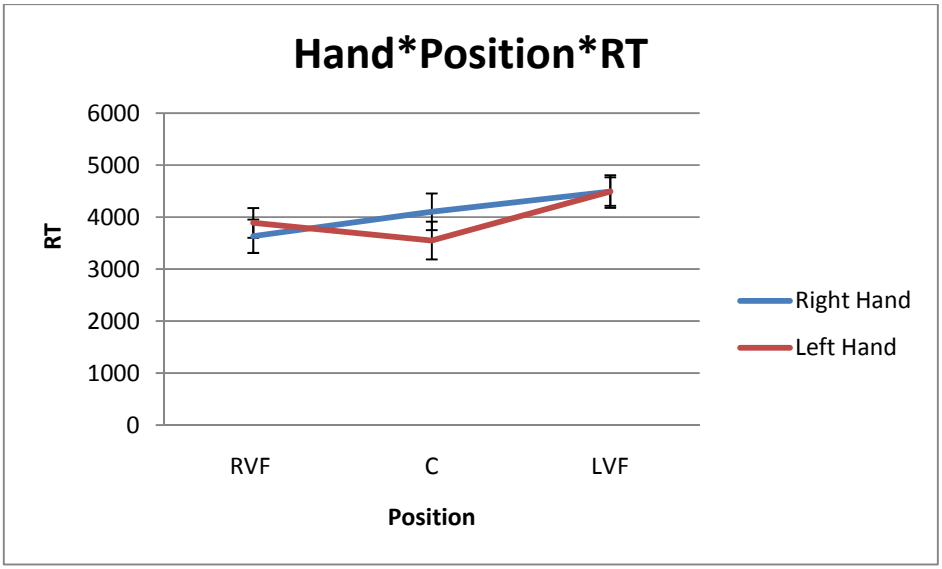

Figure 134: Mean Reaction Times and Standard Errors for Hand*Position

Position*Orientation

The graph is drawn to clarify the main effect of the Position*Orientation interaction. Mean Reaction Times and Standard Errors are represented in Table 310 and Fig.134

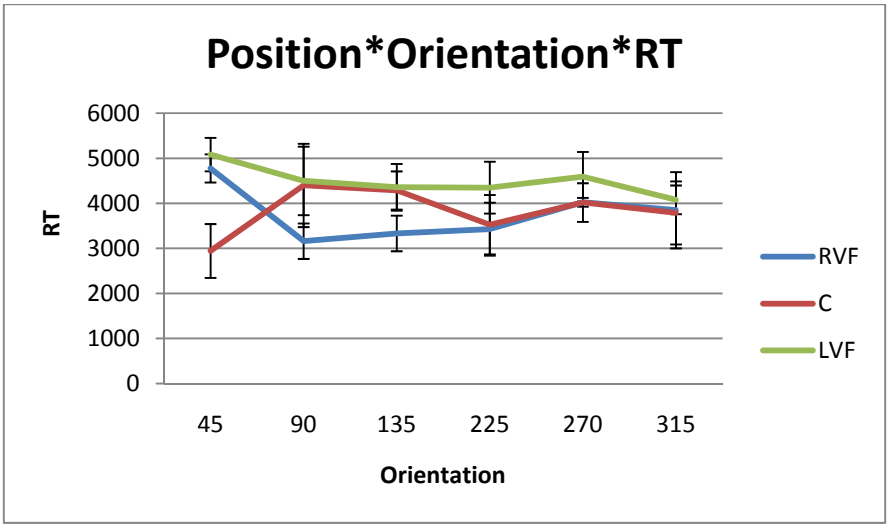

Figure 135: Mean Reaction Times and Standard Errors for Position*Orientation

Orientation	position	Mean	Std. Error
45°	RVF	4775.923	311.9833
	C	2943.556	597.7656
	LVF	5084.069	370.7911
90°	RVF	3160.914583	393.8185184
	C	4398.275	924.3276172
	LVF	4498.325	760.0469408
135°	RVF	3332.458	395.132
	C	4287.34	423.2166
	LVF	4357.6	517.9984
225°	RVF	3427.344	587.2897
	C	3526.15	659.3555
	LVF	4349.181	575.5145
270°	RVF	4024.906	97.87424
	C	4018.013	429.2728
	LVF	4591.652	549.9799
315°	RVF	3848.3	846.5935
	C	3787.488	700.0353
	LVF	4078.338	319.2602

Table 310: Mean Reaction Times and Standard Errors for Position*Orientation

Accuracy

The data obtained from the neglect subject organized and the graphs drawn based on the Accuracy for all the factors and their interactions.

Strategy

The graph is drawn to clarify the main effect of the Strategy type. Percentage error (%) and standard errors are represented in Table 311 and Fig.134

STRATEGY	Mean	Std. Error
Motor	59.03%	3.17%
Visual	64.58%	3.91%

Table 311: Percentage error (%) and standard errors for Strategy

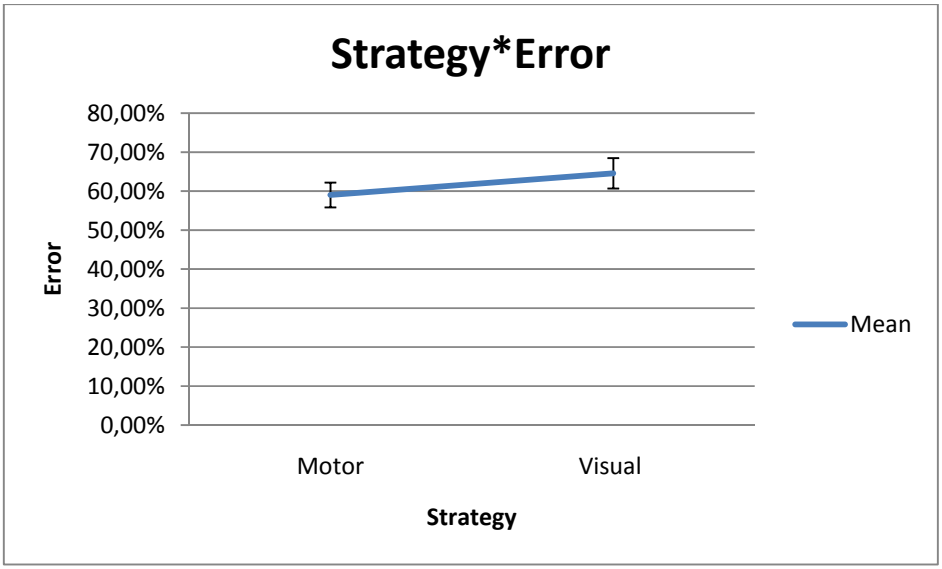

Figure 134: Percentage error (%) and standard errors for Strategy

Hand

The graph is drawn to clarify the main effect of the Hand Stimulus. Percentage error (%) and standard errors are represented in Table 313 and Fig.135

Hand	Mean	Std. Error
Right	61.81%	3.38%
Left	61.81%	3.79%

Table 312: Percentage error (%) and standard errors for Hand

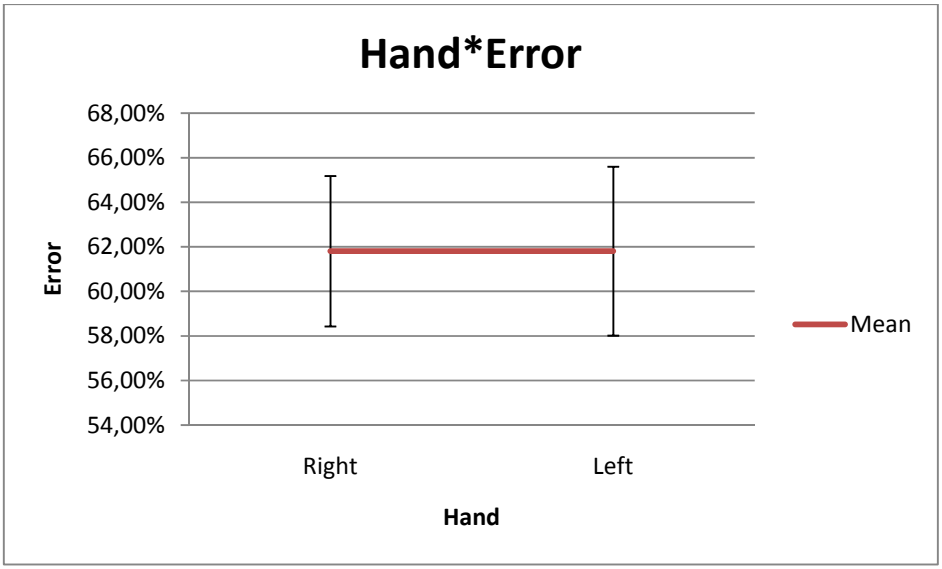

Figure 136: Percentage error (%) and standard errors for Hand

Orientation

The graph is drawn to clarify the main effect of the Orientation. Percentage error (%) and standard errors are represented in Table 314 and Fig.136

Orientation	Mean	Std. Error
45°	62.50%	4.87%
90°	75%	7.54%
135°	66.67%	3.55%
225°	58.33%	6.41%
270°	56.25%	6.25%
315°	52.08%	6.50%

Table 313: Percentage error (%) and standard errors for Orientation

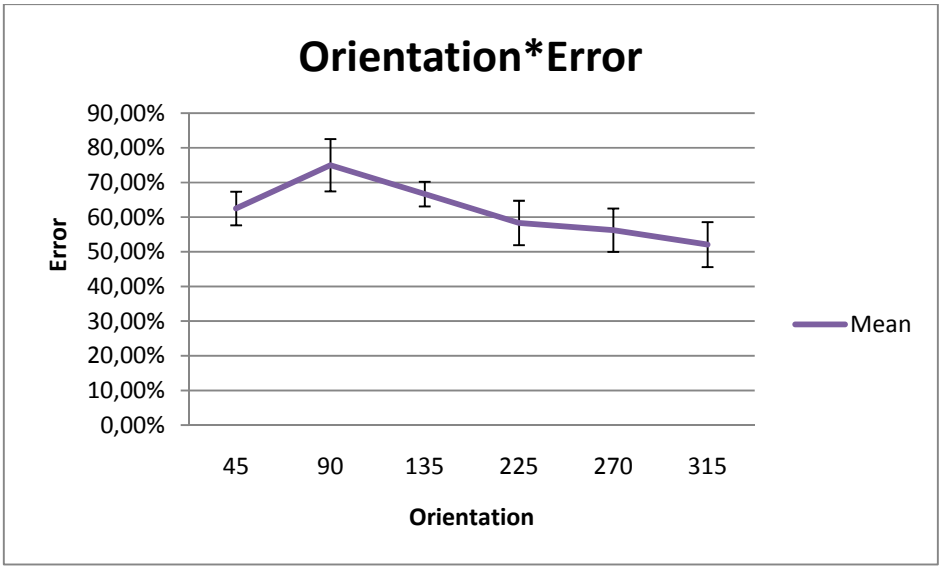

Figure 137: Percentage error (%) and standard errors for Orientation

Position

The graph is drawn to clarify the main effect of the Position. Percentage error (%) and standard errors are represented in Table 315 and Fig.137

Position	Mean	Std. Error
RVF	60.42%	3.66%
C	64.58%	5.19%
LVF	60.42%	4.23%

Table 314: Percentage error (%) and standard errors for Position

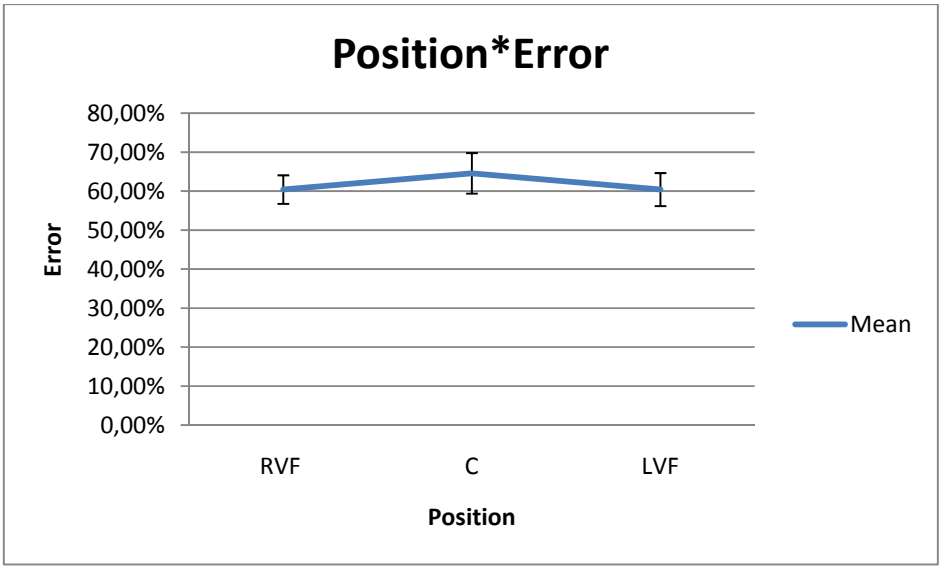

Figure 138: Percentage error (%) and standard errors for Position

Strategy*Orientation

The graph is drawn to clarify the main effect of the Strategy*Orientation interaction. Percentage error (%) and standard errors are represented in Table 316 and Fig.138

STRATEGY	ANGLE	Mean	Std. Error
Motor	45°	58.33%	5.27%
	90°	66.67%	12.36%
	135°	62.50%	5.59%
	225°	58.33%	10.54%
	270°	54.17%	7.68%
	315°	54.17%	4.17%
Visual	45°	66.67%	8.33%
	90°	83.33%	8.33%
	135°	70.83%	4.17%
	225°	58.33%	8.33%
	270°	7.68%	7.68%
	315°	50%	12.91%

Table 315: Percentage error (%) and standard errors for Strategy*Orientation

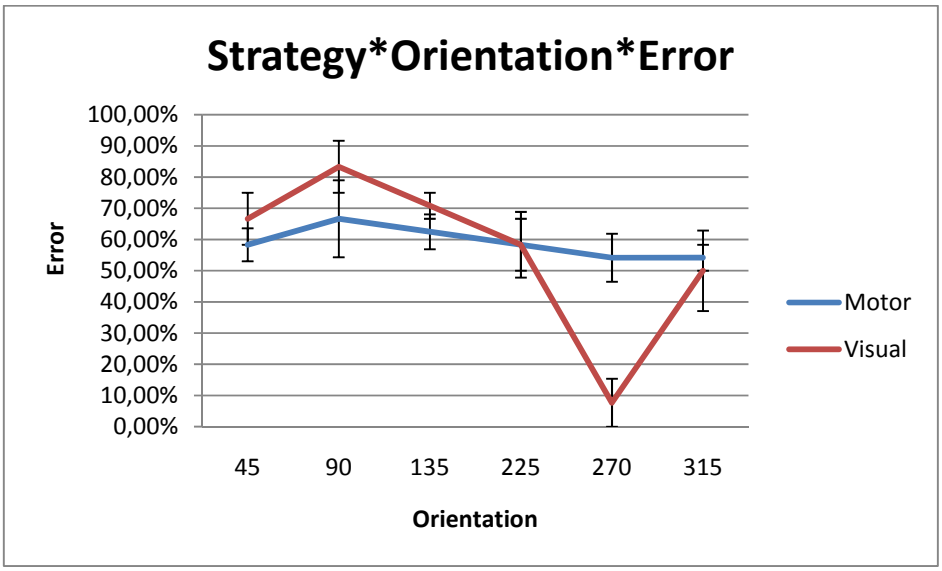

Figure 139: Percentage error (%) and standard errors for Strategy*Orientation

Strategy*Hand

The graph is drawn to clarify the main effect of the Strategy* Hand interaction. Percentage error (%) and standard errors are represented in Table 317 and Fig.139

STRATEGY	HAND	Mean	Std. Error
Motor	Right	58.33%	4.52%
	Left	59.72%	4.58%
Visual	Right	65.28%	5.01%
	Left	63.89%	6.14%

Table 316: Percentage error (%) and standard errors for Strategy*Hand

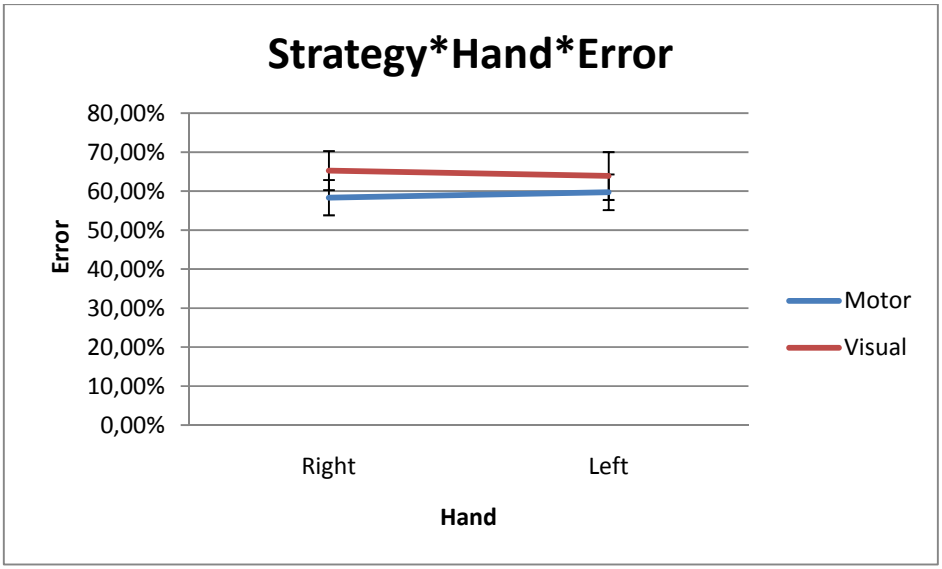

Figure 140: Percentage error (%) and standard errors for Strategy*Hand

*Strategy*Position*

The graph is drawn to clarify the main effect of the Strategy* Position interaction. Percentage error (%) and standard errors are represented in Table 318 and Fig.140

STRATEGY	POSITION	Mean	Std. Error
Motor	RVF	56.25%	4.49%
	C	66.67%	6.41%
	LVF	54.17%	5.18%
Visual	RVF	64.58%	5.72%
	C	62.50%	8.43%
	LVF	66.67%	6.41%

Table 317: Percentage error (%) and standard errors for Strategy*Position

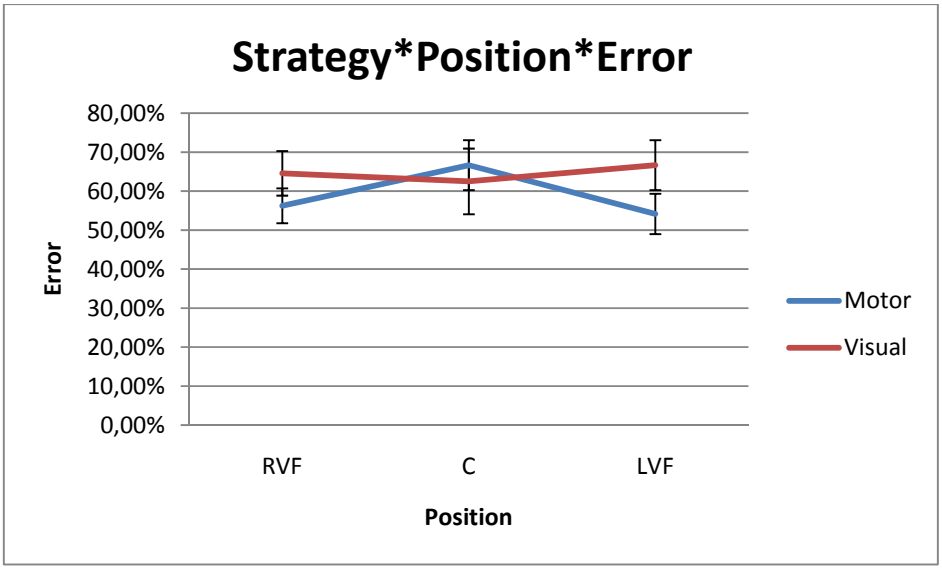

Figure 141: Percentage error (%) and standard errors for Strategy*Position

Hand*Orientation

The graph is drawn to clarify the main effect of the Hand*Orientation interaction. Percentage error (%) and standard errors are represented in Table 319 and Fig.141

HAND	Orientation	Mean	Std. Error
Right	45°	50%	0%
	90°	70.83%	11.93%
	135°	66.67%	5.27%
	225°	54.17%	7.68%
	270°	66.67%	8.33%
	315°	62.50%	10.70%
Left	45°	75%	6.45%
	90°	79.17%	10.03%
	135°	66.67%	5.27%
	225°	62.50%	10.70%
	270°	45.83%	7.68%
	315°	41.67%	5.27%

Table 318: Percentage error (%) and standard errors for Hand*Orientation

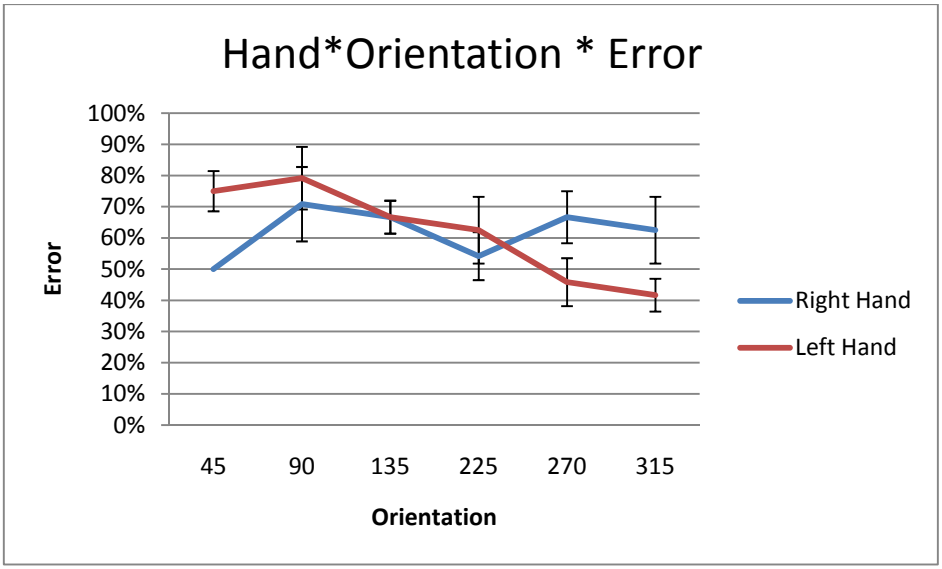

Figure 142: Percentage error (%) and standard errors for Hand*Orientation

Hand*Position

The graph is drawn to clarify the main effect of the Hand*Position interaction. Percentage error (%) and standard errors are represented in Table 320 and Fig.142

HAND	POSITION	Mean	Std. Error
Right	RVF	62.50%	4.87%
	C	64.58%	7.19%
	LVF	58.33%	5.62%
Left	RVF	58.33%	5.62%
	C	64.58%	7.82%
	LVF	62.50%	6.53%

Table 319: Percentage error (%) and standard errors for Hand*Position

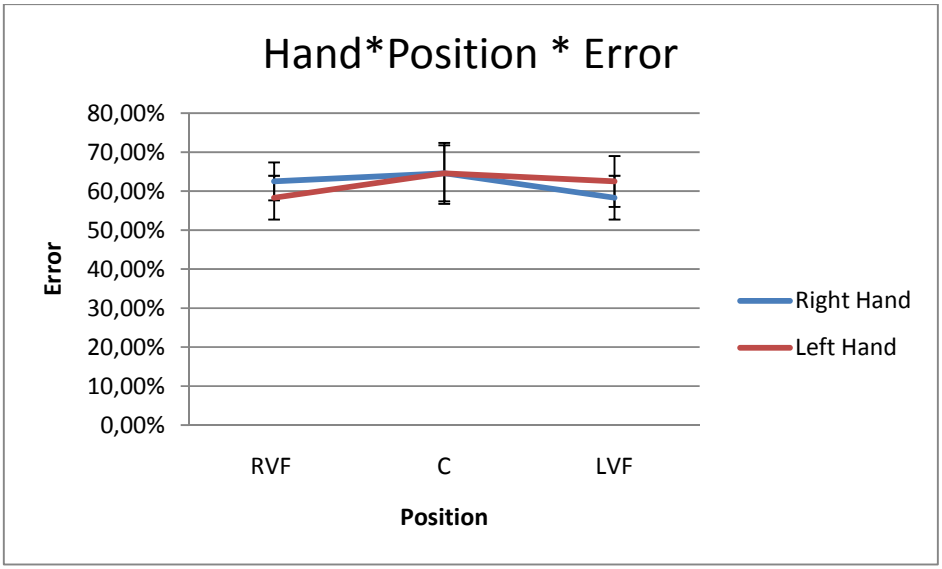

Figure 143: Percentage error (%) and standard errors for Hand*Position

Position*Orientation

The graph is drawn to clarify the main effect of the Position*Orientation interaction. Percentage error (%) and standard errors are represented in Table 321 and Fig.143

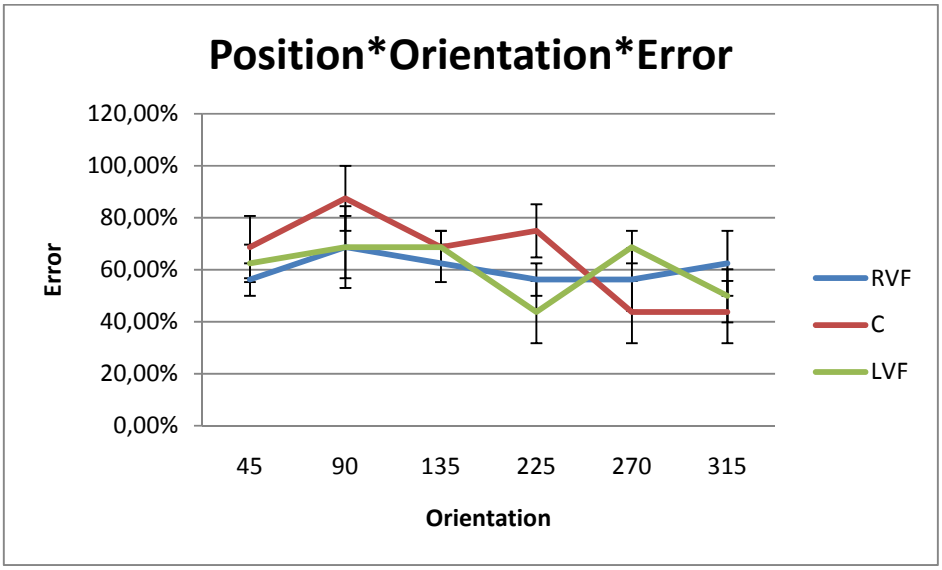

Figure 144: Percentage error (%) and standard errors for Position*Orientation

Orientation	position	Mean	Std. Error
45°	RVF	56.25%	6.25%
	C	68.75%	11.97%
	LVF	62.50%	7.22%
90°	RVF	68.75%	11.97%
	C	87.50%	12.50%
	LVF	68.75%	15.73%
135°	RVF	62.50%	7.22%
	C	68.75%	6.25%
	LVF	68.75%	6.25%
225°	RVF	56.25%	6.25%
	C	75%	10.21%
	LVF	43.75%	11.97%
270°	RVF	56.25%	11.97%
	C	43.75%	11.97%
	LVF	68.75%	6.25%
315°	RVF	62.50%	12.50%
	C	43.75%	11.97%
	LVF	50%	10.21%

Table 320: Percentage error (%) and standard errors for Position*Orientation

Data analyses

Data analyses were carried out with SPSS 11.5. Data were examined following a single-case approach. The performance of patient was compared with that of the controls using a z test. A further Wilcoxon Signed-Rank Test Performed on data obtained from patient in order to better clarified the difference between performing the Motor and Visual strategy regarding to both Response Time and Accuracy data.

Wilcoxon Signed-Rank Test for Response Time:

The result for RT data indicate that patient performed the Mental Rotation test using Motor strategy better than Mental Rotation test using Visual Strategy (Wilcoxon, $p = 0.03$). This means

the effect of strategy was significantly different for Motor vs. Visual strategy regarding to RT's data. See details in table 322-324.

	N	Mean	Std. Deviation	Minimum	Maximum
MOTOR	36	3561.3132	1000.18801	1847.40	5646.43
VISUAL	36	4493.1125	1078.76321	1875.20	6500.00

Table 321 : Descriptive Statistics for RT

Ranks

		N	Mean Rank	Sum of Ranks
VISUAL - MOTOR	Negative Ranks	9(a)	15.89	143.00
	Positive Ranks	27(b)	19.37	523.00
	Ties	0(c)		
	Total	36		

Table 322: Wilcoxon Signed Ranks Test for RT

a) VISUAL < MOTOR
b) VISUAL > MOTOR
c) VISUAL = MOTOR

	VISUAL - MOTOR
Z	-2.985(a)
Asymp. Sig. (2-tailed)	.003

Table 323: Test Statistics for RT

a) Based on negative ranks.
b) Wilcoxon Signed Ranks Test

Wilcoxon Signed Ranks Test for Accuracy

The result for Accuracy data indicate that patient was not more accurate in performing the mental Rotation test using Motor better than Visual Strategy (Wilcoxon, p = 0.265). This means the effect of strategy was not significantly different for Motor vs. Visual regarding to Accuracy data. See details in table 325-327

	N	Mean	Std. Deviation	Minimum	Maximum
MOTOR	36	59.0278	19.04204	25.00	100.00
VISUAL	36	64.5833	23.43304	25.00	100.00

Table 324: Descriptive Statistics for Accuracy

Ranks

		N	Mean Rank	Sum of Ranks
VISUAL - MOTOR	Negative Ranks	9(a)	12.50	112.50
	Positive Ranks	15(b)	12.50	187.50
	Ties	12(c)		
	Total	36		

Table 325: Wilcoxon Signed Ranks Test for Accuracy

a) VISUAL < MOTOR

b) VISUAL > MOTOR

c) VISUAL = MOTOR

	VISUAL - MOTOR
Z	-1.116(a)
Asymp. Sig. (2-tailed)	.265

Table 326: Test Statistics for Accuracy

a) Based on negative ranks.

b) Wilcoxon Signed Ranks Test

Z- Test

Motor strategy:

The result from the Z-Test indicates that patient performed pathologically [z value= 9.429 $p<0.001$] when imagining rotational hand movements using Motor Strategy with the degree of accuracy: 40.97% compared with controls: 76.35%.

Visual Strategy:

For the Visual Strategy the result from the Z-Test indicates that patient performed pathologically [z value= 11.838 $p<0.001$] when imagining rotational hand movements using Visual Strategy with the degree of accuracy: 33.33% compared with controls: 77.32%.

Discussion

In This study we measured the performance of control subjects and patient concerning to the response time and accuracy in both experiments (Motor and Visual strategy). The mental rotation of body parts has widely been used to activate motor imagery. In similar studies using Mental Rotation task (Parsons, 1987; Sekiyama, 1982) [45], participants asked to make a decision whether the stimuli (pictures of rotated hands) correspond to their own left or right hand. After the analysis of the data corresponding to the response times over all the subjects, they evidently indicated that participants performed this task as a consequence of their own action; accordingly by mentally rotating their own hand in the direction of the stimulus position. They clearly pointed out that the time take for subjects to perform a mental rotation task intimately corresponds to the time that would take to carry out identical movement. Moreover, they implied that bio-mechanical limitations of body part and by awkwardness of movements directly impact the times needed to response (Parsons, 1987; Sekiyama, 1982). Keeping with this notion, in our study average data over all the control subjects showed that longer reaction times were needed for mentally rotation the hand stimuli with orientations (135◦) in which real movements would be more difficult to be performed. In the result that we obtained for the interaction of hand with Stimulus orientation, RTs were longer and accuracy was lower when stimuli Right hand had an orientation of 135° and for the left hand RTs were longer and accuracy was lower when the stimuli hand had an orientation of 225°. It may happened because they mentally rotated their hands to reach the upright position and for the right hand 135° is the longest distance and accordingly takes more time to mentally rotate it and the same reason for the left hand and 225° orientation. For the Neglect patient the result indicated that the factor orientation dose not obey the same roll compare to normal subject and it is most probably due to the lesion in his right hemisphere of the brain.

According to neuropsychological evidence, it may give the impression that Mental Rotation is specific representation in the brain for different kinds of stimuli with the Right Hemisphere is specialized for external objects and the Left Hemisphere is for body parts (Tomasino et al., 2003). On the other hand, in latest neuroimaging studies, it was discussed that Mental Rotation is not stimulus-specific but to a certain extent it would affected by the type strategy adopted for the test (Kosslyn et al., 2001). From the other point of view, in a similar study has been showed that mental rotation is also influenced by the frame of reference in which takes place (Zacks et al., 2002). In this study, we provided evidence in support of a view that the type of strategy adopted is independent of the stimulus and demand different cognitive process. For the normal subject Results showed that STRATEGY factor was significant with significantly longer RTs and lower accuracy for the motor than the visual strategy. On the other hand, the Neglect patient (with right hemisphere lesion) was impaired in a selective manner in performing Mental Rotation using visual strategy, but still was capable to carry out Mental Rotation test using motor strategy. Hence, the patient had difficulty to perform the task based on the reference frame of the object and still was able to perform viewer-based Mental Rotation task. By contrast, in a similar study (Tomasino et al, 2005) it has been investigated that that patients with Left hemisphere lesion were selectively impaired in performing Mental Rotation task of body parts based on the viewer's reference frame(using motor strategy) and succeed in performing the object-based Mental Rotation task (using visual strategy). Although, in our study the Neglect patient was impaired in performing the mental rotation task using the visual strategy with higher rate of errors and higher response time than performing the mental rotation task using the motor strategy, he performed both of the tasks pathologically compared to result obtained from normal subjects. This means that the lesion in his brain influenced the essential cognitive process demanded during the performance of Mental Rotation task using these two different strategies.

Averaged data across all the data showed that the factor Hand Stimulus side was significant as Response Time were longer for the right hand than the left hand, and it is probably because of the fact that they had to respond with the right hand; furthermore, since they consider mental rotation task as a consequence of their own action it is harder to respond to right hand stimuli. On the other side, averaged data across all the data showed that the factor Hand Stimulus side was significant as RT were higher for the left hand than the right hand, and it is because again they consider mental rotation task as their own action and as the left hand is in contralateral side

of lesion and he was unable to move it, the performance was more impaired for the left hand stimuli. One possible explanation is that a lesion to the left hemisphere of the brain may disrupt the performance for the left hand. This hypothesis is in the same line with the result obtained from functional neuroimaging studies with healthy subjects which indicated that the left sensorimotor area were activated when subjects were performing a motor imagery task relating to the right hand. (Porro et al., 2000)[46].

Averaged data across all the data showed that the factor stimulus position was not significant for the normal subjects since none of them had significant visual disability. On the other hand, the data obtained from the Neglect patient showed that the factor stimulus position was significant with significantly longer RTs and less accuracy for Left Visual Field than Central and R Visual Field and it is due to the fact that he is suffering from left hemiparesis and has difficulty to perceive the sensory events happening in contralateral side of lesion (Left Visual Field).

Conclusion

Based on the averaged data across all the normal subjects, the result indicated that they performed the mental rotation test using visual strategy more accurate and faster than performing mental rotation using visual strategy. On the other hand the result obtained from Neglect patient showed that the theory of perceptual neglect is correct, because in this case TS (neglect patient) was more impaired in performing the mental rotation task using the visual strategy with higher rate of errors and higher response time than performing the mental rotation task using the motor strategy.

To summarize, our experiments showed that TS (neglect patient) was significantly slower than control subjects in mentally rotating pictures of a hand using both strategies. From the other point of view, the result from the Z-test indicates that patient performed pathologically when imagining rotational hand movements using both Motor Strategy and visual strategy compared to result obtained from normal subjects.

References

[1] Ryle, 'Imagination', Concept of Mind (London 1949).
[2] Decety J, Jeannerod M, Prablanc C (1989) The timing of mentally represented actions. Behav Brain Res 34:35–42
[3] Parsons LM, Gabrieli JD, Phelps EA, Gazzaniga MS (1998) Cerebrally lateralized mental representations of hands shape and movement. J Neurosci 18(16):6593–6548
[4] Porro CA, Francescato MP, Cettolo V, Diamond ME, Baraldi P,Zuiani C, Bazzocchi M, di Prampero PE (1996) Primary motor and sensory cortex activation during motor performance and motor imagery: a functional magnetic resonance imaging study.J Neurosci 16(23):7688–7698
[5] Tomasino, B., Toraldo, A., & Rumiati R., I. (2003). Dissociation between the mental rotation of visual images and motor images in unilateral brain-damaged patients. Brain & Cognition, 51, 368–371.
[6] Zacks, J., Rypma, B., Gabrieli, J. D. E., Tversky, B., & Glover,G. H. (1999). Imagined transformations of bodies: An fMRI investigation. Neuropsychologia, 37, 1029–1040.
[7] Kosslyn, S. M., Thompson, W. L. Wraga, M., & Alpert, N. M.(2001). Imagining rotation by endogenous versus exogenous forces: Distinct neural mechanisms. NeuroReport, 12,2519–2525.
[8] Cohen MS (1996) Changes in cortical activity during mental rotation: a mapping study using functional magnetic resonance imaging.Brain 119:89–119
[9] Corballis MC, Sergent J (1989) Hemisferic specialization for mental rotation. Cortex 25(19):15–25
[10] Parsons LM (1987a) Imagined spatial transformation of one's body. J Exp Psychol Gen 116(2):172–191
[11] Zacks, J. M., Ollinger, J. M., Sheridan M. A., & Tversky, B. (2002). A parametric study of mental spatial transformations of bodies. Neuroimage, 6, 857–872.
[12] Tomasino, B. & Rumiati, R.I. (2004). Effects of strategies on mental rotation and hemispheric lateralization: neuropsychological evidence. Journal of Cognitive Neuroscience, 5, 878-888.
[13] Wraga, M., Creem, S. H., & Proffitt, D. R. (1999). The influence of spatial reference frames on imagined object and viewer rotations. Acta Psychologica, 102, 247–264.
[14] Corballis, M. C. (1997). Mental rotation and the right hemisphere. Brain and Language, 57, 100–121.
[15] Parsons, L. M. (1987). Imagined transformation of one's body.Journal of Experimental Psychology: General, 116, 172–191.
[16] Parsons, M. L. (1994). Temporal and kinematic proprieties of motor behavior reflected in mentally simulated action.Journal of Experimental Psychology: Human Perception and Performance, 20, 709–730.
[17] Tomasino, B., & Rumiati, R. I. (2004). Effects of strategies on mental rotation and hemispheric lateralization: Neuropsychological evidence. Journal of Cognitive Neuroscience, 16, 878–888.
[18] Rumiati, R. I., Tomasino, B., Vorano, L., Umilta`, C., & De Luca, G. (2001). Selective deficit of imagining finger configurations. Cortex, 37, 730–733.

[19] Parsons, L. M. (1994). Temporal and kinematic properties of motor behavior reflected in mentally simulated action. Journal of Experimental Psychology: Human Perception and Performance, 20, 709–730.
[20] Duncombe, M. E., Bradshaw, J. L., Iansek, R.,&Phillips, J. G. (1994). Parkinsonian patients without dementia or depression do not suffer from bradyphrenia as indexed by performance in mental rotation tasks with and without advance information. Neuropsychologia, 32, 1383–1396.
[21] Bonda, E., Petrides, M., Frey, S.,&Evans, A. (1995). Neural correlates of mental transformations of the body-in-space. Proceedings of the National Academy of Science, USA, 92, 11180–11184.
[22] Ganis, G., Keenan, J. P., Kosslyn, S. M., & Pascual-Leone, A. (2000). Transcranial magnetic stimulation of primary motor cortex affects mental rotation. Cerebral Cortex, 10, 175–180.
[23] Kosslyn, S. M., DiGirolamo, G. J., Thompson, W. L., & Alpert, N. M. (1998). Mental rotation of objects versus hands: neural mechanisms revealed by positron emission tomography. Psychophysiology, 35, 151–161.
[24] Sirigu, A., & Duhamel, J. R. (2001). Motor and visual imagery as two complementary but neurally dissociable mental processes. Journal of Cognitive Neuroscience, 13, 910–919.
[25] Berlucchi, G., & Aglioti, S. (1997). The body in the brain: neural bases of corporeal awareness. Trends in Neuroscience, 20, 560–564.
[26] Amorim, Michel-Ange, Brice Isableu and Mohammed Jarraya (2006) Embodied Spatial Transformations: “Body Analogy” for the Mental Rotation. Journal of Experimental Psychology: General.
[27] Parsons, L. M. (1987b). Imagine spatial transformations of one’s hands and feet. Cognitive Psychology, 19, 178–241.
[28] Tomasino, B., & Rumiati, R. I. (2004). Effects of strategies on mental rotation and hemispheric lateralization: Neuropsychological evidence. Journal of Cognitive Neuroscience, 16, 878–888.
[29] Gainotti G, D’Erme P, Bartolomeo P. Early orientation of attention toward the half space ipsilateral to the lesion in patients with unilateral brain damage.J Neurol Neurosurg Psychiatry 1991; 54:1082–1089.
[30] Kwon SE, Heilman KM. Ipsilateral neglect in a patient following a unilateral frontal lesion. Neurology 1991;41:2001– 4.
[31] Albert ML. A simple test of visual neglect. Neurology 1973; 23:658–64.
[32] Berti A, Bottini G, Gandola M, et al. Shared cortical anatomy for motor awareness and motor control. Science 2005; 309:488–491.
[33] Weintraub S, Mesulam MM. Right cerebral dominance in spatial attention. Further evidence based on ipsilateral neglect. Neurology 1987;44:621–5.
[34] Beis JM, Keller C, Morin N, et al. Right spatial neglect after left hemisphere stroke: qualitative and quantitative study. Neurology 2004; 63:1600–1605.
[35] Bisiach, E., Geminiani, G., Berti, A. and Rusconi, M. L. (1990) Perceptual and premotor factors of unilateral neglect. Neurology, 40, 1278-1281.
[36] Bisiach, E., Ricci, R. and Neppi Mòdona, M. (1998b) Visual awareness and anisometry of space representation in unilateral neglect: A panoramic investigation by means of a line extension task. Consciousness and Cognition, 7, 327-355.
[37] Vallar, G. and Maravita, A. (2009) Personal and extra-personal spatial perception. In G. G. Berntson & J. T. Cacioppo (Eds.) Handbook of Neuroscience for the Behavioral Sciences, pp. 322-336. New York, John Wiley & Sons.

[38] Ellis, A. W., Flude, B. M. and Young, A. W. (1987) "Neglect dyslexia" and the early visual processing of letters in words and nonwords. Cognitive Neuropsychology, 4, 439-464.
[39] Young, A. W., De Haan, E. H. F., Newcombe, F. and Day, D. C. (1990) Facial neglect. Neuropsychologia, 28, 391-415.
[40] Heilman, K. M. (2004) Intentional neglect. Frontiers in Bioscience, 9, 694-705.
[41] Fink, G. R. and Marshall, J. C. (2005) Motor aspects of unilateral neglect and related disorders. In H. J. Freund, M. Jeannerod, M. Hallett & R. Leiguarda (Eds.) Higher-order motor disorders, pp. 413-441. Oxford, Oxford University Press.
[42] Heilman, K. M., Watson, R. T. and Valenstein, E. (2003) Neglect and related disorders. In K. M. Heilman & E. Valenstein (Eds.) Clinical neuropsychology, 4 ed, pp. 296-346. New York, Oxford University Press.
[43] Wilson, B. A., Cockburn, J., & Halligan, P. (1987). Behaviouralinattention test. Titchfield, Hampshire: Thames Valley Test Company.
[44] Menon A, Korner-Bitensky N. Evaluating unilateral spatial neglect post stroke: working your way through the maze of assessment choices. Top Stroke Rehabil 2004; 11:41-66
[45] Sekiyama, K. (1982). Kinesthetic aspects of mental representations in the identification of left and right hands. Perceptual Psychophysics, 32, 89–95
[46] Porro, C. A., Cettolo, V., Francescato, M. P., & Baraldi, P. (2000). Ipsilateral involvement of primary motor cortex during motor imagery. European Journal of Neuroscience, 12, 3059–3063.