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The efficacy of computer-based calculating model of multiple resources in the prediction of execution process

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ABSTRACT

The main purpose of the present study was to investigate the efficacy of the multiple resources four-dimension model in predicting the execution and calculation of the relative intervention with multiple tasks. For the reason, 22 girls and 24 boys were taken up as the sample of the study. After designing the computer-based model of the multiple resources, the degree of the driving task intervention and the conversation task was measured with the mobile and headphone phone; among this the relationship between the process and the response time towards the visionary and hearing stimulant was investigated during the driving in different conditions. The findings analysis was carried out by Pearson test. There was a high significant and direct correlation between the degree of calculated intervention with software and response time of the respondents. This result represents that the four-dimension computer-based model of the multi attention resources theory has the ability of predicting the execution in two and multiple tasks. The calculation model showed that the type of the stimulant (visionary and hearing) does not influence on the response time of the respondents but the driving different conditions (without conversation with cell phone, with conversation with cell phone, conversation with headphone cell phone) have a considerable impact on the response time of the respondents. The driving task and conversation task with cell phone and headphone has higher intervention and the application of headphone cell phone is not reduced in compare to the cell phone regarding to the intervention degree.
Key words: *designing, computer-based model, multi attention resources, cell phone, conversation*

INTRODUCTION

Recently most theories about the attention has been focused on the flexibility of the information processing issue; for example, it is roughly paid attention to the only one stimulant in compare to the attention requirements steps; it also is suggested these resources should be divided equally through the processing [14]. The multiple resource theories have been suggested for the attention resources in compare to the central resources theories. Other theories have been also recommended in this pavement. Based on the multi resources theories, the process of the attention has got its own approaches with their own limited resources. The save of every resource has exclusive skills execution. The most common theories have been recommended by [13, 1, 9, 24]. Among these theories, Wickens theory has got the most common reputation potentially. Based on the multi resources theories of Wickens, there have been four-dimensions of two sides distinct each other in this regard representing the difference of the periodical participations. In other words, in the main model formation, both sides have clarified levels [11].The main aim of the theory is that if two tasks in the steps of perceptual/cognitive or response, perceptual methods (hearing or visionary), codes (spatial or verbal) and visionary information stream (focus or environmental) have commonality together, there will be appeared higher intervention between these two tasks. Wickens (2002, 2008) represented a preliminary model of the computer-based pattern from the multi resources in addition to the description of the fundamental concepts and theories of the multiple resources [25, 26]. Van Engelen (2011) optimized the Wickens multi resources computer-based model providing the application of the measurement in relation to the degree of intervention in different driving conditions [11]. The highest reliability of this model is related to the relative anticipation into the task intervention between the combinations of the different tasks. This model can be applied for predicting of confusing levels or the intervention between two tasks with periodical participations particularly in different driving conditions. Although the efficacy of this model has been investigated in the anticipation of results with real experimental experimentations, but there have been more experimental experimentations should be carried out for evaluating and gathering the related data [11].Therefore the main question of the present study is whether the prediction of the intervention degree possible between the different functions of driving and conversation with cell phone along with the application of Van Engelen Multi Resources Computer-based Measuring Model or no?

MATERIALS AND METHODS

First the multi resources computer-based measuring model was designed according to Van Engelen in order to achieve this research accurately [11]. Then, the degree of intervention between the different combinations of the tasks was measured by the use of this software (Figure 1). In order to measure the carried out calculations with the related software, the response time of hearing stimulant (rear car horning) and visionary (front car brake lights) of 46 physical training BA students of Eastern Tehran Azad University was carried out and measured in different driving conditions. By the use of Pearson correlation coefficient, the relationship between the response time of stimulants in different driving conditions and the degree of the measured intervention were determined in this case. The number of the participants was 24 male and 22 female students ranging from 3.4±24.9 year olds with 6.3±3.2 years driving background that they were totally taken up by the available sampling method.

Table 1: Computational software of interference with the 4-dimensions model

Demand vector of tasks					Task A										
					Demand vector										
					Perceptual								Cognition		Response
					Vsf	Vsa	Vv	As	Av	Ts	Tv	Cs	Cv	Rs	Rv
						6.00	2.00								
Task	Demand vector	Perceptual Cognition Response	Vsf		1.00	0.80	0.60	0.40	0.40	0.60	0.40	0.75	0.47	0.40	0.20
			Vsa			1.00	0.60	0.40	0.60	0.40	0.75	0.47	0.40	0.20	0.20
			Vv				0.80	0.40	0.60	0.40	0.60	0.50	0.67	0.20	0.40
			As					0.80	0.60	0.60	0.40	0.65	0.47	0.40	0.20
			Av						0.80	0.40	0.60	0.45	0.67	0.20	0.40
			Ts							0.80	0.60	0.65	0.67	0.40	0.20
			Tv								0.80	0.45	0.67	0.20	0.40
			Cs									0.80	0.60	0.60	0.40
			Cv										0.80	0.40	0.60
			Rs											0.80	0.60
			Rv												100
Interference calculation															

The analyzed tasks and the degree of tasks requirements to the related resources were put into the guideline table (table 1) in order to measure the degree of tasks intervention with the related software.

Table 2: guideline of resources

Phase	Resources	Abbreviations	Example
Perception	Visual spatial focal	Vsf	Distance estimation
Perception	Visual spatial ambient	Vsa	Considering highway lines
Perception	Visual verbal	Vv	Reading text and traffic signs
Perception	Auditve spatial	As	Auditive positioning
Perception	Auditive verbal	Av	Listening to message
Perception	Tactile spatial	Ts	Determining distance between radio button
Perception	Tactile verbal	Tv	Reading Brail statement
Cognition	Cognityive spatial	Cs	Reviewing mental picturesque
Cognition	Cognitive verbal	Cv	Reviewing phone number or a list
Response	Response spatial	Rs	Different hand activities
Response	Response verbal	Rv	Speaking

The implementation of the research was carried out according to measure of the variables as following steps. The whole participants have to count from 500 to 1000 before the beginning of the experimentation in order to control the degree of the participants' attention in this regard. The counting harmony of these participants was observed and they were asked to keep their own harmony of counting the numbers in this pavement [20]. Then, the researcher sitting in the rear of a car was responsible for conversation of cell phone and the participant was driving the same car; the participant had to response to the front car when driving and keeping his distance with the same t car and pressing the key on the car stick and under his finger; he had to response to the front car brake lights or the rear car horning. The response time of the participant to the front car brake lights and or to the rear car horning was recorded in total 6 moods and every situation was also registered in ten times by the use of software and hardware installed into the same car. The factorial intergroup designs were applied in order to measure the response time of the participants; also the influence of both independent variables was observed on the dependent variable of the response time in both female and male groups along with iterative measurements in this present study. In this section, the descriptive statistical methods such as central tendencies indices, distribution indices, distribution and tables for summarizing and categorizing of the participants' information and the measured variable were applied potentially in this regard[12].

Table 3: simple perspective of research to measure the response time

Independent variable of driving conditions / independent variable of stimulant type	Without speaking with cell phone	During speaking with handy cell phone	During speaking with headphone cell phone
Auditive stimulant	Group 1	Group 1	Group 1
Visual stimulant	Group 1	Group 1	Group 1

In the entire steps of the above-mentioned issues, the participant was responsible for controlling and managing the speed of the automobile, distance and the secondary achievement of the conversation; the distance of the car should be adjusted with the front car accurately. When the participant started to speak with the cell phone, he had to count from 500 to 1000 reversely. In every condition, ten responses towards the visionary stimulant were recorded and totally about 60 responses were registered in relation to the visionary stimulant. In order to measure the participant's response time regarding to the hearing stimulant, the same participant should indicate ten responses and totally 60 responses to the rear car horning in three different situations. The arrangement of the stimulants and different conditions of the participants regularly were achieved in order to manage and control the impact of the participants' familiarity with the next measurements; first, the visionary stimulant and then the hearing stimulant should response in this case; but the second participant has to response to the hearing stimulant and then to the visionary stimulant; the different driving conditions were regularly changed and the experimentation was considered between 10-20 minutes periodical distance in order to reduce the influence of the transformation between the different conditions.

RESULTS

According to the table 3, the degree of the intervention of driving task in the University Street was negligible in relation to the hearing stimulant (horning) while the same degree is really considerable in relation to the visionary and hearing stimulants when the driver is speaking with a cell phone and headphone.

Table 4: degree of the measured intervention between different combinations with the use of Van Engelen computer-based model

Task 1 / task 2	Response to visual stimulant (brake light)	Response to auditive stimulant (horning)
Driving in the University Street (without speaking with cell phone)	4.29	4.00
Driving in the University Street (during speaking with headphone cell phone)	6.91	7.20
Driving in the University Street (during speaking with handy cell phone)	7.28	7.56

Table 4 shows that the male participants showed the rapid reflection in the hearing and visionary stimulants in different conditions that they do not use the cell phone and the slowest response was shown in the hearing and visionary stimulants when they use the cell phone; also cell phone and headphone applications increased the response time of the participants in their visionary and hearing issues.

Table 5: time of pressing the button on the car stick by male participants regarding to the visionary and hearing stimulants in different driving conditions

Variable	Number	Minimum	Maximum	Mean	Deviation
Response time to visual stimulant without using cell phone	24	280	1340.067	792.21	286.31
Response time to visual stimulant during speaking with handy cell phone	24	424.38	1469.73	914.49	308.79
Response time to visual stimulant during speaking with headphone cell phone	24	406.40	1393.07	913.44	291.17
Response time to auditive stimulant without speaking with cell phone	24	319.31	1313.31	783.28	270.63
Response time to auditive stimulant during speaking with handy cell phone	24	483.63	1501.56	958.07	266.21
Response time to visual stimulant during speaking with headphone cell phone	24	458.57	1408.14	937.96	237.71

Table 5 shows that the female participants had the rapid responses from the hearing and visionary stimulants in different conditions regarding to the driving without speaking with the cell phone and the slowest response to the hearing stimulant was subjected to the headphone cell phone; also, speaking with cell phone and headphone cell phone increased the response time of participants in relation to the visionary and hearing stimulants.

Table 6:time of pressing the button on the car stick by female participants regarding to the visionary and hearing stimulants in different driving conditions

Variable	Number	Minimum	Maximum	Mean	Deviation
Response time to visual stimulant without using cell phone	22	241.77	1589.36	891.7	395.19
Response time to visual stimulant during speaking with handy cell phone	22	304.40	1646.77	985.59	393.16
Response time to visual stimulant during speaking with headphone cell phone	22	319.67	1805	1006.23	452.46
Response time to auditive stimulant without speaking with cell phone	22	319.46	1883	873.29	426.25
Response time to auditive stimulant during speaking with handy cell phone	22	428.85	1983	1003.52	415.72
Response time to auditive stimulant during speaking with headphone cell phone	22	413.08	1905.75	1027	407.65

Table 6 shows that the male participants showed the rapid reflection in the hearing and visionary stimulants in different conditions that they do not use the cell phone and the slowest response was shown in the hearing and visionary stimulants when they use the cell phone; also cell phone and headphone applications increased the response time of the participants in their visionary and hearing issues.

Table 7: time of pressing the button on the car stick by female and male participants regarding to the visionary and hearing stimulants in different driving conditions

Variable	Number	Minimum	Maximum	Mean	Deviation
Response time to visual stimulant without using cell phone	46	241.77	1589.36	839.83	342.50
Response time to visual stimulant during speaking with handy cell phone	46	304.40	1646.77	948.50	349.51
Response time to visual stimulant during speaking with headphone cell phone	46	319.67	1805.00	957.82	375.70

Response time to auditive stimulant without speaking with cell phone	46	319.31	1883.00	826.33	352.55
Response time to auditive stimulant during speaking with handy cell phone	46	428.85	1983.00	979.81	342.64
Response time to auditive stimulant during speaking with headphone cell phone	46	413.08	1905.75	980.54	329.32

Table 7 shows that the male participants showed the rapid reflection in the hearing and visionary stimulants in different conditions that they do not use the cell phone and the slowest response was shown in the hearing and visionary stimulants when they use the cell phone; also cell phone and headphone applications increased the response time of the participants in their visionary and hearing issues.

Table 8: time of pressing the button on the car brake by male and male participants regarding to the visionary and hearing stimulants in different driving conditions

Variable	Number	Minimum	Maximum	Mean	Deviation
Response time to visual stimulant without using cell phone	24	80.00	1493.00	685.25	368.27
Response time to visual stimulant during speaking with handy cell phone	24	153.00	1458.00	822.12	373.89
Response time to visual stimulant during speaking with headphone cell phone	24	206.40	1419.00	846.51	325.21
Response time to auditive stimulant without speaking with cell phone	24	90.00	1555.00	693.40	385.15
Response time to auditive stimulant during speaking with handy cell phone	24	378.00	1458.70	901.32	348.77
Response time to auditive stimulant during speaking with headphone cell phone	24	166.00	1802.00	878.81	390.09

Table 8 shows that the male participants showed the rapid reflection in the hearing and visionary stimulants in different conditions that they do not use the cell phone and the slowest response was shown in the hearing and visionary stimulants when they use the cell phone; also cell phone and headphone applications increased the response time of the participants in their visionary and hearing issues.

Table 9:time of pressing the button on the car brake by female and male participants regarding to the visionary and hearing stimulants in different driving conditions

Variable	Number	Minimum	Maximum	Mean	Deviation
Response time to visual stimulant without using cell phone	22	83.00	1339.00	697.81	373.06
Response time to visual stimulant during speaking with handy cell phone	22	128.00	1600.00	786.81	395.39
Response time to visual stimulant during speaking with headphone cell phone	22	156.00	1463.00	818.40	368.70
Response time to auditive stimulant without speaking with cell phone	22	150.00	1334.00	737.40	385.12
Response time to auditive stimulant during speaking with handy cell phone	22	249.00	1565.00	842	367.91
Response time to auditive stimulant during speaking with headphone cell phone	22	185.00	1427.00	868.40	352.11

Table 9 shows that the male participants showed the rapid reflection in the hearing and visionary stimulants in different conditions that they do not use the cell phone and the slowest response was shown in the hearing and visionary stimulants when they use the cell phone; also cell phone and headphone applications increased the response time of the participants in their visionary and hearing issues.

Table 10: time of pressing the button on the car brake by male and female participants regarding to the visionary and hearing stimulants in different driving conditions

Variable	Number	Minimum	Maximum	Mean	Deviation
Response time to visual stimulant without using cell phone	46	80.00	1493.00	691.26	366.48
Response time to visual stimulant during speaking with handy cell phone	46	128.00	1600.00	805.23	380.43
Response time to visual stimulant during speaking with headphone cell phone	46	156.00	1463.00	833.07	343.07
Response time to auditive stimulant without speaking with cell phone	46	90.00	1555.00	714.47	381.48
Response time to auditive stimulant during speaking with handy cell phone	46	249.00	1565.00	872.95	355.30
Response time to visual stimulant during speaking with headphone cell phone	46	166.00	1802.00	873.83	368.33

The analysis of the findings with Pearson test in the alpha smaller than 0.05 shows that the high correlation was observed significantly and directly between the degree of the measured intervention using the related software and the response time of the whole participants regarding to the visionary and hearing stimulants in the different driving conditions.

Table 11: correlation of the measured intervention degrees with the computer-based model software and response time of the participants in the different conditions

Response time and degree of interference (data of table 3)	Statistical index	
Pressing button on the stick of male participants (data of table 4)	P value	R
	<0.001	-0.99
Pressing button on the stick of female participants (data of table 5)	0.002	-0.996
Pressing button on the stick of male and female participants (data of table 6)	<0.001	-0.986
Response of pressing brake in male (data of table 7)	0.002	-0.966
Response of pressing brake in female (data of table 8)	0.022	0.877
Response of pressing brake in male and female (data of table 9)	0.005	0.942

DISCUSSION AND CONCLUSION

When the drivers do not use the cell phone, the degree of the measured intervention was low between the driving task in the University Street and the response to the visionary stimulant (brake light) and the driving task in the University Street to the hearing stimulant (horning) using the attention multiple resources measuring model. The same problem can be interpreted that some required resources for achieving the preliminary task of the driving in the University Street (required resources: visionary, spatial, focus, visionary, spatial, environmental and touching-spatial, spatial-cognitive, spatial response) and response to the hearing stimulant (required resources: verbal-hearing, spatial-touching, verbal-cognitive, spatial response) are completely common together in this pavement. Hence it is expected that there should be appeared some intervention between preliminary driving task in the University Street and response to the visionary and hearing stimulants but in response to the hearing stimulant the attention structure of the verbal hearing was applied in this case that the same structure does not apply in the driving preliminary task. Hence, the intervention response to the hearing stimulant is lower than the response to the visionary stimulant. When the drivers with cell phone (required resources: visionary spatial environmental, perception hearing verbal, spatial touching, verbal cognitive, verbal response, spatial response) or the headphone cell phone (required resources: visionary spatial environmental, hearing verbal, spatial touching, verbal cognitive, verbal response) speak, the attention requirements will be high in their own tasks having more commonalities with the preliminary task in this case. Therefore, the degree of the obtained intervention is high in this case, too. Based on the results of the present study, speaking or conversation with cell phone increases the response time of the participants towards the visionary and hearing stimulants; the model calculation was also confirmed the same subject in this case. The reason is that the required resources of the driving task in the University Street and response to the brake (required resources: perception visionary spatial focus, visionary spatial environmental, visionary verbal, hearing spatial, touching spatial, cognitive spatial, cognitive verbal, spatial response) and response to the horning (required resources: perception visionary spatial focus, visionary spatial environmental, visionary verbal, hearing verbal, hearing spatial, touching spatial, cognitive spatial, verbal cognitive, spatial responding) have higher commonalities with the required resources of speaking with cell phone. Thus, the fulfillment of these two tasks has high intervention and the response time to the visionary stimulant increases in compare to the participants' cell phone application and the measured intervention will become high, too.

Based on the results of the present study, speaking or conversation with cell phone increases the response time of the participants towards the visionary and hearing stimulants; the model calculation was also confirmed the same subject in this case. The reason is that the required resources of the driving task in the University Street and response to the brake (required resources: perception visionary spatial focus, visionary spatial environmental, visionary verbal, hearing spatial, touching spatial, cognitive spatial, cognitive verbal, spatial response) and response to the horning (required resources: perception visionary spatial focus, visionary spatial environmental, visionary verbal, hearing verbal, hearing spatial, touching spatial, cognitive spatial, verbal cognitive, spatial responding) have higher commonalities with the required resources of speaking with cell phone. Basically, speaking with cell phone acts as a confusing factor increasing the response time of the visionary and hearing stimulants of the participants as the secondary factor; [23, 12, 20, 18, 28, 1]. Observed in their researches that the confusing factor increases the response time. Based on the results of the present study, the response time of the drivers to the visionary and hearing stimulants when speaking with the cell phone do not have considerable difference in this field because the attention resources required to the driving task in the University Street and response to the brake and horning does not change but the number of the required resources for speaking with a cell phone is lower than the number of the required speaking to a handy cell phone; in other words, there is no need to the attention resource in speaking with cell phone; the spatial response is possible but it is not required in speaking with cell phone; but due to the similarity of these both tasks, the degree of intervention does not make any difference in this regard. Generally, due to the long time of speaking of drivers during their talks with cell phone, the reaction of the visionary and hearing stimulants do not make any difference and this is not coincident with the results of Charlton, Legg and Mathews (2003) researches [9]. The results of this section is supported with the experimental results of [7,23,12,11,27] stating that the headphone cell phone speaking does not recover the response time of the participants in compare to the handy cell phone talks. Also, the risks of using handy and headphone cell phones have been confirmed according to the report of National Highway Traffic Safety Administration [5,6,7].Based on the results of the present study, the response time of the drivers to the visionary and hearing stimulants is increased during the conversation and there is no observed any considerable difference together. The calculation model showed that the degree of the governed intervention is higher than the visionary stimulant than the hearing stimulant. The subject is that the secondary task resources of speaking with phone in response to the visionary and hearing stimulants do not change but the type of the required resources in response to the visionary stimulant is different than the hearing stimulant. Hence, the resources in the visionary stimulant and handy cell phone are subjected to the hearing-visionary and in response to the hearing are related to the hearing-hearing type of stimulants. According to the attention multi resources model, the division of the attention between the ear and eye is better than the attention division between two ears or two eyes; in other words, the periodical participations between Cross-modal is better than the Intra-nodal time sharing issue. As a result, the degree of the measured intervention is little in response to the visionary stimulant during speaking with cell phone. The same issue is true about the speaking with headphone cell phone. This kind of benefit has been mentioned for the time sharing between the scales with intra-modal by Wickens et al (1983) in an experimentation of radar and flight simulation [25]. Also, Parkes and Colman showed that the drivers being conducted in the simulation task have better function in their hearing affair than drivers have been conducted in the visionary task. The relative benefit of the time sharing between the visionary-hearing than the hearing-hearing and visionary-visionary may not come from the perceptual resources into the brain but also it may be originated from the effective environmental factors in both intra sensations of the hearing-hearing or visionary-visionary; in other words, when the visionary information get provided from the away, two visionary canals will require to seek the visionary between both related areas overlapping together in this case. The same similar situation happens about the hearing messages. In other words, the hearing messages may overlap the temporal lobe causing to perplex and confusing task in this pavement. In researches that controlled the whole environmental factors, there has been observed some sensory benefits; of course, Spence and Helleberg and Wickens (2002) showed in their studies that the existence of the non-resource factors could be considered as the attention information hearing features that may compensate the benefit of the separate resource in this case[5,8]. In general, the obtained results of the present study showed that there is a direct and complete correlation between the degree of the measured intervention and the response time (pressing stick key and brake) drivers towards the visionary and hearing stimulants in different driving conditions. The common variance is also high between two variables. Hence, it can be stated that the computer-based calculating model can be applied in predicting the execution and the measurement of the relative intervention degree between the different combinations of the tasks. Also it can be presented that there have been established some effective factors in designing the calculation model of the multi resources theory. The commonality of the perceptual resources (spatial visionary focus, visionary spatial environmental, visionary verbal, spatial hearing, hearing verbal, touching spatial and touching verbal) and processing resources (cognitive spatial and verbal cognitive) and response resources (spatial verbal) are the main effective factors in implementing both simultaneous tasks and the degree of both simultaneous tasks intervention being paid attention in the related designing process potentially.

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