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The Effect of Cell Phone Use on Fine Motor Functioning

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ABSTRACT

It may be an imprudent endeavor to talk on a cell phone while performing a task that requires the coordination of fine motor functioning such as driving a motor vehicle. The purpose of this study is to evaluate the effects of cell phone use on fine motor functioning as might be required in a driving situation. Fifty-three undergraduate psychology students volunteered to participate and were randomly assigned to Group A (experimental) and Group B (control). In Group A, each participant performed a grooved pegboard fine motor task while answering arithmetic questions on a cell phone. Group B performed the motor task without the cell phone. The results indicated a significantly higher overall mean time for Group A than for Group B. Group A also had a significantly higher mean time for dominant and non-dominant hand assessment. There was no significant difference between men and women or between right-handed and left-handed individuals for time achieved on the assessment.

INTRODUCTION

Cellular phones were introduced in 1983 and have infiltrated every aspect of modern day life. A growing concern is the increased use of cell phones by individuals while operating a motor vehicle. Cell phones can distract motorists in a number of ways. Simply finding, turning on and off, answering, and ending a phone call redirects the driver’s hands from steering and his or her eyes from watching the road. Phone conversations can also affect the driver’s attention and performance.

Glassbrenner (2005), with the National Highway Traffic Safety Administration (NHTSA), conducted an observational survey of drivers in the United States and found that during daylight hours 10 % of vehicles are operated by someone using a cell phone. Of the individuals observed, 10 % were 16-24 years of age. Another study done by the NHTSA (2005), found that young drivers, ages 15-20, account for 12.6 % of fatal crashes and 16 % of drivers involved in a crash requiring a police report. There is much debate over the distractibility of cell phones while operating a motor vehicle especially with young drivers. With the increase in driver cell phone use and the high crash rates for young drivers, empirical evidence has and will play an important role in state and national legislation.

Cell Phones and Likelihood of a Crash

Based on empirical studies, many researchers have concluded that using a cellular phone while driving significantly increases the risk of a crash. According to Redelmeier and Tibshirani (1997), the estimated risk of a crash while using cellular phones was an average of four times higher than driving while not using a cellular phone, similar to driving while intoxicated. The researchers also concluded that hands-free phones seemed to offer no safety advantage over hand-held phones. Redelmeier and Tibshirani (2006) reiterated earlier findings and suggested that earlier studies have even underestimated the risk associated with driving while using a cell phone. Seo and Torabi (2004) reported that 21 % of the college students surveyed experienced an accident or near accident with at least one of the drivers using a cell phone.

Cellular Use While Driving Affects Cognitive Processes

Why does cell phone use increase the likelihood of a crash? The empirical research points to impaired cognitive processes that in turn divert attention from the primary task of operating the motor vehicle and reacting to hazardous stimuli. According to Trimmel and Poelzl (2006), even low background noise (traffic noise, irrelevant speech, and barking dogs) impaired performance in spatial attention by hindering parts of the cerebral cortex. Strayer and Johnston (2001) suggested that cell phone use, hand-held or hands-free, negatively affects driving performance by redirecting attention to an another cognitive activity. Horrey and Wikens (2006) had similar conclusions: they found that cell phone use negatively affects a driver’s reaction to external hazards. This study also concluded that passenger cell phone use has a similar effect on the driver’s reactions. Hunton and Rose (2005) addressed the issue of passenger conversation versus cellular conversations and found cell phone conversations are more hazardous in a driving situation than passenger conversations. They suggested an increase in utilized working memory in a cell phone conversation as opposed to when engaged in a conversation with a passenger. The lack of nonverbal cues with cellular conversations involves more cognitive resources.

Cell Phone Usage Effect on Reaction Time and Visual Motor Attention

The University of North Carolina Highway Safety Research Center reviewed a number of on-road and driver-simulated studies. The effect of cell phone use in both types of research showed a slower reaction time in response to a number of stimuli

(Reinfurt, Huang, Feaganes, & Hunter, 2001). Another study by Richard, et al. (2002) indicated that response times were significantly slower when coupled with a simultaneous auditory task than with an image-flicker task. Both studies alluded to visual inattention as a possible cause for the slower reaction time. Garcia-Larrea, Perchet, Perrin, and Amenedo (2001) suggested that a decrease of attention to sensory inputs and the manipulation of the phone negatively effected response to a visual target.

The studies discussed compare cell phone use and a number of effects. There are numerous studies on the overall effect of cell phone use and driving. Many attribute the effect to disrupted cognitive processes such as attention. A number of researchers have reported an increase in reaction time and hindered perception of visual stimuli (e.g., Reinfurt, Huang, Feaganes, & Hunter, 2001). However, the effect of cell phone use on motor function, specifically fine motor, has received much less attention.

Cell Phone Use and Fine Motor Functioning

Fine motor functions generally refer to small actions, such as movements of the hands, wrists, fingers, and feet. Many tasks, such as driving, require visual motor coordination, synchronization of vision, and movements of the body. The purpose of this study was to evaluate the effect of cell phone use on fine motor functioning. This study hypothesized cellular phone use coupled with answering a series of simple arithmetic problems would negatively affect performance on fine motor assessment, which required visual motor coordination. This effect should result in a significantly higher mean time (in seconds) for group A (with cell phone) than group B (without cell phone). Because women have smaller hands and fingers than men we expected women to have an advantage when performing a task requiring fine manual dexterity (Peters, Servos, & Day, 1990). We also expected left-handed individuals to have an advantage with the use of their non-dominant hand, resulting in a lower mean time (Judge & Stirling, 2003).

METHOD

Participants

Fifty-three undergraduate psychology students from a Southern regional state university, ages 18 and above, participated in this study for course extra credit. Group A (experimental) consisted of 24 participants: a random assignment of 16 women and eight men. Group B (control) consisted of 29 participants: a random assignment of 17 women and 12 men. Forty-nine participants were right-handed and four were left-handed.

Design

We used a randomized two-group (Group A: cell phone and pegboard vs. Group B: peg-board) independent-groups design. The independent variable involved answering or not answering simple arithmetic questions on a cell phone. The dependent variable was the time achieved on the Grooved Pegboard Test, Model 32025. We treated gender and dominant hand as participant variables.

Instrument

We used the Grooved Pegboard Test, Model 32025 from the Lafayette Instrument Company to assess fine motor function. The Grooved Pegboard is a manipulative dexterity test consisting of 25 holes with randomly positioned slots. Pegs with a key along one side must be rotated to match the hole before they can be inserted. This test requires complex visual-motor coordination (Lafayette Instrument Company, 1997). The cell phone used in this experiment was a Samsung X496 flip phone.

Procedure

We randomly assigned each participant to Group A (experimental) or Group B (control), and assessed each participant individually. We greeted and informed each participant that the experiment dealt with cell phone use and fine motor function. We gave each participant a demographic survey and a pencil (see Appendix A) and requested that each participant answer all the questions and turn the survey and pencil in upon completion.

Researcher #1 then informed each participant in Group A that the next portion of the assessment included participation in a timed fine motor assessment task. Researcher #1 placed the Grooved Pegboard Test on the table directly in front of the seated participant. Researcher #1 instructed each participant to place as many pegs into the Grooved Pegboard Test as he or she could within three minutes using his or her dominant hand, while answering simple arithmetic questions on the cell phone (see Appendix C). (Researcher #2, in another room, placed the call to the cell phone.) Researcher #1 handed the phone to the participant, asked the participant to hold the cell phone in his or her non-dominant hand, and instructed the participant to say, when ready, “ready, set, go”. After the participant had said “go” the assessment began. Researcher #2 called out the arithmetic problems to the participant and recorded his or her response. Researcher #1 used a stop watch to time the assessment and then recorded the time (see Appendix B). The researcher also insured that the participant was following the instructions of the experiment.

The assessment ended when the participant had placed all 25 pegs into the pegboard or upon completion of the three-minute time limit. Researcher #1 instructed the participant to shift the cell phone to his or her dominant hand and to then perform the Grooved Pegboard Test with his or her non-dominant hand while answering simple arithmetic problems (see Appendix D).

In Group B each participant participated in the same timed fine motor assessment task first with his or her dominant hand and then with his or her non-dominant hand. Researcher #1 gave the same explanation and instructions to Group B, but omitted the cell phone instructions. The time was kept and recorded for each participant.

After the conclusion of motor assessment task, we debriefed each participant and answered all questions. We thanked each participant for his or her participation and requested they not share any information about this study with other individuals that may participate.

RESULTS

We used an independent *t*-test to compare the two groups on all measures and a conservative alpha level of .01 for all statistical tests since we performed multiple *t*-tests.

Group A and Group B

Group A (experimental) (*M*=159.33, *SD*=5.98) had a significantly higher mean Grooved Pegboard Test time than Group B (control) (*M*=133.52, *SD*=4.32), *t*(51)= 3.57, *p*=.001. Group A (*M*=77.08, *SD*=3.19) had a significantly higher mean time for the dominant hand than Group B (*M*=61.43, *SD*=3.11), *t*(51)=3.48, *p*=.001. Additionally Group A (*M*=82.25, *SD*=3.08) had a significantly higher mean time for the non-dominant hand than Group B (*M*=70.10, *SD*=2.46), *t*(51)=3.117, *p*=.003.

Men and Women

We did not find a significant difference between the total mean times for men (*M*=152.75, *SD*=28.118) and women (*M*=140.64, *SD*=28.966), with a *t*(51)=-1.492, *p*=.142. For the dominant hand there was no significant difference between men (*M*=73.15, *SD*=14.8125) and women (*M*=65.71, *SD*=19.252), with *t*(51)=-1.481, *p*=.145. Also there was no significant difference for the non-dominant hand assessment between men (*M*=79.60, *SD*=15.796) and women (*M*=73.18, *SD*=14.636), with *t*(51)=-1.502, *p*=.139.

Left-Handed and Right-Handed Individuals

The dominant hand assessment for left-handed (*M*=51.87, *SD*=35.333) and right-handed (*M*=69.88, S*D*=15.661) individuals approached statistical significance, with a *t*(51)= 1.985, *p*=.053. For the non-dominant hand assessment left-handed (*M*=63.00, *SD*=11.605) and right-handed (*M*=76.63, *SD*=15.150) individuals approached statistical significance with *t*(51)=1.752, *p*=.086. There was not a significant difference for the total mean time achieved for left-handed (*M*=129.28, *SD*=21.172) and right-handed (*M*=146.51, *SD*=29.316) individuals, *t*(51)=1.149, *p*=.256.

DISCUSSION

The results of the analysis support the hypothesis that the use of a cell phone may distract individuals, causing poorer performance on a fine motor task. The researchers hypothesized that women may have an advantage on fine motor assessments due to smaller finger and hand size. We did not find a significant difference between men and women. The researchers observed that many of the female participants had long artificial fingernails and this may have slightly impaired their performance. We did not find a significant advantage for left-handed individuals (N=4); however, they achieved a lower mean time in all three assessments. We suggest future research be conducted with a larger sample of left-handed individuals.

The researchers concluded that cell phone use negatively affects performance on a fine motor task. The researchers performed this simple task in a controlled environment without any notable internal or external distractions. There are reasons to believe that the effects of cell phone use and a task that requires the coordination of fine motor functioning, such as driving a motor vehicle, would be amplified in a real world situation**.** There are many internal and external distractions in play when operating a motor vehicle. Richard, et al. (2002) stated that driving a vehicle involves not only the execution of motor processes, but also perceptual and cognitive processing, which also requires attention. It may be an imprudent endeavor to talk on a cell phone while performing a task that requires the coordination of fine motor functioning such as driving a motor vehicle**.**

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Appendix A

Demographics

Age ______ Years of Education______ Id #______

Please check the appropriate blank

Sex: Male ____ Female _____

Dominant Hand (hand you write with): Right____ Left_____ Ambidextrous_____

Do you have full use of your left and right hand and fingers? Yes____ No_____

--If you checked No then please specify which hand: Right____ Left_____

Do you use a cell phone? Yes____ No_____

--If you checked yes, how many hours per day______

Appendix B

Score Sheet: Grooved Pegboard Id #______

Right Hand

Grooved Pegboard time to complete: ________

Over 2 minute's ______

Left Hand

Grooved Pegboard time to complete: ________

Over 2 minute's ______

Appendix C

Arithmetic Questions- Dominant Hand

Dominant Hand

7/14	5+12	8x8
11+11	7-9	2x2
2x8	5x5	3+9
3+4	8x11	4-6
3-3	12/12	6x7
5-6	12+12	8/16
8+9	2-4	11/11
6/12	5+10	6-10
6-12	7-7	9x11
2+4	10+11	2x6
2x11	3+12	4x11
4-4	4x8	7+11
6x12	7-11	2x4
3+7	4x6	10-10
2/14	7+9	3x6
2/18	2-6	5x9
4-8	4+9	9+10
6x9	6-7	4x4
10/10	2-8	7+7
2+2	4-11	11-11
5-10	6-9	2+6
8+10	3+5	3-5
2+8	5x11	5-12
3-11	8-8-	8+12
3-7	5-8	5/10
3x4	8-11	3x8
4/8	4+7	6+11
4+12	9x9	9+12
6+8	4+5	5/20
9-12	4+10	5x7
11x11	6+6	3x12
2+11	9-10	5+8
7x12	3+10	7x8
2-10	5+6	3/15

Appendix D

Arithmetic Questions- Non-Dominant Hand

Non-Dominant Hand

9x12	5x12	4+4
8+8	3x5	7/7
2+5	10+10	8+11
6x11	7-12	5-7
4-7	5+5	3-8
2x5	3+8	2+3
2-5	11-12	2/16
6x8	7-10	12/1
4x12	5+11	9+11
2x9	3+6	6+10
2-11	11+12	4+11
7x9	7+8	7/14
5-5	4x9	8x12
3-6	3+5	5x6
2+12	10-11	3x7
9-11	6-6-	12/12
6+7	4-12	6x6
4+6	2x12	4-9
4/16	2-9	2x7
5/20	6-8	2-3
7x7	4-5	9-9
5-11	2x3	6+9
3-4	2-7	4+8
2+10	8-12	4/8
11/1	5-9	7+10
7x11	3x3	4x5
5+9	8-10	3+11
3-12	10+12	2+9
12-12	3x11	8x9
7-8	6-11	5x8
5+7	4-10	3x9
3-10	3/9	9/18
11x12	9+9	10/20
8-9	6+12	7+12