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Does Use of a Cell Phone Affect Cognition?

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DOES USE OF A CELL PHONE AFFECT COGNITION?

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Abstract

This research examined the effects that a cell phone distraction had on subjects completing a maze task. Twenty-four subjects participated in the study (12 Younger subjects and 12 Older subjects; 14 females and 10 males). Subjects completed an identical maze task during each of three sessions. During the first session, subjects completed the maze task without the distraction of cell phone use. The second session involved completion of the maze task while listening to a transcript read over a cell phone. The third session involved completion of the maze task while participating in a cell phone conversation. Subjects' performances were recorded for analysis selected parameters: maze completion time, number of dead-ends entered, pauses, and loss of concentration. These data were compared by age and gender. Significantly, females took longer than males to complete the maze task in both cell phone sessions. However, males had a significant increase in the number of pauses during the maze task (Sessions 2 and 3), but still managed to complete the task more quickly than the female subjects. Younger subjects had a significant loss of concentration in both cell phone sessions, which was not observed in the Older subjects. This study suggests that the use of cell phone should be limited when performing a task that relies on attentiveness.

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Acknowledgements

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Chapter I

Background

1.1 The Development of the Cell Phone

Mobile or Portable Cell Phones have existed for a relatively brief time. The idea of a portable cell phone developed out of a pre-existing invention, the mobile car phone (1). These original mobile car phones were mounted inside a car, but to place a call, one had to stop and connect to the local telephone network using a large pair of electric wires (1). Although mobile car phones have been under development for decades, inventor Martin Cooper in partnership with Bells Labs and Motorola did not place the first portable cell phone call until 1973 (1).

1.2 Distraction

As the use of the cell phone has evolved from emergency situations to replacing rotary and touch-tone phones, so has the user of the cell phone. Cell phones have moved from being used by and available to only military operations (as a replacement for walkie-talkie devices) to usage by almost every age group and gender. Recently, cell phone use has become controversial. Cell phones today are used for full-blown conversations behind the wheels of two-ton machinery such as cars. Many studies explore the transition of the phone from stationery use to mobile use to use in cars (2-

8). A great majority of these studies point to cell phone use by drivers as being dangerous and these observations are well documented (2-9).

In a study in which cell phone use was related to hospitalization from car accidents, researchers documented a 400% increase in the chance of being involved in a collision when a cell phone was used (10). Although the presence of a passenger is a distraction, use of a cell phone provides a four-fold greater risk of a collision (11). A passenger, aware of the driving environment can serve to redirect the driver back to the task of driving (12). In a simulated driving study, subjects using a cell phone were not able to stay within the confines of their own lane and noticeably increased the headway or following distance between themselves and the vehicle in front of them; conversing with a passenger present had little effect on these measurements (11). Using a cell phone and driving has been compared to getting behind the wheel intoxicated (13). A study comparing cell phone use while driving and driving while inebriated (without use of a cell phone) found that drivers using a cell phone had slower reaction times, took longer to resume previous speed, and were involved in more rear end collisions. In contrast, drivers under the influence had a more aggressive and exaggerated approach to driving and were noted to brake more harshly and also drive at a closer following distance to cars in front of them (13).

1.3 Age Related and Reaction Time

Studies measuring reaction time while driving of cell phone users across age groups, suggest: 1.) cell phones had a negative effect on reaction time in drivers over 60

years compared to drivers under 60 years of age (3); 2.) Seventy-five percent of measured reaction times were one second or less for both 41-54 year old drivers and 20-29 year old drivers compared to older drivers, 60-64 years old (14); 3.) Brake response in older drivers using a cell phone increased by almost one-third of a second, compared to younger drivers whose brake response increased by only one-tenth of a second (15).

1.4 Situational Awareness/Attention

Situational and environmental awareness is important for persons operating heavy machinery, such as a car. This awareness is important not only to the driver, but also to passengers, pedestrians and to other drivers who are sharing the road. It is important for drivers to be alert to the driving environment in order to adjust to gradual (i.e. uneven roads) or abrupt changes (an accident occurring) that may change the way the driver handles the car. Data suggest cell phone conversations are disruptive and can cause drivers to direct their attention to the conversation, losing focus on driving (16, 17). Another study supported this finding and concluded that there was a reduced safety margins while driving due to reduced situational awareness and late detection of driving environment (18). In distracted situations (i.e. high traffic or accidents), it was found that those participating in a cell phone conversation were more likely to collide with stationery vehicles and have sluggish braking responses (19). Subsequently, cell phones have been found to impair the driver's ability to compensate for many environmental stimuli, including pedestrians, posted signs, speed limits, and other

vehicles (20). Subjects, who were scored on situational awareness while using a cell phone and driving, were noted to have deficits in coping with operating their vehicle and following directions (20).

1.5 Legalities of Hands free versus Handheld

With respect to the move to hands free devices, studies have shown that, use of a hands free device does not decrease the likelihood of being involved in a crash (10). Users of hands free devices had similar experiences to those not using them, in that they also missed traffic signals while conversing and had increased reaction times (4).

Laws as recent as September 2010 have been enacted in some states to abolish cell phone use while driving, according to the Governor's Highway Safety Association (21). Many states, reluctant to abolish cell phone use while driving, have moved towards new rules about how cell phones are used while driving (21). Most notably, these laws are moving toward hands free phone use via Bluetooth or wired headset, with large fines levied for non-compliance. Currently, legislation is in effect to move the public from handheld cell phones to hands free phone usage and/or abolish cell phone use during driving. While no state bans all cell phone use, many prohibit cell phone use by certain drivers; 28 states and the District of Columbia ban all cell phone use by novice drivers, 8 states prohibit all drivers from using handheld cell phones while driving, and 30 states, the District of Columbia, and Guam ban text messaging for all drivers (21).

1.6 Mental Workload

Cell phone conversations, depending on the topic, can be very taxing and time consuming. In a study in which items were randomly placed throughout an environment, persons in the cell phone user group were less likely to remember those fixed items (recognition and perceptual memory were both affected), paid less attention to visual inputs, and braking reactions were decreased compared to those in a control group (19). However, in this same study, just listening to a dialogue did not provide enough of a distraction to affect driving while using a cell phone (19). Another study measuring glance frequency reported persons using cell phones seldom glanced outside of the car to assess the driving environment or checked driving instruments (mirrors) and spent more time focused centrally (22). Drivers using cruise control have been found to have a greater ability to make accurate projections of the driving situation compared to those using a cell phone (23). Cell phone use also caused an increase in accelerator pedal angle (the person drove more slowly or lightened up on the accelerator pedal) with decreased speed that varied, regardless of conversation type (24).

1.7 Purpose

The present study was designed to assess the ability of younger and older subjects to complete a maze in the presence of a cell phone distraction. The need to focus on a critical task can have implications for cell phone use while driving.

1.8 Hypothesis

The study hypothesized that cell phone distractions would hinder a subject's ability to focus on a maze completion task that is performed simultaneously.

Hypothesis Testing

π is the arithmetic time it took a group of subjects to complete the maze.

H_o is the null hypothesis or states that there is no difference between the measurements.

H_a is the alternative hypothesis or states that there is a difference between the measurements.

The overall model hypotheses for the older and younger subjects are as follows:

H_o: $\pi_{\text{no distraction}} = \pi_{\text{distraction / listening}} = \pi_{\text{distraction / conversation}}$

H_a: $\pi_{\text{no distraction}} \neq \pi_{\text{distraction / listening}} \neq \pi_{\text{distraction / conversation}}$

This model was applied to evaluate the following parameters: 1.) Maze completion time; 2.) Number of pauses before completion; 3.) Loss of concentration during completion; 4.) Number of dead-ends encountered during completion; 5.) Parameter of differences between older and younger subject; 6.) Parameter of differences between gender.

Chapter II

Materials & Methods

2.1 Participants

The Institutional Review Board (IRB) of the Philadelphia College of Osteopathic Medicine approved the use of human subjects in this protocol.

2.1.1 Recruitment Criteria

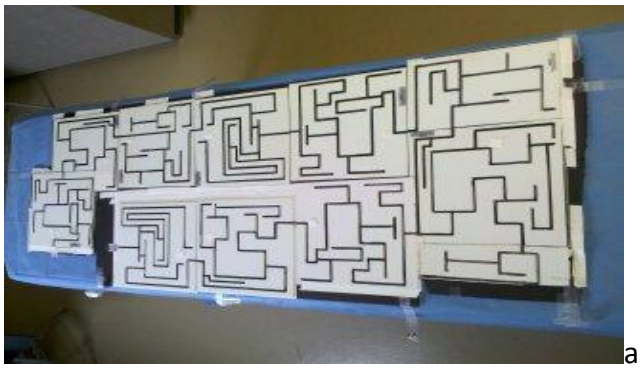
Prior to participation in the study, each subject was given an informed consent; that included a brief description of the nature of the study. Subjects also were required to fill out a brief questionnaire prior to participating in the study, to collect demographic information (Appendix A). After reading the informed consent and questionnaire, subjects were asked if they would still like to participate in the study. Participants could withdraw from the study at any time.

The overall study sample included all willing and available students, faculty, staff, and employees of the Philadelphia College of Osteopathic Medicine that fell within two identifiable groups; 12 younger subjects (20-30 years old) and 12 older subjects (45-55 years old), from which the data was derived.

2.2 Instrumentation & Procedure

2.2.1 Finger Maze

A large finger maze composed of 10 smaller mazes was constructed and used as the main task/focus (Fig 1a). A screen was placed to shield subject identity from the recording device; only their hands were visible for video recording purposes (Fig 1b). One investigator remained behind the screen so that distractions not visible to the camera could be manually recorded.


a.


b.

Fig 1. Finger maze used in research protocol, a.) TOP DOWN view of finger maze ; b.) FRONTAL view of finger maze with screen shown.

2.2.2 Cell Phone

A prepaid cell phone and headset were purchased and used to provide the secondary or dual task (Fig 2a). A remote landline was used to send calls to the cell phone (Fig 2b). Alcohol swabs were used to clean the headset prior to each cell phone session.


a.

b.

Fig 2. Phone devices used in protocol, a.) Cell phone and headset ;b.) Landline Phone

2.2.3 Recording Device

A motion-sensored camera was purchased to record video (without audio) of the hands of each subject as they completed the finger maze (Fig 3). The camera was used to obtain accurate timing of starts and finishes of the maze task, as well as to discern when the subject started down a dead-end, paused/hesitated during maze activity.

Fig 3. Recording Device

2.2.4 Testing Sessions

Subjects were required to participate in three testing sessions, no less than one week apart.

2.2.4.1 Session 1: Subjects completed the finger maze without use of the cell phone distraction.

2.2.4.2 Session 2: Subjects were oriented on the use of the cell phone, and required to hold the phone in their non-dominant hand while completing the maze. Subjects were informed that they would be receiving a cell phone call from a remote landline. Subjects were instructed to listen to the call but not to respond, while the transcript of the Listening Portion was read (Appendix D).

2.2.4.3 Session 3: Subjects were re-familiarized with the cell phone and instructed that they would be receiving a phone call. Subjects were told they would be required to participate in a dialogue with the caller and answer any questions posed (Appendix C).

2.2.5 Transcripts

Two different transcripts were prepared for the two different cell phone sessions. Transcript 1 consisted of several health-related news

reports, obtained from KYW Radio News Medical Reports; Transcript 2 consisted of spelling, math problems, and thinking exercises (Appendices C, D).

2.2.6 Preliminary Testing Procedures

Before enrolling any subjects, a licensed cell phone distributor and two non-subjects were recruited for mock testing sessions. Each was an experienced and frequent cell phone user, and fell within one of the two age groups. They each completed a mock testing session. Their input resulted in modifications to the transcripts to make them more realistic and also lengthening of the maze to increase the duration of each session.

2.2.7 Testing Procedures

2.2.7.1 Instruction to Participants

Subjects were shown a sample maze before beginning the study and instructed in the logistics of finger placement, starting and finishing directions. Subjects also were oriented on how to use the mobile phone and headset during the second and third sessions. They were informed that they would be directly observed during each session by one of the investigators in order to record actions not caught on the camera.

2.2.7.2 Recording Procedures

Prior to beginning each session, the recording device was activated. The session began upon a signal from the investigator behind the screen (Session 1) or by the ringing of the cell phone (Sessions 2 and 3). The subject indicated completion of the maze by verbally stating that they were finished.

2.2.8 Data Analysis

Data from each recording session were entered into a spreadsheet format as well as the observations recorded by the investigator behind the screen. Each parameter was analyzed statistically using univariate analysis and an analysis of variance by parameter. Probability values of $p \leq 0.05$ were considered statistically significant.

Timeline of Events

Phase I	Phase II	Phase III	Phase IV	Phase V	Phase VI	Phase VII
Participant Recruitment Material & Equipment Set-up and Testing	Maze Only Testing (Session 1)	Maze + Cell Phone Listening Only (Session 2)	Maze + Cell Phone-Conversation (Session 3)	Data Entry Statistical Analysis	Completion of Thesis. Manuscript, defense, and approval	Submission of Manuscript for Publication

Fig 4. Protocol Timeline from Implementation to Completion

Chapter III

Results

3.1 Age, Gender, Cell Phone

The frequency distribution for age and gender for subjects is given in Table 1. The ages for the younger adult subjects ranged from 20 to 30 years old, with a mean of 25.5 years. The ages for the older adult subjects ranged from 45-55 years old, with a mean of 50.6 years. A total of 42% of subjects were male and 58% of subjects were female. One hundred percent of the subjects were familiar with cell phone use.

Table 1. Questionnaire Responses

Measure	Frequency	Percent
AGE		
20-30	12	50
45-55	12	50
GENDER		
Male	10	42
Female	14	58
CELL PHONE		
Use	24	100
Do Not Use	0	0

It was hypothesized that cell phone distractions would hinder a subject's ability to focus on a maze completion task that is performed simultaneously. The hypothesis assumed that a similar correlation would be found for both age groups, but that the distraction would be greater for the older group. Assumptions also were made about the effect of gender. An analysis was conducted to explore, not only the effect the use of a cell phone had as a distracter, but also how the other variables (gender and age) affected concentration. The Upper and Lower Confidence intervals were calculated for the mean maze completion after the data were sorted by each of the variables above. None of the resulting comparisons based on gender, or age were found to be significant. The wide confidence intervals were attributed to the performance of one subject. It was deemed appropriate to drop the outlying values until this study could be expanded to include a larger number of subjects.

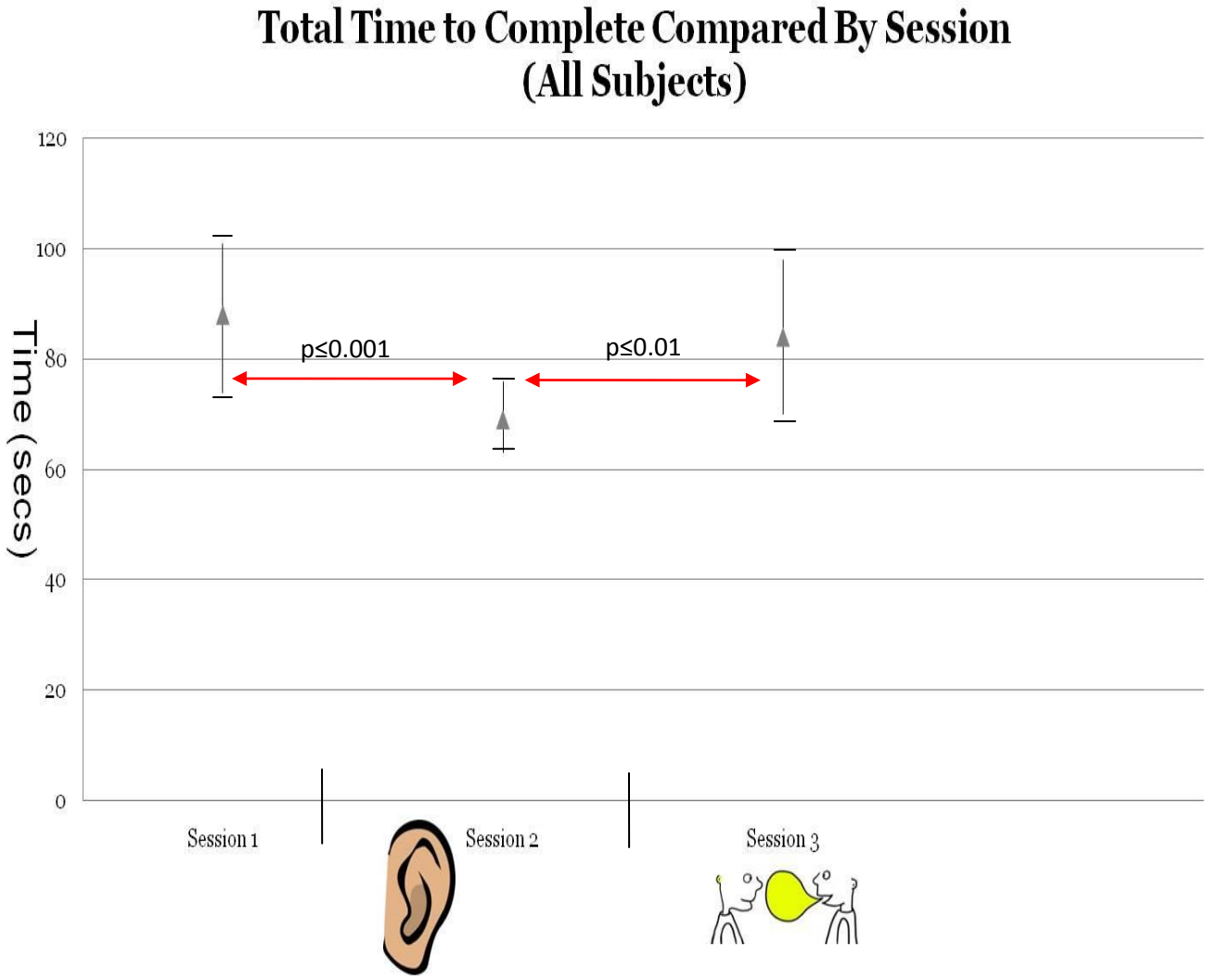


Fig 5. Total Time to Complete Compared By Session (All Subjects)

3.2 Total Time to Complete the Maze; Compared By Session (n=24)

All subjects' maze completion times were combined to establish a mean completion time for each session and these values were statistically analyzed (Univariate Analysis; Fig 5). The time needed to complete the maze was longest for the initial session where no cell phone distracter was used. Even though a listening-only cell phone distracter was used for Session 2, the mean time to complete the maze was significantly shorter for all subjects than for the initial session. The completion time for Session 3 although still significantly shorter than the initial session, fell in between the completion times for Session 1 and Session 2 (Univariate Analysis; Fig 5).

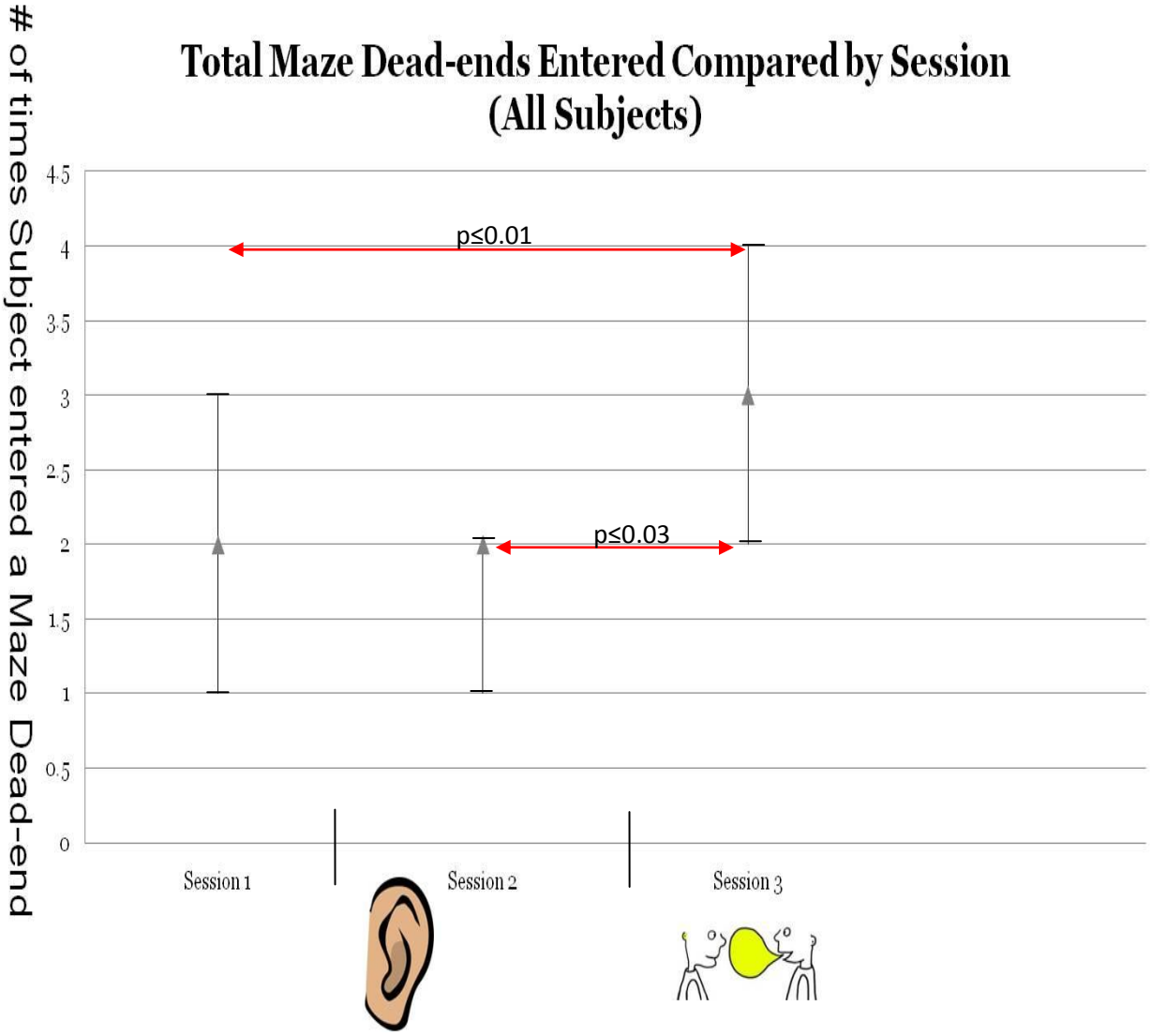


Fig 6. Total Maze Dead-ends Entered Compared by Session (All Subjects)

3.3 Total Maze Dead-ends Entered; Compared by Session (n=24)

Maze Dead-ends Entered were defined as any paths taken that would block completion of the maze. The data was captured via the camera throughout each session and manually recorded during review of the video. The average number of maze dead-ends taken by all subjects did not differ significantly between Session 1 and Session 2. All subjects had two or more entries into dead-ends during Session 3. (Univariate Analysis; Fig 6).

3.4 Total Pauses; Compared by Session (n=24)

A pause was defined as any time in which the subject was not continuously moving their finger through the maze. The average number of pauses did not vary significantly among the three sessions (data not shown).

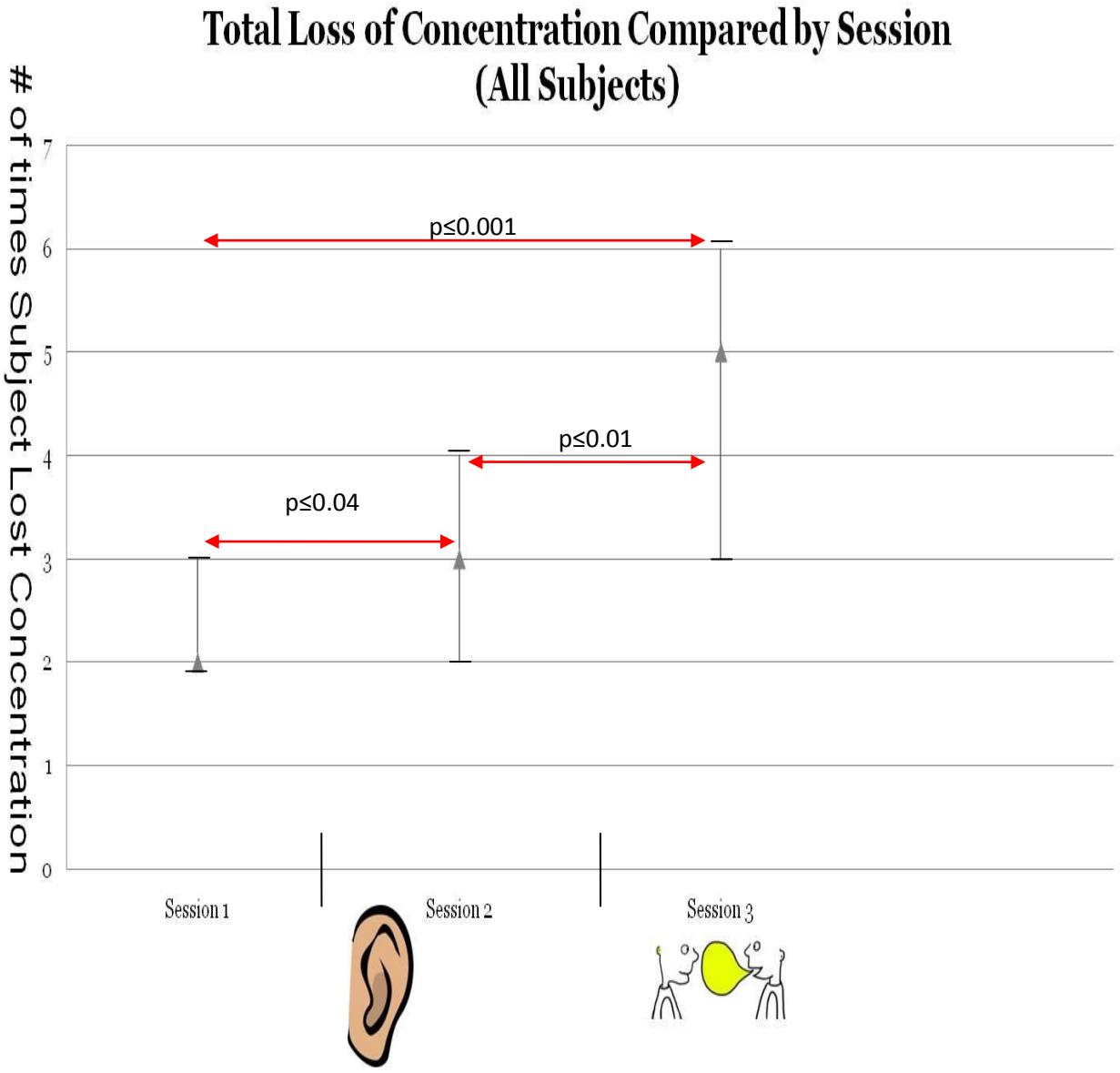


Fig 7. Total Loss of Concentration; Compared by Session

3.5 Loss of Concentration on Maze Task; Compared By Session (n=24)

Loss of Concentration on maze task was defined as looking up/away from the maze, and was observed and recorded by Investigator 2, who was positioned behind the screen. Loss of concentration on maze task increased significantly over the three sessions. It occurred less frequently during Session 1 and became significantly more frequent during Sessions 2 and 3 with the greatest loss of concentration observed between Session 1 and Session 3 (Univariate analysis; Fig 7).

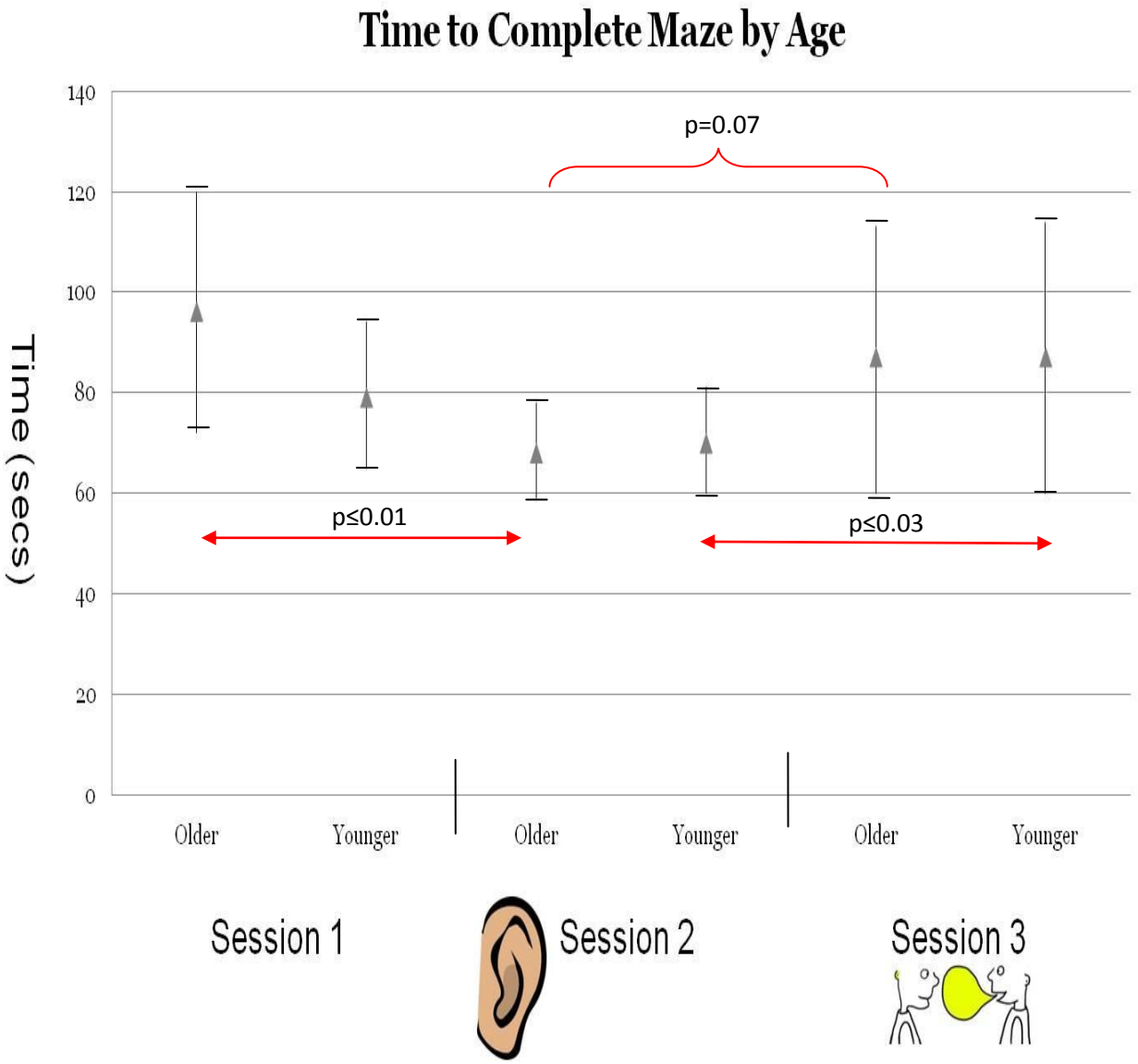


Fig8. Time to Complete Maze by Age

3.6 Time to Complete Maze; Compared by Age (n_1=12, n_2=12)

Maze completion time for the Older subjects was significantly less for Session 2 compared to Session 1. In comparison, the Younger subjects demonstrated a significant increase in completion times between Sessions 2 and 3. However, Younger subjects did not differ significantly in their completion time between Session 1 and Session 2. Older subjects took a longer time to complete maze during Session 3 compared to Session 2. Although the longer completion times were significant, they did display a trend toward significance at the p=0.07 level for Older subjects between Session 2 and Session 3. Younger subjects took a significantly longer time to complete the maze during Session 3 compared to Session 2 (Univariate analysis; Fig 8).

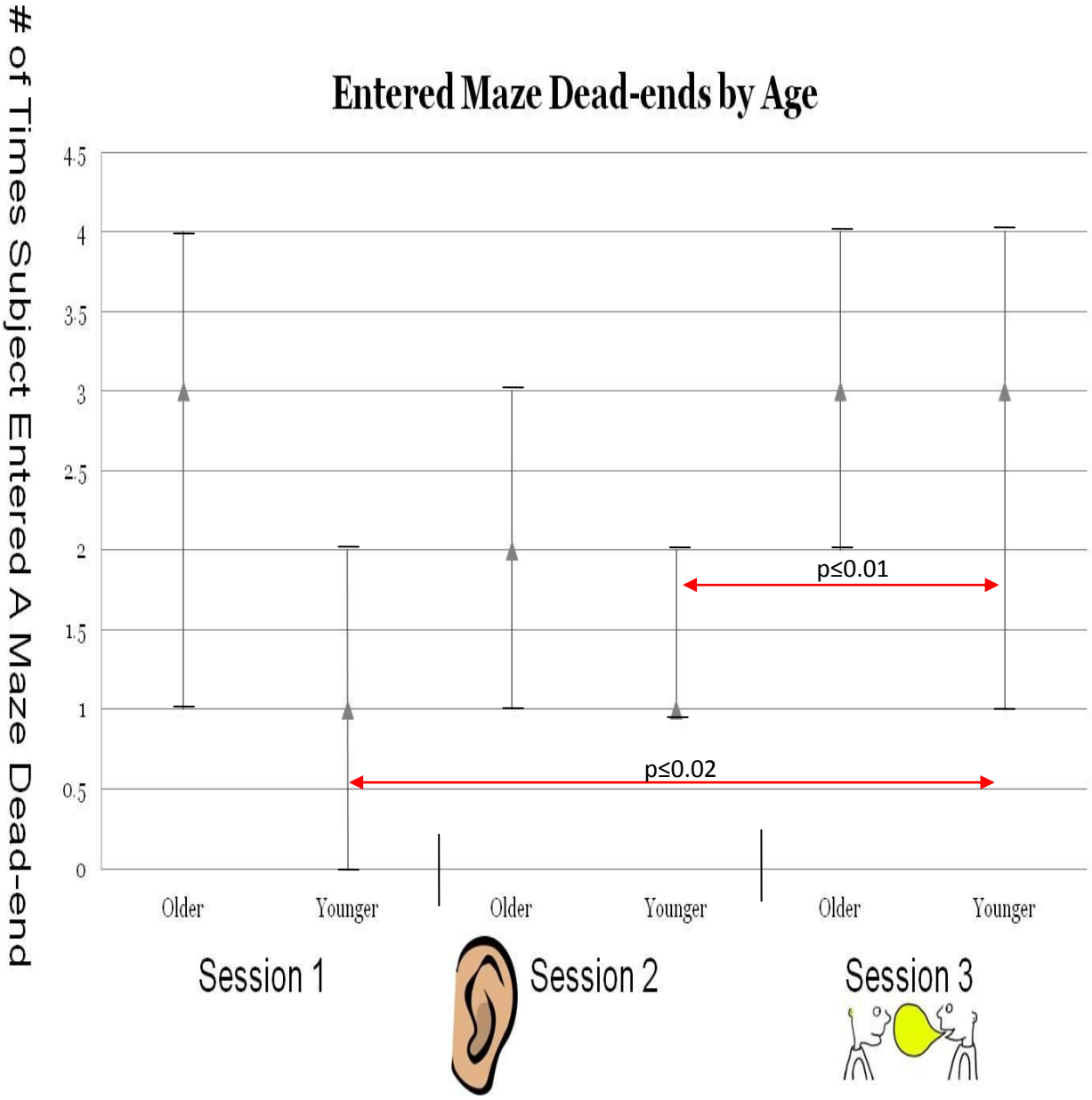


Fig 9. Entered Maze Dead-ends by Age

3.7 Maze Dead-ends; Compared by Age (n_1=12, n_2=12)

The number of dead-ends encountered increased significantly from Session 1 through Session 3 for the Younger group of subjects. While older subjects encountered more dead-ends than the Younger subjects during each session, this number did not change significantly from one session to the next. The presence of a wide range in initial values for older subjects during Session 1 contributed to the large confidence intervals and the seemingly elevated mean value (Univariate analysis, Fig 9).

3.8 Pauses during Maze Completion; Compared by Age (n_1=12, n_2=12)

The average number of pauses did not differ significantly between the two age groups during any of the three sessions (data not shown).

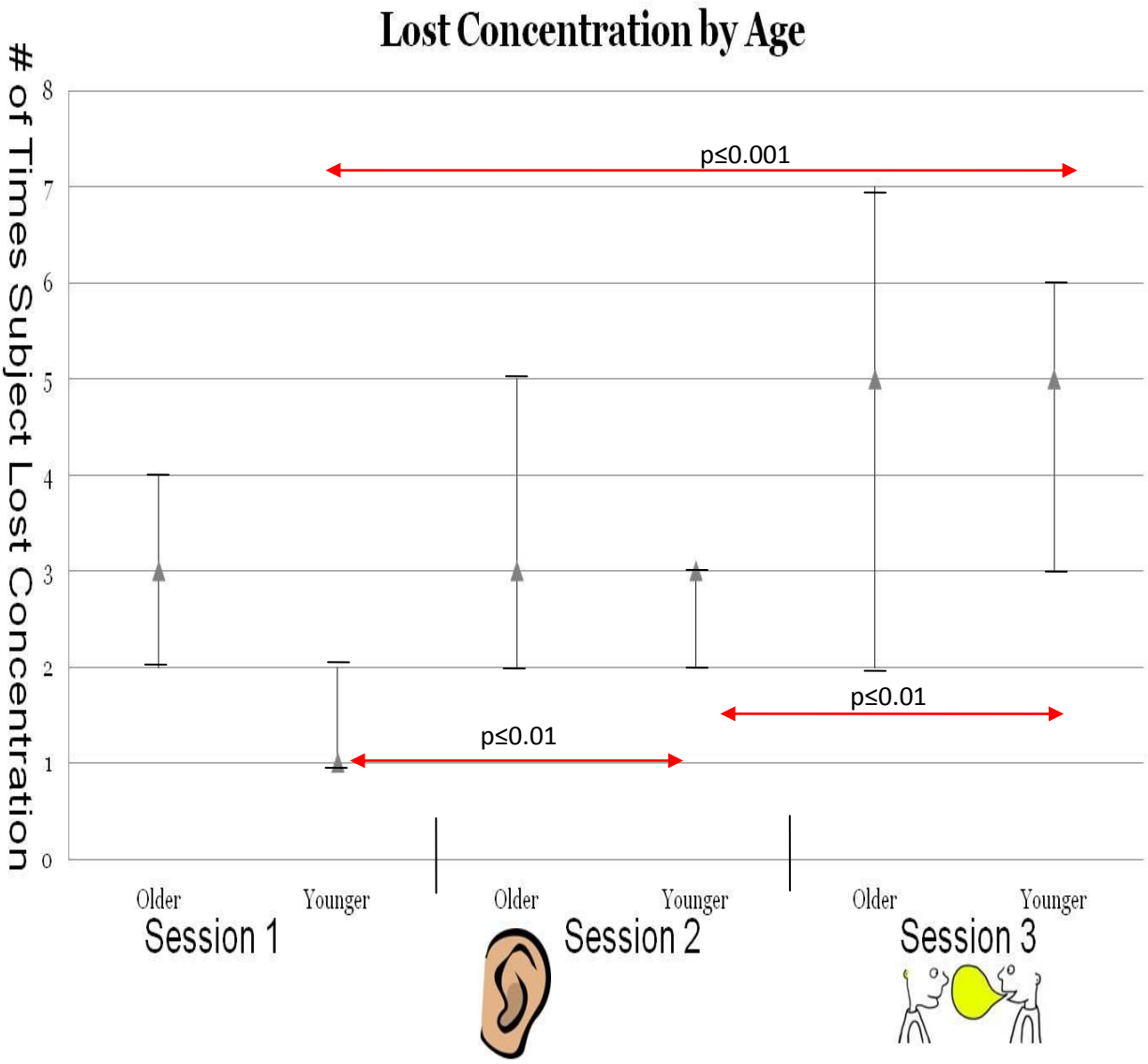


Fig 10. Lost Concentration by Age

3.9 Loss of Concentration on Maze Task; Compared by Age (n_1=12, n_2=12)

Loss of Concentration on maze task was defined as looking up/away from the maze, and was observed and recorded by Investigator 2, who was positioned behind the screen. Loss of concentration on maze task became significantly more frequent in Sessions 2 and 3 for Younger subjects. While Older subjects appeared to also lose concentration with the introduction of the concentration distracter, it could not be statistically confirmed because of the wide range of the data recorded (Univariate analysis; Fig 10).

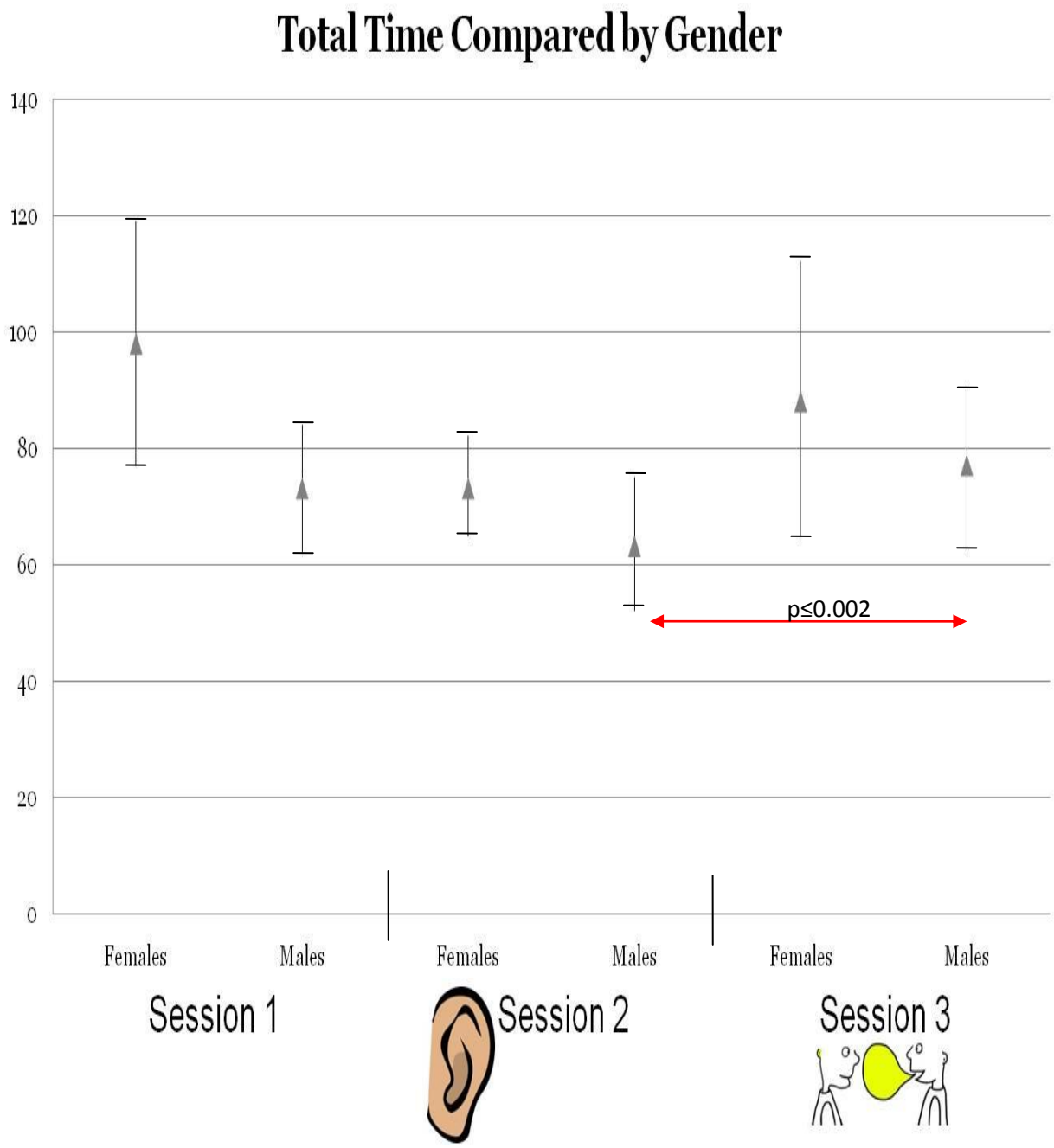


Fig 11. Time to Completion; Compared by Gender

3.10 Time to Complete Maze; Compared by Gender (n_{male}=10, n_{female}=14)

Although males during each of the three sessions completed the maze in less time than the female subjects, male completion times only differed significantly between Sessions 2 and 3. When comparing males to males only, their completion times were significantly longer in Session 3 compared to Session 2. For each of the three sessions the female times were insignificant (Univariate analysis; Fig 11).

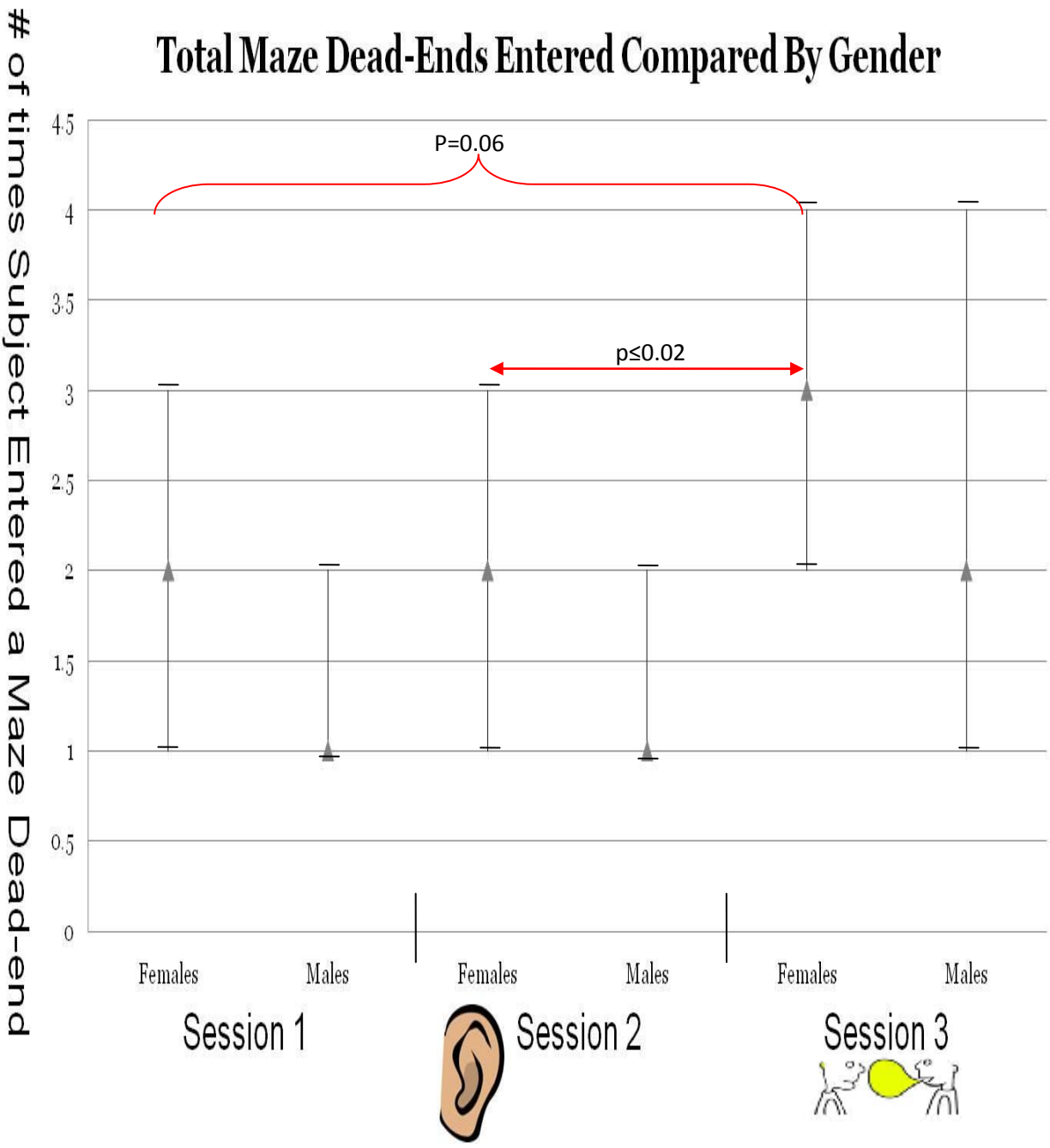


Fig 12. Total Maze Dead-ends Entered Compared by Gender

3.11 Maze Dead-ends; Compared by Gender (n_{male}=10, n_{female}=14)

The only significant change in the number of dead-ends encountered occurred in the female group of subjects for which there was an increase from Session 2 to 3. Male subjects encountered a similar number of dead-ends over all three sessions. However, there was a wide disparity in the data for Session 3 that accounts for the increase of mean value and the large confidence intervals. The conversation distracter in Session 3 led to a significantly increased number of dead-ends encountered by female subjects, a similar trend was observed for these same subjects between Session 1 and Session 3 (Univariate analysis; Fig 12).

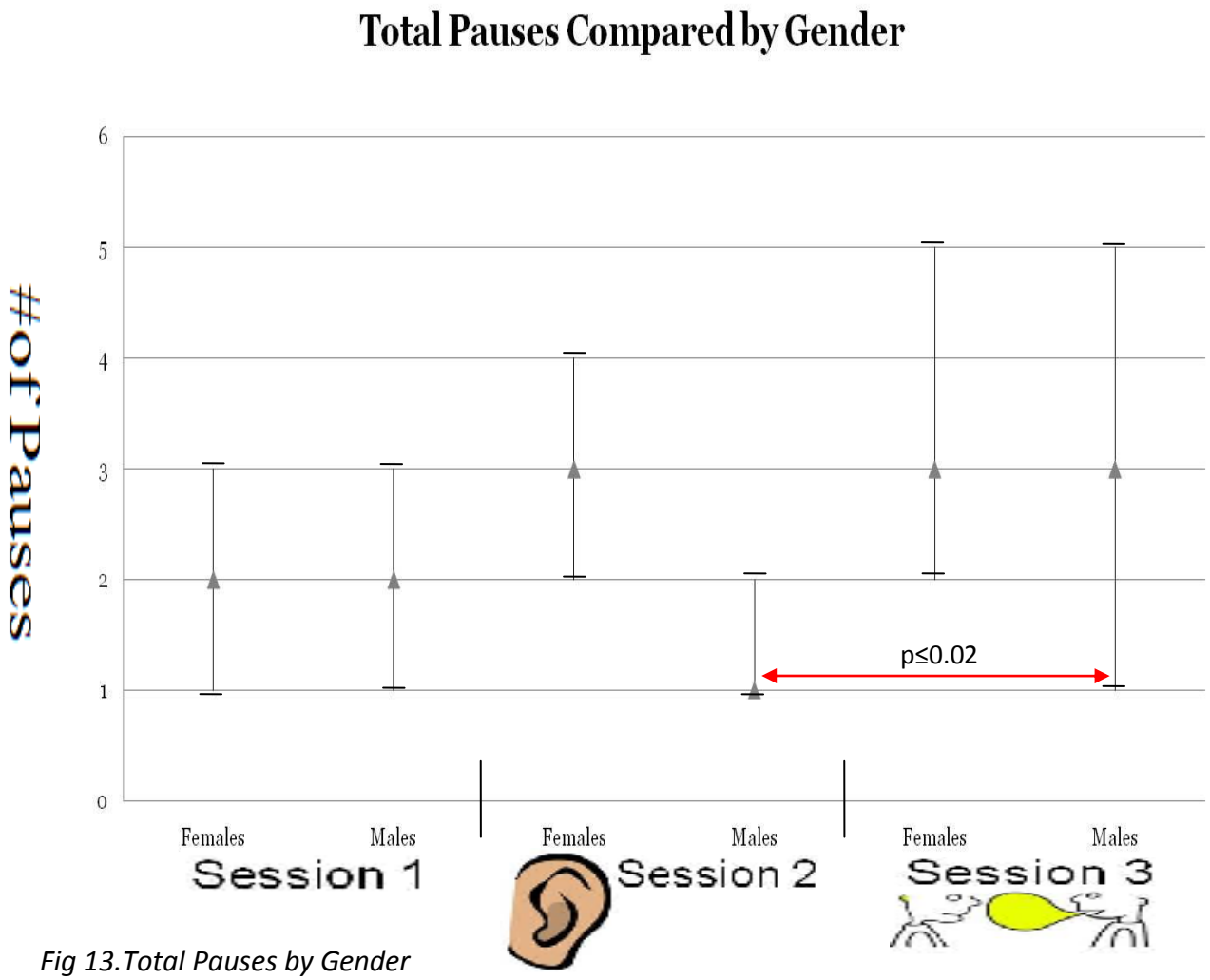


Fig 13.Total Pauses by Gender

3.12 Pauses; Compared by Gender (n_{male}=10, n_{female}=14)

Female subjects made a similar number of pauses throughout all three sessions. However, male subjects made a significantly greater number of pauses during Session 3 compared to Session 2 (Univariate analysis; Fig 13).

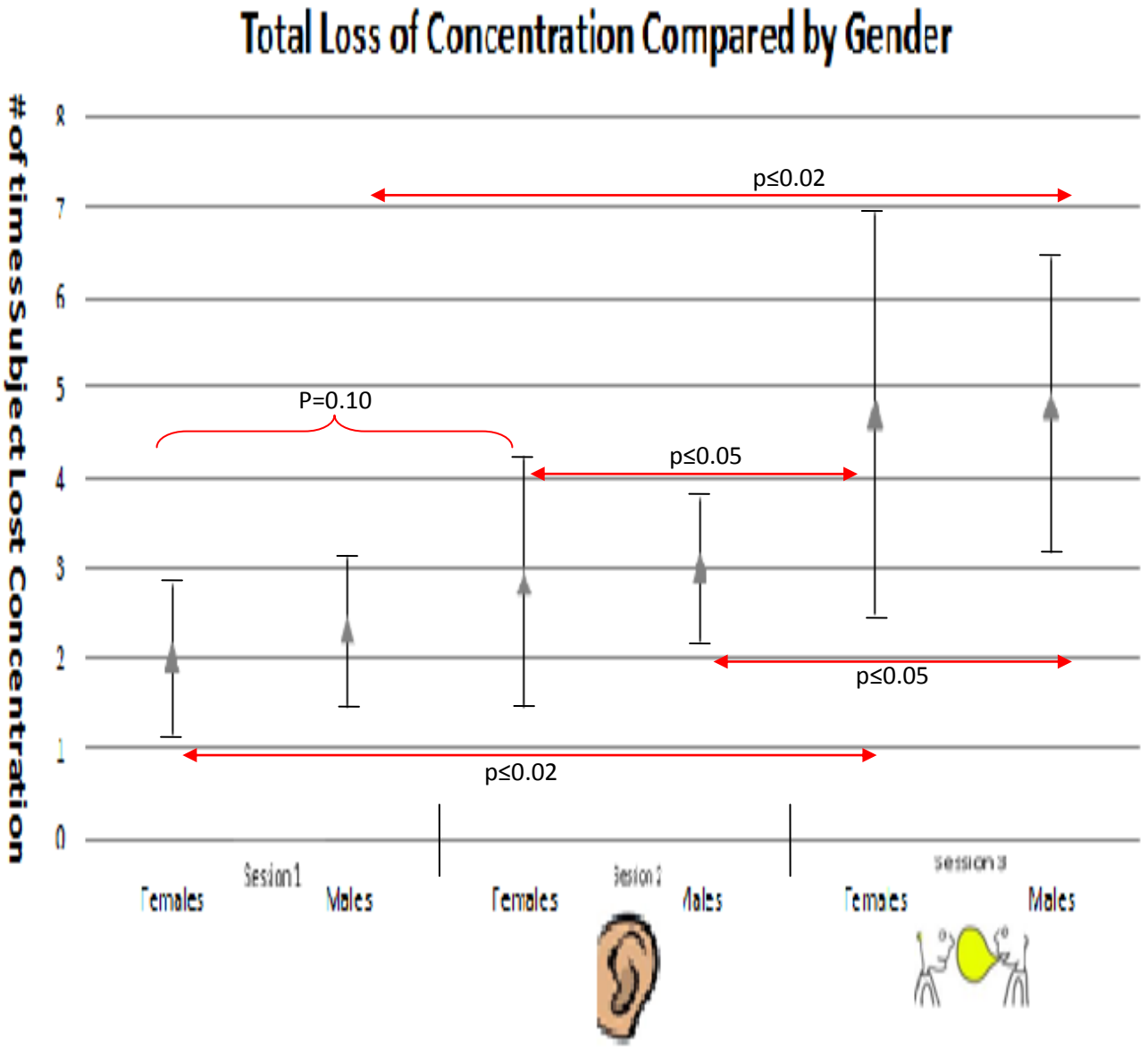


Fig 14.Total Loss of Concentration; Compared by Gender

3.13 Loss of Concentration; Compared by Gender (n_{male}=10, n_{female}=14)

In general, both males and females had a significant loss of concentration when Session 3 was compared to Session 1. Likewise, both males and females had a significant loss of concentration when Sessions 3 was compared to Sessions 2. Neither group exhibited a significant loss of concentration from Session 1 to Session 2, although the number of times that concentration was lost did increase. There was an observable trend among female subjects toward a greater loss of concentration during Session 2 compared to Session 1 (Univariate analysis; Fig 14).

Chapter IV

Discussion

4.1 Maze Completion Time, General Consideration

Although comparisons of reaction time to maze completion time are not directly equivalent, they both can reflect the consequences of a distraction during the performance of a task. Prior to the present study, all reports of the cell phone as a distraction seem to be based on its detrimental effect on reaction time. In this study, we took another approach to determine whether a cell phone distracter would affect the ability of a user to complete a maze task as a reflection of its effect on cognition. We found that not only did the cell phone use itself distract from the maze completion task, but that another variable also influenced completion times; a learning curve effect developed between the first and second exposures to the maze task. Despite the addition of a cell phone to Session 2, prior learning served to improve maze completion times to a greater extent than listening to a cell phone conversation hindered maze completion times.

4.2 The Effects of Age and Gender on Loss of Concentration during Maze Completion

Age did not have a significant effect on the sum total time to complete all three maze sessions; both older and younger subjects had equivalent performances in this

respect. However, older subjects ran into approximately the same number of dead-ends in all sessions, which was reflected in completion times that were similar for all three sessions. The younger subjects encountered a greater number of dead-ends as they progressed through each succeeding session. Thus, the total time to complete all three sessions was similar for both age groups. This suggests that in the final analysis younger cell phone users are more affected by the distraction of using a cell phone when completing a dual task and that actively engaging in a conversation is more distracting than passive listening to a cell phone conversation. In contrast, cell phone use in older subjects proved no more distracting than the maze task itself when they were faced with a dual task.

There was only a difference in performance or loss of concentration between the male and female subjects when completion time for Session 3 was compared to Session 2. Our results seem to be in keeping with a study where dual task conditions produced deficits in driving accuracy during listening to sentences, which is similar to results obtained during Session 3 and Session 2 of this study (29). There was a significant increase in female completion times when they were required to participate as well as listen to a cell phone conversation while completing the maze task; the male subjects did not demonstrate a similar increase. This study was not designed to explore the reason(s) for this gender difference in performance. Another study, which looked at language processing in both sexes, found no significant differences could be demonstrated between males and females in the way language was processed (30).

4.3 Limitations

1.) The camera used in this study only recorded video. It would be an advantage to include audio to adequately analyze reaction time during the cell phone conversation session. This would permit pinpointing the portions of the conversation where the subjects had the most difficulty (e.g. backwards spelling, calculation, etc). **2.)** Although attempts were made to schedule sessions at regular intervals, it was difficult to do so for every subject. **3.)** No measurement tool was included to test comprehension or recall following either cell phone session. Hesitancy in responding to a question only served to prompt the tester to go on to the next question. To address comprehension or recall, appropriate measuring tools could be administered at the end of Sessions 2 and 3. **4.)** The negative impact of cell phone use while performing a maze task is speculated to be due to lapses in attention and the distraction of performing a dual task. However, there is a lack of research to address how individuals process dual tasks. For example, does one task serve to distract performance of either task or do subjects alternatively prioritize the performance of one task in preference to another.

4.4 Future Studies

Some of the variables encountered in this study could be addressed by looking at the same two populations that were used with the cell phone distracter during the maze completion task and substituting other distracters than the cell phone. Such distracters

as ambient or background conversations that take place in the vicinity of the testing area could be used. Conversely, this same test population could be asked to complete a task other than a maze while using a cell phone.

To address the learning that took place between Sessions 1 and 2, the subjects could be instructed to complete a Pre-Session where they would perform a maze task using a maze other than the one used in the study. Alternatively, the subjects could be instructed to perform the maze task repeatedly prior to Session 1, so that maze learning would not contribute to differences in performance between Session 1 and Session 2. This method could be used to reduce the processing of demands and is linked to a quicker training of the task, but enhances the rate of learning (30).

Future consideration should also be given to the effects that cell phone microwave radiation may have on cognitive functions and neuromuscular performance as suggested by other investigators working with animal models (31-33). It is conceivable that this form of radiation exposure could be a factor in cell phone use and change human performance of a dual task.

4.5 Conclusion

This study presents documentation of a deficit which occurs when individuals are attempting to converse on a cell phone while simultaneously performing another task. Although a maze completion task does not involve the same set of skills as driving a vehicle, parallels are suggested, as both require the ability to attend to a task while

excluding factors that impair performance. This study suggests that cell phone use should be limited when performing a task that relies on attentiveness.

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Appendix A.

Does Use of A Cell Phone Impair Cognitive Performance? Questionnaire

Name: _____

Date of Birth: _____/_____/_____

Gender: _____

1. Are you a student, employee, or faculty member affiliated with the Philadelphia PCOM Campus? Y/N
2. Do you have full use of your dominant hand, both eyes, and both ears? Y/N
3. Do you use a cell phone? Y/N

Appendix B.

Date_____

Subject I.D. #_____

Does Subject Use Glasses (G), Bifocals(B), or Neither (N). Please Circle One. G B N

Please Circle One Task # 0 1 2

Times Subjects Reached a Dead End _____Actual_____43_____Possible

Times Subject Lost Focus on Maze (Lost Concentration or Looked Up)_____

Time to Completion_____(secs)

Notes:

Observer:

Signature of Observer:_____

Appendix C.

Transcript 1

Sections from the KYW NEWSRADIO Medical Reports were used for Session 2.

Section 1 (Dated 9/14/09 Length 3:59 min)

One of the problems with many studies that look at thousand of X-Rays, MRI's, or diagnostic heart tests is that people who are getting the studies performed are already ill with certain medical conditions. In other words, they have abnormalities on the studies, and the message becomes that everyone in a certain age group, could have these abnormalities, which may not be true, says a report from the Journal of Neuropsychology. In the article, researchers discovered that the scientific belief that older brains are substantially smaller than Younger brains may stem from studies that did not screen out people who had undetected slowly developing brain disease. According to the new study, which looked at people who were healthy for 9 years, it found that healthy people without mental decline had similar sized brains as Younger people, and only those with mental decline had smaller brains.

Over the years, there has been a theory that children who attend daycare tend to develop more health problems, things like cold, ear infection, throat infection, in the first years of life than children who stay home. It makes sense because there is an earlier exposure to problem, but theory also suggests that as children get older they have fewer infections and problems than the kids who stayed home and are now being exposed to various problems. A new study of 4000 Dutch children, from birth to 8 years of age showed that children who started daycare early were more likely to experience wheezing in the first year of life, than those who did not go to daycare. By age 5, daycare kids were slightly less likely to wheeze than non-daycare kids were, and by eight the effects evened out and daycare, attendants had no association with wheezing.

There is great mystery surrounding Attention Deficit Hyperactivity Disorder and its cause. Controversy swirls about treatment, you get the idea. We are continuing to learn a great deal about ADHD. A new study looking at brain imaging from the NIH has uncovered the first definitive evidence, that patients suffering from ADHD have lower than normal levels of certain proteins essential for experiencing reward and motivation. Why is this important? It could help explain some symptoms of ADHD, including inattention, and reduced motivation, as well as the increased risk of drug abuse and obesity. ADHD is estimated to affect 3-5% of the U.S adult population, which makes it one of the most prevalent of all psychiatric disorders.

We don't talk much about embryology because it can be highly technical, but the changes that occur as we develop as a fetus are fascinating. Over the course of weeks, vital organs develop, as we get closer to entering the real world and leaving the womb behind. It is the time of development, where we share much with other species as well. Scientists are now studying other organisms to gain insight into how we became who we are as a species. According to new reports in the Journal of Nature, a new embryological study of lizard and turtle shows a division of an ancestral single vessel of the heart in the two chambers is related to the expression of a transcription factor called, TBX-5. Now what does all this mean? Well it means that our four-chambered heart may have slowly evolved over time from species to species and we may soon be able to track that path.

Oxysterols could play a major role in the development of heart disease. If you are asking, "What the heck is an oxysterol?" you are definitely not alone. I'm sure you heard about the plaque and debris that can develop inside our blood vessels, as we're developing heart disease. Well, when plaque or debris inside our blood vessels interacts with our immune system in our body, the plaque is broken down. The product of this breakdown is a combination of cholesterol and ozone called oxysterols. We are always looking for ways to detect if our blood vessels are damaged. There was yet another study, which shows that ozone could play a role in the development of oxysterols. Ozone is in our atmosphere, but also appears to affect the process of the body leading to development of these oxysterols. The presence of these oxysterols means there is damage going on in the body, testing for this may one-day lead to a way to predict heart disease. It is definitely a complex process when you realize the environment the food we eat the immune system and the way our body reacts, it all comes together.

Section 2 (Dated 9/21/09 Length 3:13 min)

The latest study by the Substance Abuse and Mental Health Administration clearly links substance abuse with suicide. The overall numbers are that 32,000 suicides occur in the United States each year, but among people with a substance abuse disorder, 11% had considered suicide compared to 3% for people without such disorders. This year there was another important twist in the study; in the past, the only people asked about suicide were those suffering from depression, but according to the new report a wide variety of people with and without depression were asked. The other high-risk group was people between the ages of 18-25.

Too much alcohol could be linked to heart problems in women. All it takes is two or more alcoholic beverages per day to increase the risk of atrial fibrillation. A study of over 35,000 women aged 45 and above found that just drinking two or more alcoholic beverages per day had a higher rate of atrial fibrillation than those drinking no alcohol. The women were followed for an average of more than a decade. This research comes from Brigham and Women's Hospital. It was one of the major studies of alcohol in the heart. Now if you have concerns, talk with your family physician or cardiologist for more information.

Happier people tend to be healthier people. If you try to get along with others, your day probably will go smoother, and yes healthier. It makes sense that it is easier to get through the day if you are in good spirits. A short time ago, an Oregon study showed that getting along with others is good for your health. The report looked at 700 older adults and found that those who got along with their relatives, friends, and neighbors were less likely to report health problems than physical limitations. This study was unique because it looks specifically at interactions between people. It is not known that this is due to the immune system or not.

The bathroom can be a dangerous place for Younger children. Now you may be thinking about risks like drowning in an unsupervised tub with water or being exposed to scalding hot water, but the biggest concern may be the medicine cabinet. If you have Younger children, you need to have medicine with child safe caps and the medicine cabinet should be secured with a latch. There are other concerns, for instance, mouthwash may contain alcohol, it is a small amount but it still could be dangerous for children. Keep mouthwash away from a child's reach. Yet, another problem, many people store toilet cleaners, ammonia, dangerous solvents, that can also be a grave risk. It is important to look at these risks and think about them ahead of time.

Exercise may be one of the best defenses against cancer; we have seen this in multiple studies, but what about the role of sleep. Among those under 65, sleeping less than 7 hours a night, had an increased risk of cancer, even among those who were physically active. Researchers suggest that sleep duration, can affect the strength of the relationship between physical exercise and cancer risk, though they say these findings need to be confirmed in other studies. This is one of the latest research products being done at the National Cancer Institute looking at lifestyle. I think it's very important, because lifestyle changes are clearly going to have a role, not only in cancer, but also in heart disease and other major disease processes as well. It all comes down to common sense health habits.

Section 3 (Dated 9/28/09 Length 3:29 min)

There is no doubt the communication of medical information is crucial and can save lives; the perfect example is in the case of a heart attack. There are classic warning signs, including crushing pain in the chest, some people describe the pain as an elephant standing on their chest, other symptoms include pain radiating to the jaw or down the left arm, but this is not always the case. The classic examples aren't always classic, some people feel very little pain and experience indigestion and sweating. It's particularly true in women, that many women can have vague symptoms and can ignore their heart attacks. This can be a deadly mistake because ignoring a heart attack means the heart is supplied with very little oxygen and can slowly die, never returning to its former self.

Do you want to stay Younger? Well if you want to stay Younger, you don't have to use facial creams or start the latest fad diet. Believe it or not, you just need to use

common sense and care for yourself. The most important step is eating a balanced diet, plenty of fruits and vegetables, and trying to cut back on sugar and pre-processed foods. The other concept to get down is that you do not have to be perfect, you can have a piece of cake or pie or stops at a fast food restaurant every now and then, just limit the high-risk exposure. Another important thing is exercise, again you do not need to be an Olympic Athlete, just get out there, participate, and make it fun, if you have fun you will continue to play and that is the key. The best way to achieve success, whether diet or exercise is to design a reasonable plan and stick to it. If you do this, you will stay Younger both physically and mentally.

I often talk about the health problems associated with obesity, but one of the key problems in reports of obesity is that very few of us, consider ourselves as obese. Let's face it; the term obese is one of those terms that conjure up dramatic images. The truth is the word obese means different things to different people. It's better to talk about easier ways to measure weight, like being ten percent over ideal body weight, that's ten pounds more for every one hundred pounds. The reason we worry about obesity and weight loss, is because a wide variety of chronic conditions, like heart disease, stroke, and even certain forms of cancer can be linked to poor diet and being overweight.

There are many obstacles to successful vaccination of children. One of the biggest obstacles is whether mothers of children buy into the concept and that is a big issue. If your children are going to be vaccinated, you have to understand what the purpose of them is. I think a lot of this has to do with physicians explaining the reasons for vaccinations. It's very important that you can talk to your doctor, about the pros and cons of the wide variety of vaccinations that your child will receive. There are many serious medical diseases that have been all but eradicated due to vaccinations, making it easy to forget why it is important to get them. This year, there is the added talk surrounding H1N1 and the vaccine reduces the chance of getting the sever form of this flu. More than ever, it is a good time to communicate with your family physician or pediatrician about vaccines.

There are many causes of injury around the house, and they can be the result of a wide variety of seemingly harmless things, for instance, injuries from bunk beds sent an estimated 36,000 Americans aged 21 and under to the emergency department each year. Half of the injuries were in Younger children under the age of six. The study, which looked at bunk bed injuries between 1990 and 2005, determined that falls were the most common problem. Falls accounted for more than 70% of injuries, including those that were alcohol related. Overall males were more likely than females to be injured. Nearly 94% of bunk bed injuries occur at home. Cots are the most common injuries. If you have bunk beds in your house for the children, make sure there is a safety barrier to prevent falls.

Appendix D.

Transcript 2

Sections from BrainReady.com's Braincast were used for Session 3.

Brainready.com Braincast Episode 10

START

Spell the word FABULOUS.

Now spell the word CANDY backwards.

What shoes did you wear yesterday?

What is 75/3?

What is 75/25?

What does a banana smell like burning on fire?

What does a carrot smell like burning?

Use the word mesmerized in sentence.

Spell mesmerized.

What is the sum of the following equation?

1+1+2+2+3+3+9

21?

How many letters are in your mother's maiden or original last name?

Name a food that cats love to eat.

What do dogs love to eat?

What do birds love to eat?

How about a food that cats love but dogs and birds not as much?

Memorize the following number 4738536

Got it? Now say it? Did you say 4738536?

Good. Now memorize 824738536

Got it? Say it now. Did you say 824738356?

Now add one more element. 824738536011. We're just adding an -011 at the end.

Did you say 824738536011?

What is…….

13-5=?

9+0=?

2*6=?

7+3=?

8-1=?

7*7=?

11-5=?

8*6=?

5+8=?

1*6=?

3+4=?

12-8=?

6+6=?

7*4=?

12-3=?

4-1=?

3+2=?

8+7=?

7-2=?

5*3=?

14-9=?

7+5=?

1+3=?

5+8=?

9*4=?

4-3=?

3+9=?

7*5=?

6+7=?

9*2=?

5+1=?

13-5=?

7*9=?

10-1=?

6*6=?

2+8=?

7+4=?

12-3=?

4*6=?

9-0=?

4*3=?

2+9=?

2+5=?

9*3=?

8+7=?

8-1=?

4+2=?

4+3=?

5-5=?

9*4=?

5*3=?

4+9=?

2*5=?

16-8=?

1+8=?

3*3=?

7+4=?

6-2=?

7*5=?

15-9=?

2+3=?

13-5=?

9*8=?

6+4=?

7*3=?

4-3=?

1+6=?

11-5=?

2*1=?

9+2=?

4*3=?

6+9=?

3*8=?

7+6=?

3-1=?

12-5=?

6+7=?

5*8=?

2+9=?

12-7=?

6*4=?

4-2=?

2+5=?

7+2=?

8-5=?

Chapter 8 of 11 Logic and Memory Exercise (Length 3:39 min)

1. There are 30 elk in a herd, 13 are black, 12 are red and the rest are white. How many white elk are there? Question repeats.

    a. Well the correct answer is 5.

2. Which is further; the distance from Paris to London or the distance from the ground at sea level to the ozone layer of the earth's atmosphere? Question repeats.

    a. It may surprise you that the ozone starts at about 10 miles up from the earth's surface and extends to thirty miles whereas London is 210 miles from Paris, therefore the Paris to London distance is further.

3. Who do you suppose might make a better coal miner? A claustrophobe or an agoraphobe? Question repeats.

    a. The answer would be the agoraphobe as the claustrophobe is afraid of small places like coalmines and the agoraphobe is scared of very large open places.

4. A café Au Lait has half milk and half coffee. A latte has 3/4 milk and 1/4 coffee. Which one has more milk, an 8-ounce latte or a 16-ounce cafe Au Lait? Question repeats.

a. The correct answer is the Café Au Lait, as it has 8 ounces of milk and the latte has 6 oz of milk.

5. Two boats are participating in a river race, which lasts 50 miles. The rivers current is 5 mph throughout and they are racing downstream. Both boats have the exact same speed. The first boat has gas for 30 miles and the second boat has gas for 45 miles. Who will win the race? Question repeats.

    a. The second boat will win having passed the first boat at the 30-mile mark and drifting downstream for the last 5 miles.

Chapter 9 of 11 Follow the Number (Length 1:54 min)

Follow the number. Try to keep solving the running equation in your head. The goal is to try to keep up. Ready, here we go.

3+11

-4

*2

+5

/1

-10

*2

Did you answer 30?

4+1

-5

+12

/2

*3

+2

-10

Did you answer 10?

14-8

*2

+3

-6

*3

+3

-5

*1

The correct answer is 25.