Effect of Activities Involving Digital Devices on Visual Reaction Time

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Introduction

- 6 million vehicle accidents per year
  - **42,795 deaths**
  - 44% are youth, ages 15-19
  - Main cause: **Distracted Driving**
- Current laws prohibit texting while driving
- No regulation on other uses of smartphones or digital devices while driving

Driving and texting

Driving and browsing social media

Introduction

- 60,000 pedestrian injuries in 2021
  - Highest number in 20 yrs
  - **7,388 deaths**
  - Main causes:
    - Jaywalking, running in front of vehicles, playing in the road and **distracted walking**
- No regulation on texting or other uses of smartphones while crossing traffic intersections.

Distracted walking while using a smartphone

Problem Statement

- Activities that involve the use of **digital devices** represent **distractions** that may **increase the reaction time** to visual stimuli.
- With smartphones becoming ubiquitous, accessing social media, using apps, taking digital videos and texting, are becoming activities of daily life, and may affect a person's reaction time during driving or walking in urban areas.
- The brain needs processing power and the ability to focus on performing one activity at a time. The reaction time to a new visual stimulus may be significantly prolonged if the brain is engaged in another activity.

Methodology

- 12 subjects, ages 15-18

- 6 Conditions:
  1. No distraction (Control)
  2. Counting backwards from 20
  3. Listening to music (The Beatles' 'Let It Be')
  4. Texting (each subject's name, repeatedly)
  5. Browsing Social Media's feed
  6. Taking a video selfie

- Materials:
  - iPhone 10
    - music, texting, social media and camera
  - Headphones
  - 115-cm wooden ruler
  - Table

Methodology

- Reaction Time (RT) of each subject calculated under each Condition
  - Dropped ruler method
  - Positions of hand and smartphone were fixed
  - Capture point (CP) of the ruler in cm converted to RT in msec
    - Formula: $[2 \times CP / 981\ sec^2] \times 1000$
- 12 RT measurements for each activity Condition in each of 12 subjects
- Average RT for each of 6 Conditions:
  - Individual (12 measurements)
  - Group (12 subjects, 144 total measurements)

1. Not Distracted
2. Counting backwards

3. Listening to music

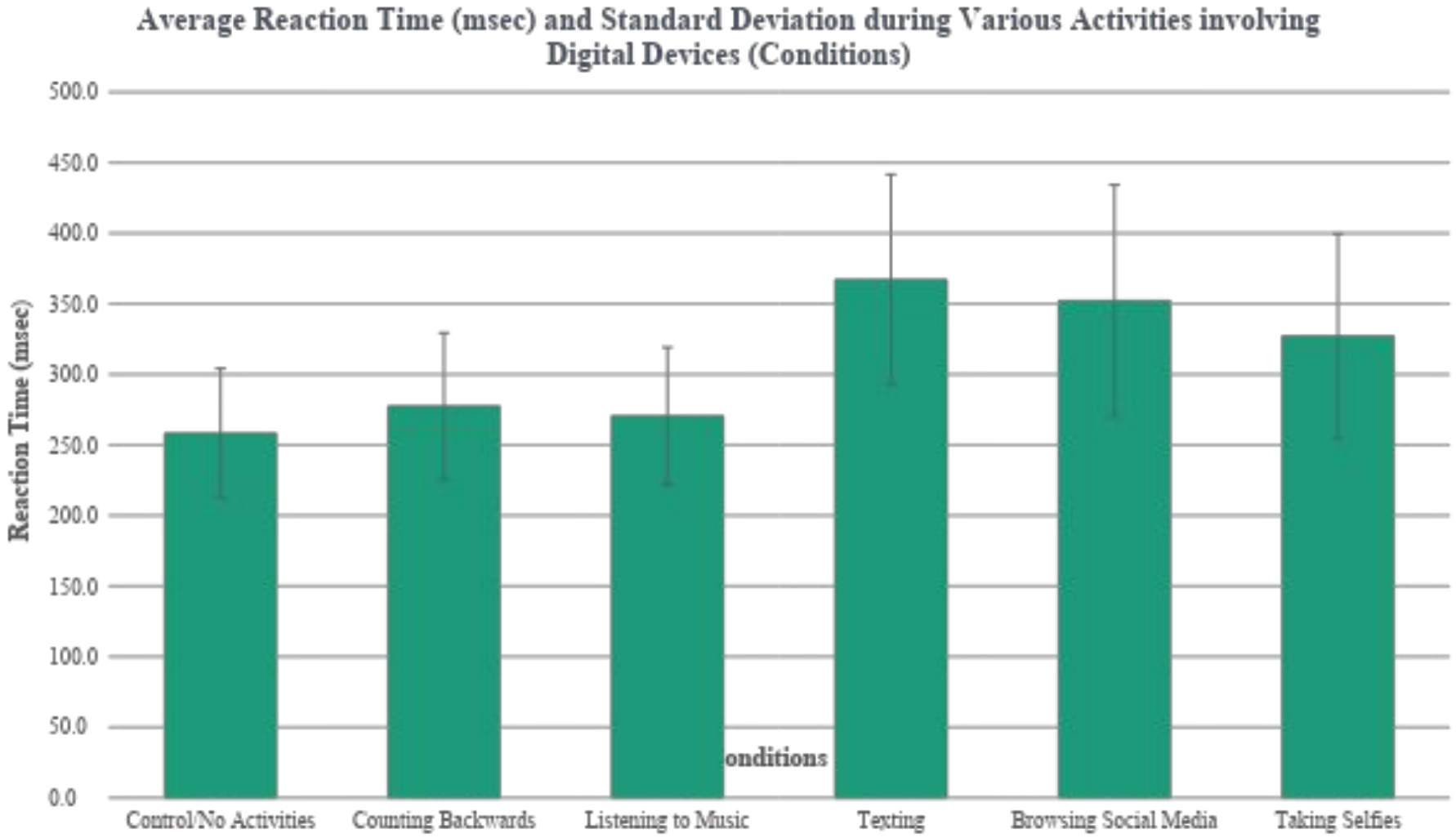
4. Texting
5. Browsing social media

6. Taking a video selfie

Results

- Data shows a difference in the Reaction Time to visual stimuli while performing various activities using the smartphone.
- Texting showed the longest average reaction time (367 msec), and the shortest reaction time was seen with No Distraction, or Control (258 msec)
- Social Media browsing showed the second longest reaction time (352 msec)

Results


Average Reaction Time (msec) and Standard Deviation during Various Activities involving Digital Devices (Conditions)
Reaction Time (msec)
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
onditions
Control/No Activities
Counting Backwards
Listening to Music
Texting
Browsing Social Media
Taking Selfies

Results

- Statistical analysis showed high statistically significant difference in the Reaction Time between each pair of conditions, except for:
  - Listening to Music & Counting Backwards
- The Reaction Time (RT) under No Distraction (Control) condition was significantly lower than under each of the other 5 conditions with any distractions.
- Texting resulted in the longest delay of any distractions.

Results

Student's t-test 2-tails paired (p-value)

	Control	Counting backwards	Music	Texting	Social Media
Counting backwards	4.82E-05				
Listening to music	3.40E-03	1.56E-01			
Texting	1.53E-35	1.68E-28	2.79E-32		
Social Media	6.43E-24	8.11E-18	2.42E-20	6.11E-02	
Taking a selfie	1.52E-20	2.38E-12	7.62E-16	3.97E-08	2.17E-03

Red p-values indicating statistically significant difference between paired groups of conditions ($p<0.05$)

Discussion

- **Counting** backwards and listening to **music** had the **least increase in RT**, after Control, while each value was significantly greater than Control.
  - It may be prudent to exert additional caution while driving and listening to music or performing computational mental activities (counting, possibly business or work-related calls, among others).

- **Texting** and **social media** browsing showed the **greatest increase in RT**, at 367 and 352 msec, respectively, with no statistically significant difference between the two ($p=0.0611$).
  - The study data may be helpful to support new laws that include a broader restriction on smartphone use while driving, such as browsing social media, in addition to the existing restrictions on texting.

- **Selfie**-taking showed a significant **increase in RT**, compared to Control.
  - Though RT was not as high as for texting, the value is significantly higher than for Control, and activities involving selfie-taking or video-calling should be avoided while driving.

Discussion

- The human brain has the ability to process and perform multiple activities at a time. However, ‘multi-tasking’ is not a safe practice while driving or crossing a road. When engaged in one activity, the human brain has reduced capacity to react to a second, sudden stimulus.
- Legal restrictions on smartphone use while driving already include texting. Based on our findings, consideration should be given to prohibiting social media use while driving.
- Advocacy for laws that limit the use of smartphones and other digital devices on crossroads and critical pedestrian areas may be warranted based on the study results and given the importance of high alertness when crossing streets.

Conclusion

Texting and Browsing Social Media are activities associated with
a significant increase in visual reaction time,
and could potentially lead to traffic- and pedestrian-related accidents,
based on the reduced ability to provide a quick response
to sudden stimuli.

References

https://www.nhtsa.gov/press-releases/traffic-crash-death-estimates-2022

https://www.cdc.gov/transportationsafety/distracted_driving/index.html

https://www.cnn.com/2020/02/03/health/texting-pedestrian-safety-study-wellness-scli-intl/index.html

https://www.nhtsa.gov/road-safety/pedestrian-safety

https://www.forbes.com/advisor/legal/auto-accident/distracted-driving-statistics/

Syed Muhammad UmairArif, Michele Brizzi, Marco Carli, Federica Battisti. Human reaction time in a mixed reality environment. Frontiers in Neuroscience, 19 August 2022, Sec. Perception Science. Volume 16 – 2022

Sternberg, S. et al. Reaction Time Experimentation. Psychology Journal, March 2010