The Hidden Cost of a Smartphone: Behavioral and neural correlates of attention and cognitive control related to smartphone distraction.

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Smartphones and Cognitive Control?

- Heavy smartphone users show impaired attention, cognitive processing, frontal cortex excitability.[1]
- Frontocentral N2 implicated in cognitive control.[2]
- Frontocentral P2 reflect early attention processes.[3]
- Smaller N2 after smartphone sounds.[4]

Goals of the Study

- **Measure cognitive control using the Oddball Effect (RT & N2 ERPs)**
- **Do smartphone notifications affect cognitive control and attention?**
- **Do these effects differ for people high or low in smartphone addiction?**

Methods & Procedure

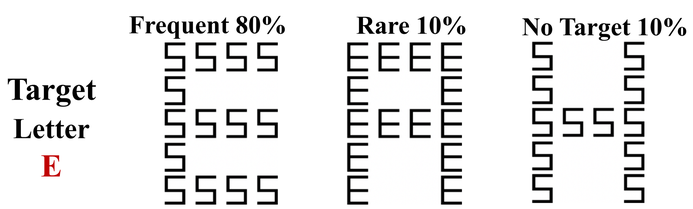
RT: N = 69 (Age = 19.76, 52% Female, 80% White)
ERP: N = 54 (Age = 19.96, 56% Female, 83% White)

Smartphone Addiction Proneness Scale (SAPS)[5]

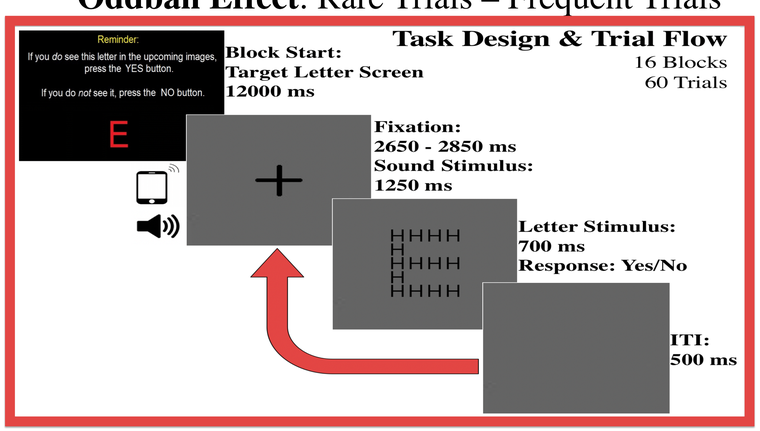
15-item scale: (1(Disagree) - 4 (Agree)) four factors.

- Disturbance of functions - "My school grades dropped"
- Virtual life orientation - "I lost the entire world."
- Withdrawal - "It would be painful"
- Tolerance - "try cutting my usage time, but fail."

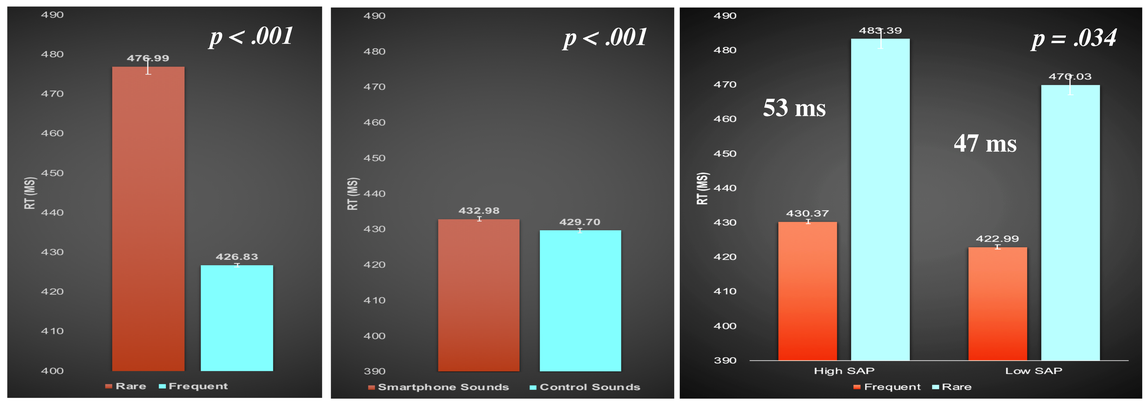
Local/Global Navon Letter Oddball Task[6]



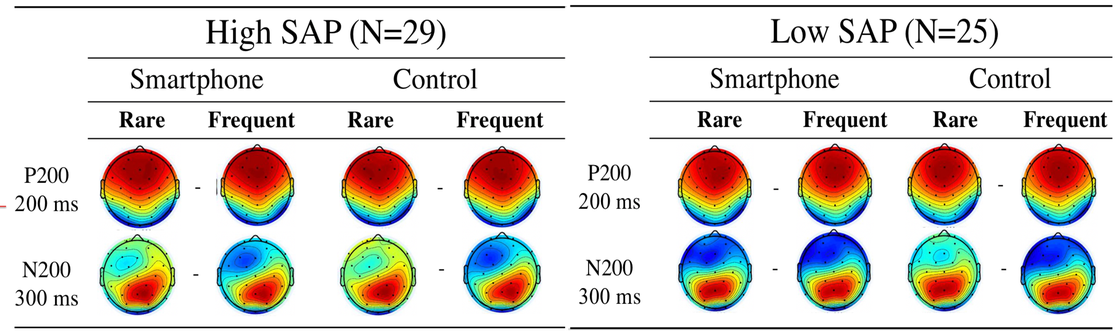
Oddball Effect: Rare Trials – Frequent Trials

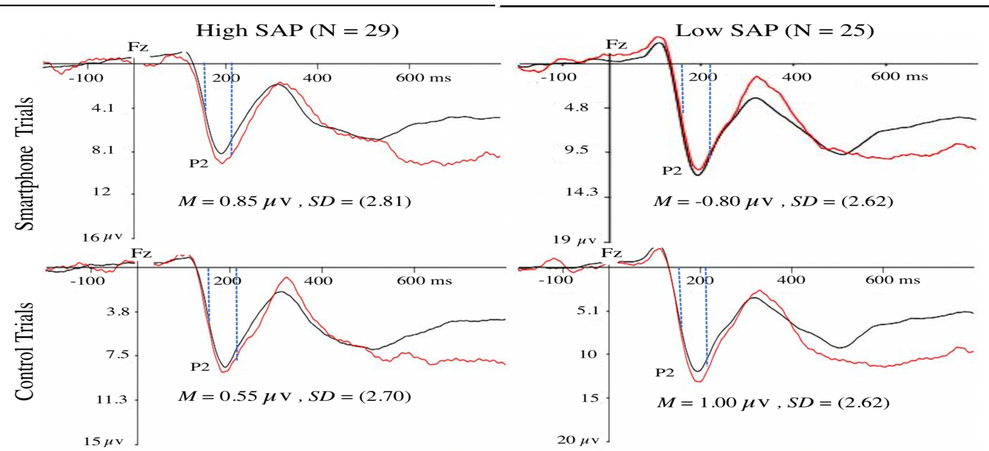


Reaction Time Results



ERP Results





	High SAPS (n = 29)	Low SAPS (n = 25)			
	Mean (SD)	Mean (SD)	*t*	*p*	*d*
P200 at Fz	7.46 μv (3.13)	10.07 μv (3.91)	2.72	.009	.74
N200 at F3	3.44 μv (3.26)	5.00 μv (3.64)	1.84	.104	.45
P2 OE	0.70 μv (1.85)	0.11 μv (1.70)	-1.22	.228	.33
N2 OE	0.19 μv (2.20)	-0.57 μv (1.80)	-1.37	.176	.37
P2 Smartphone	7.44 μv (3.27)	9.60 μv (4.10)	2.24	.029	.58
P2 Control	7.48 μv (3.20)	10.53 μv (3.89)	2.72	.008	.86
N2 Smartphone	3.27 μv (3.11)	4.71 μv (3.57)	1.52	.135	.43
N2 Control	3.62 μv (3.61)	5.29 μv (3.85)	1.84	.098	.45
	OE Difference	OE Difference			
P2	0.30 μv	-1.81 μv	2.13	.035	.41
N2	-0.65 μv	-1.45 μv	0.81	.419	.43

Conclusions

- An overall Oddball Effect was found.
- Overall, people responded slower on trials with smartphone sounds vs control sounds.
- For RT, cognitive control was worse for people higher in SAP.
- P2 (early attention) overall was smaller for people higher in SAP regardless of the sound played.
- For P2, the oddball effect was smaller for people higher in SAP
- N2 did not differ by SAP

Smartphone notifications delayed reaction time for everyone. People more addicted to their devices had worse cognitive control and attention when they heard smartphone notifications.

Limitations & Future Directions

- Non-jittered ITI for auditory ERPs
- Non-sound condition
- Objective measure of smartphone use
- Improve ecological validity of lab based EEG studies with virtual reality
- Introduce attention training paradigms such as mindfulness interventions

References

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