The Hidden Cost of a Smartphone: Behavioral and neural correlates of attention and cognitive control related to smartphone distraction. Joshua D. Upshaw¹, Carl E. Stevens, Jr.¹, Giogio Ganis², & Darya Zabelina¹



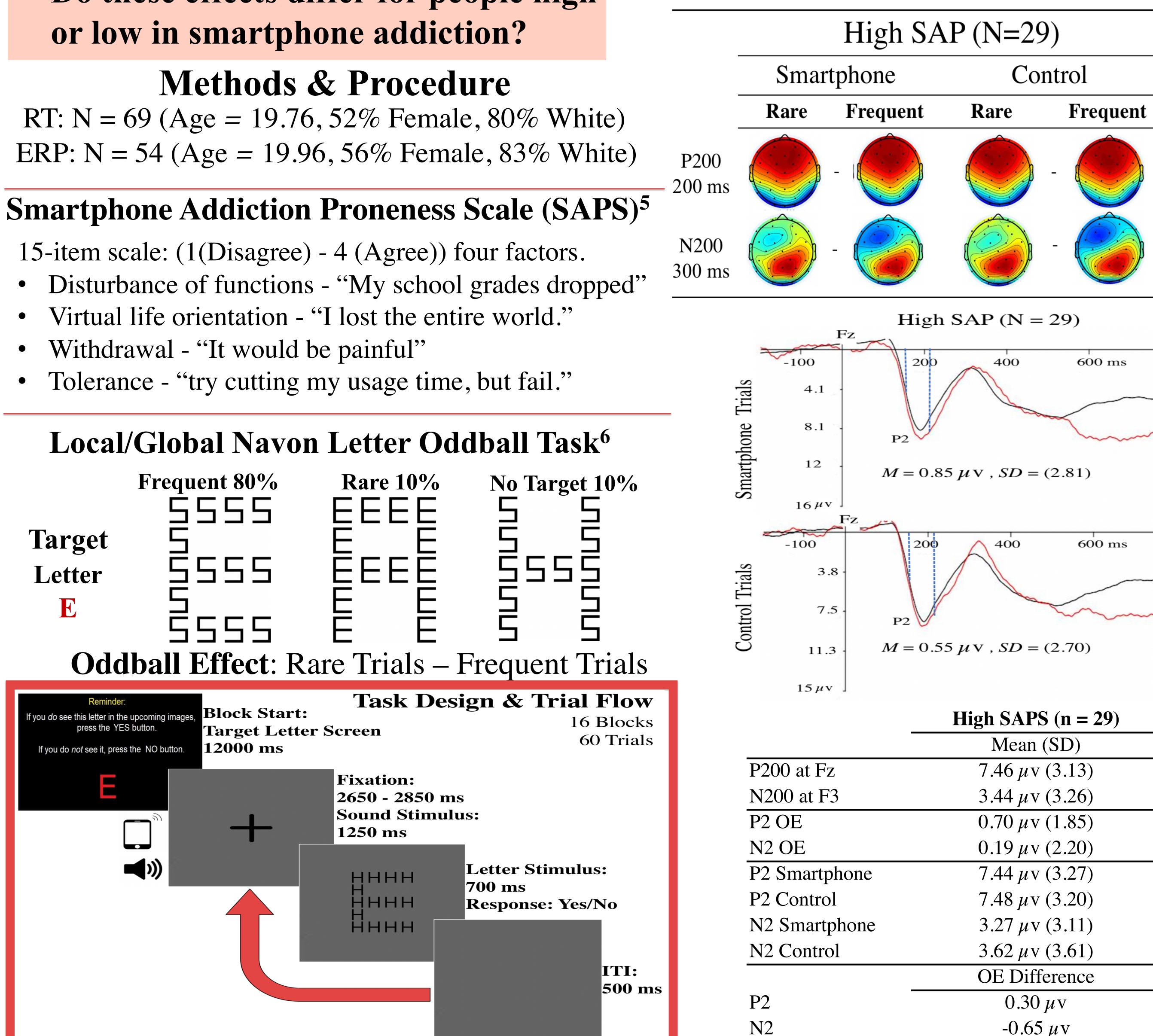
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Smartphones and Cognitive Control?

- 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

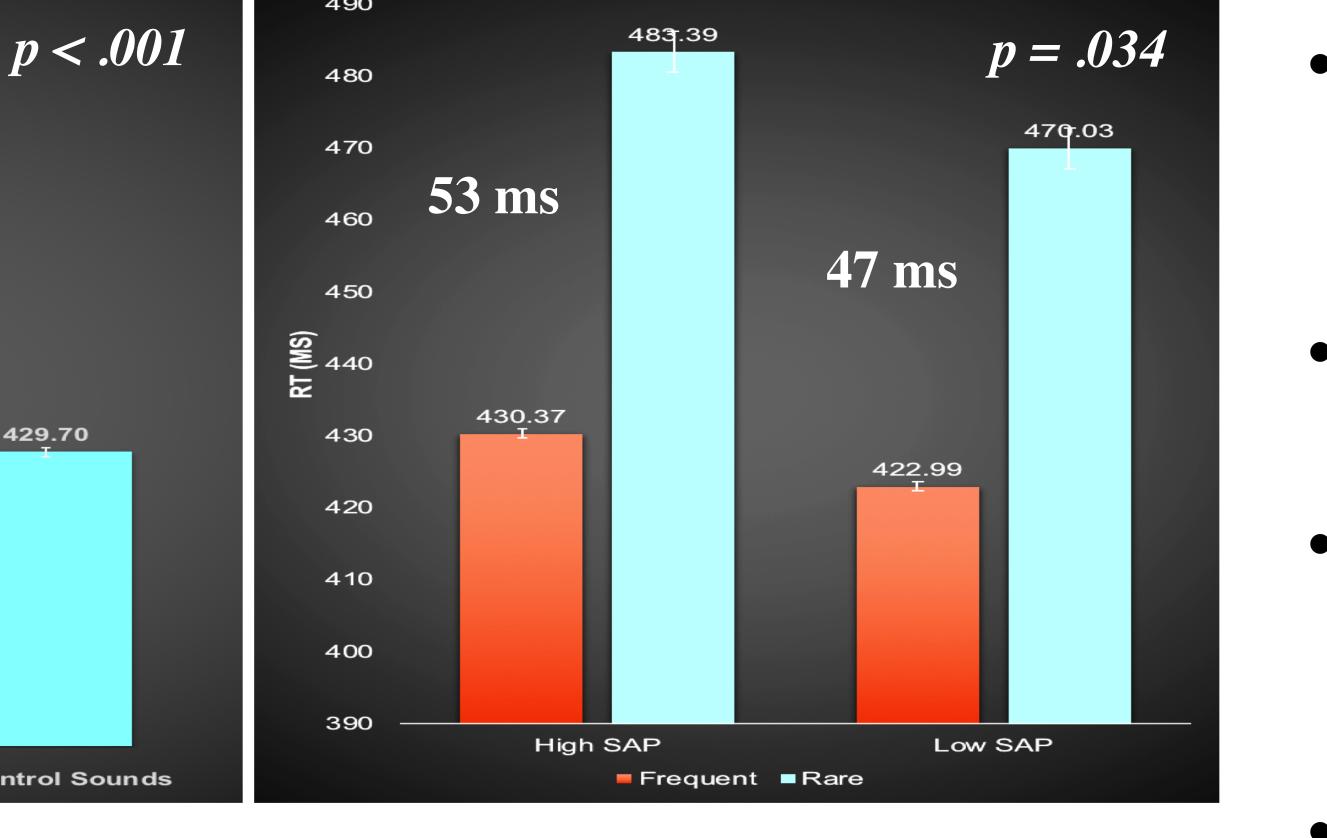
Goals of the Study

- 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?



Reaction Time Results *p < .001 p* < .001 470 470 460 460 450 450 (**SW**) 440 (SW) 440 432.98 429.70 430 430 430 420 426.83 420 420 410 410 400 410 400 390 Rare Frequent

 $-0.65 \,\mu v$



ERP Results

Resu	lts			
	Ι	Low SAP	(N=25	5)
_	Smartphone		Control	
_	Rare	Frequent	Rare	Frequen
P200 200 ms	-			
N200 00 ms	-			-
	Fz A	v SAP (N =	= 25)	
-100 4.8 9.5	200	400	600 1	ns
14	$\begin{array}{c c} P2 \lor \\ .3 \end{array} \\ M = -0 \end{array}$.80 μv , SD =	= (2.62)	
19 µ	v J Fz			
	.1 0 P2	400	600 m	ns
1	M = 1	.00 μv , SD =	(2.62)	
20 µ				
	$\frac{\text{SAPS (n = 25)}}{\text{Aean (SD)}}$)	p	А
	1000000000000000000000000000000000000	2.72	.009	.74
	$00 \mu v (3.64)$	1.84	.104	.45
0.1	$1 \mu v (1.70)$	-1.22	.228	.33
-0.5	57 μv (1.80)	-1.37	.176	.37
	60 μv (4.10)	2.24	.029	.58
	53 µv (3.89)	2.72	.008	.86
	$^{\prime}1 \mu v (3.57)$	1.52	.135	.43
	$\frac{29 \mu v (3.85)}{1000000000000000000000000000000000000$	1.84	.098	.45
	E Difference		025	<i>/</i> 1
	-1.81 µv	2.13	.035	.41
	-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 eaction time for everyone. People nore 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

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