

The Neuroeconomics of Tobacco Demand:

An Initial Investigation of the Neural Correlates of Cigarette Cost-Benefit Decision Making in Male Smokers

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Supplementary Materials

1. Supplementary Figures

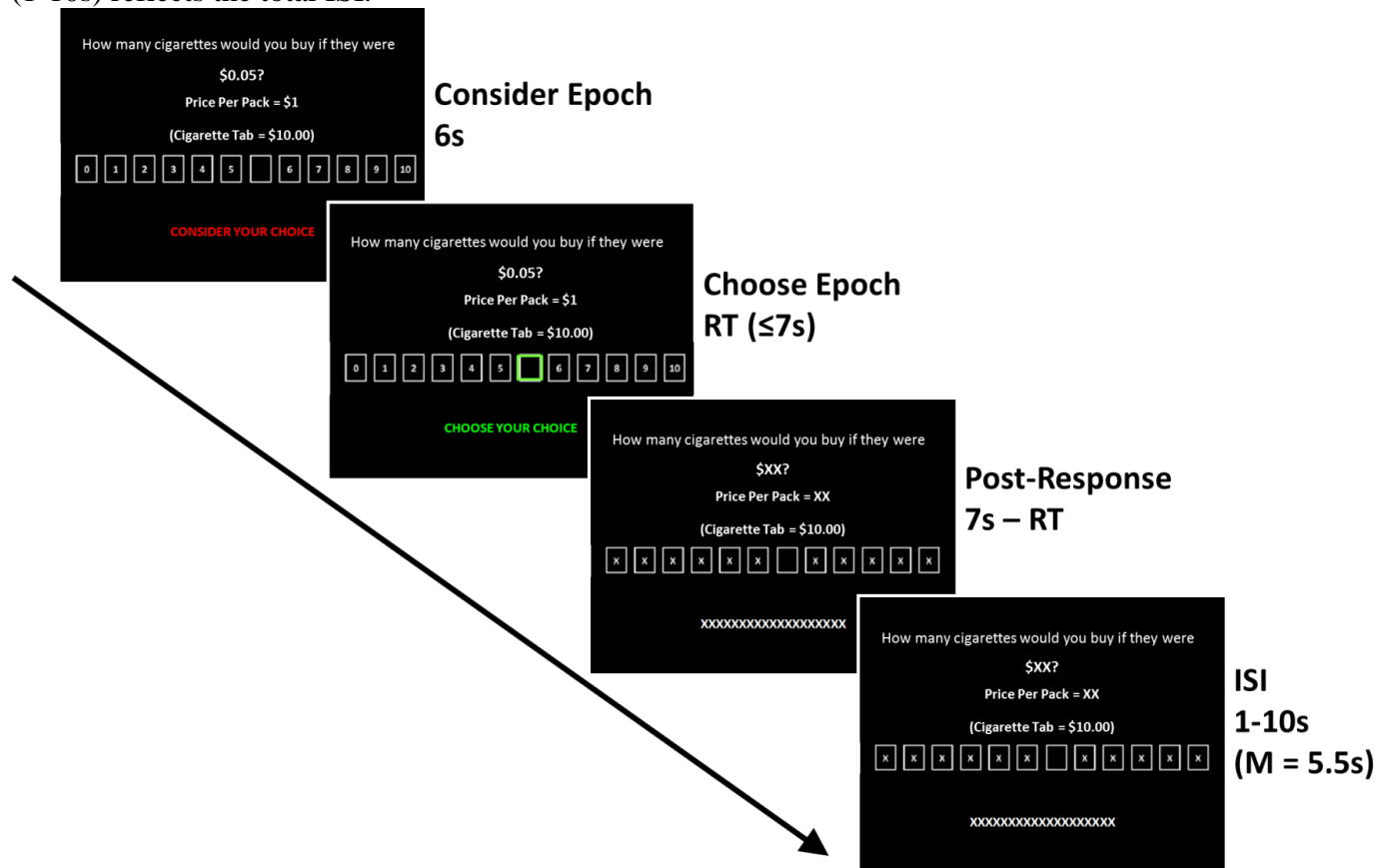
- a. Supplementary Figure 1. Schematic of the Cigarette Purchase Task (CPT) paradigm.
- b. Supplementary Figure 2. Voxel-wise contrasts of each choice condition (Inelastic, Elastic, Suppressed) to visually-matched rest during the *Consider* epoch.
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2. Supplementary Tables

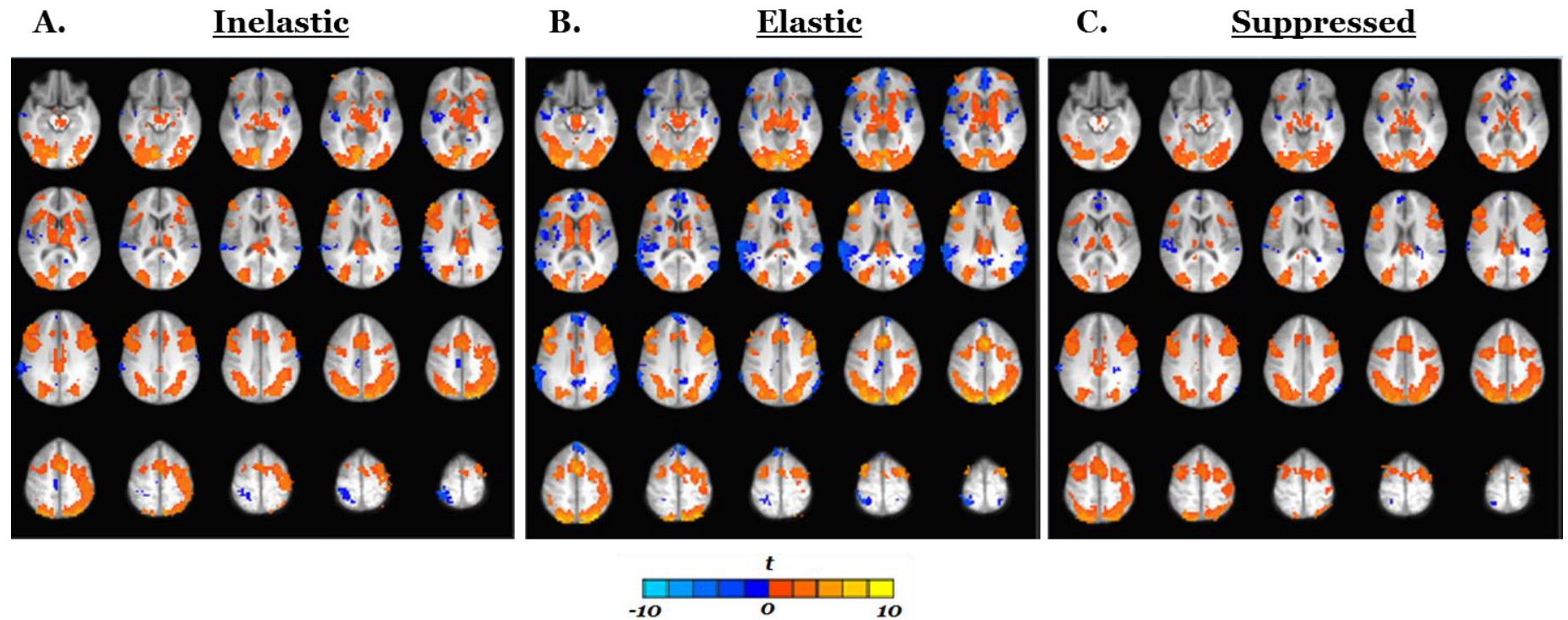
- a. Supplementary Table 1. Cigarette Purchase Task fMRI paradigm price sequences.
- b. Supplementary Table 2. *Consider* epoch ROIs revealing differential activation by choice type.
- c. Supplementary Table 3. *Choose* epoch ROIs revealing differential activation by choice type.

1. Supplementary Figures

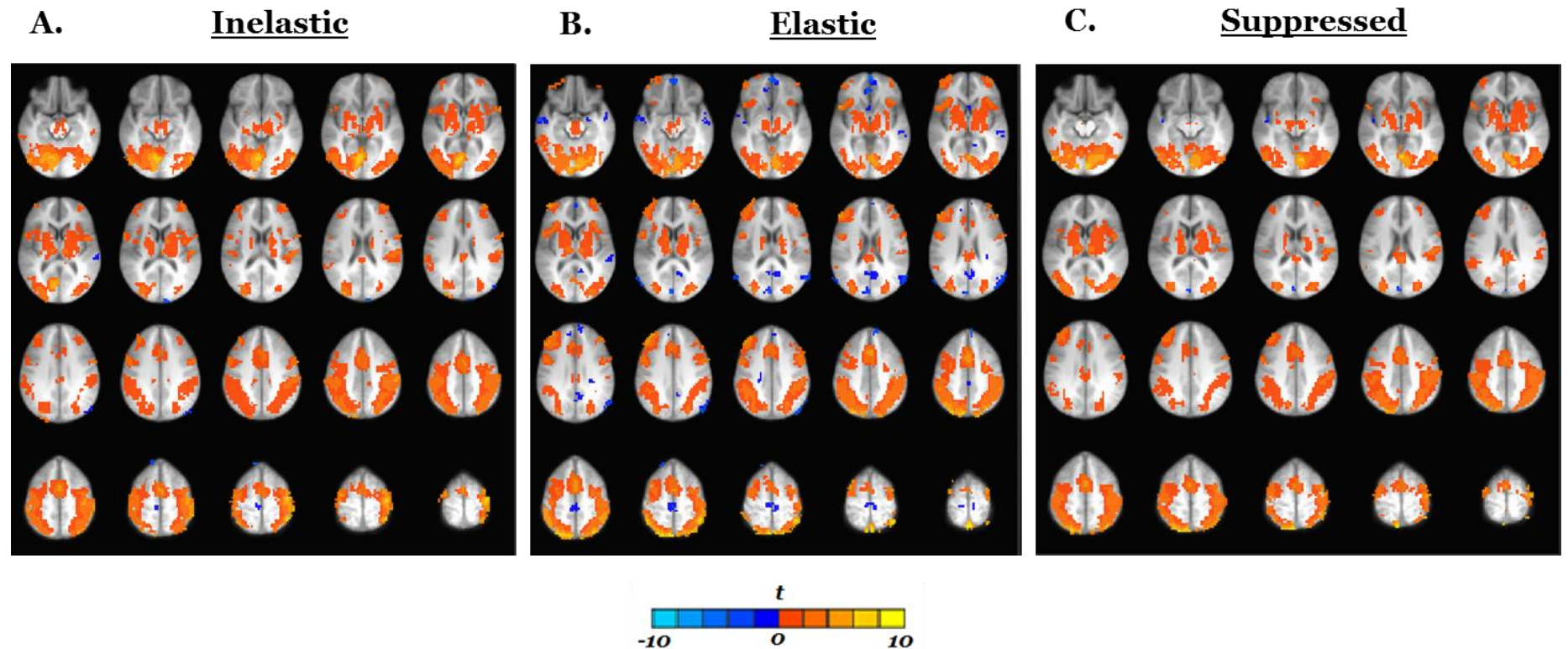
Supplementary Figure 1. Schematic of the Cigarette Purchase Task (CPT) paradigm. Participants selected how many cigarettes they would consume (0-10) at varying levels of price (\$0-\$10/cigarette). During each decision, paradigm used two epochs, a fixed duration *Consider* epoch during which the participant was asked to consider their preference and a variable duration *Choose* epoch during which participants entered their preference. Following the response, the *Choose* epoch terminated and reverted to the rest stimulus, hence the variable duration. The paradigm used an active rest stimulus with all the visual properties of the active trials and jittered interstimulus interval (ISI) consisting of the rest stimulus for the residual time remaining in the *Choose* epoch plus an additional rest period of variable duration. RT = response time. The latter two panels in the schematic are identical and the combination of post-response (7s – RT) and ISI (1-10s) reflects the total ISI.



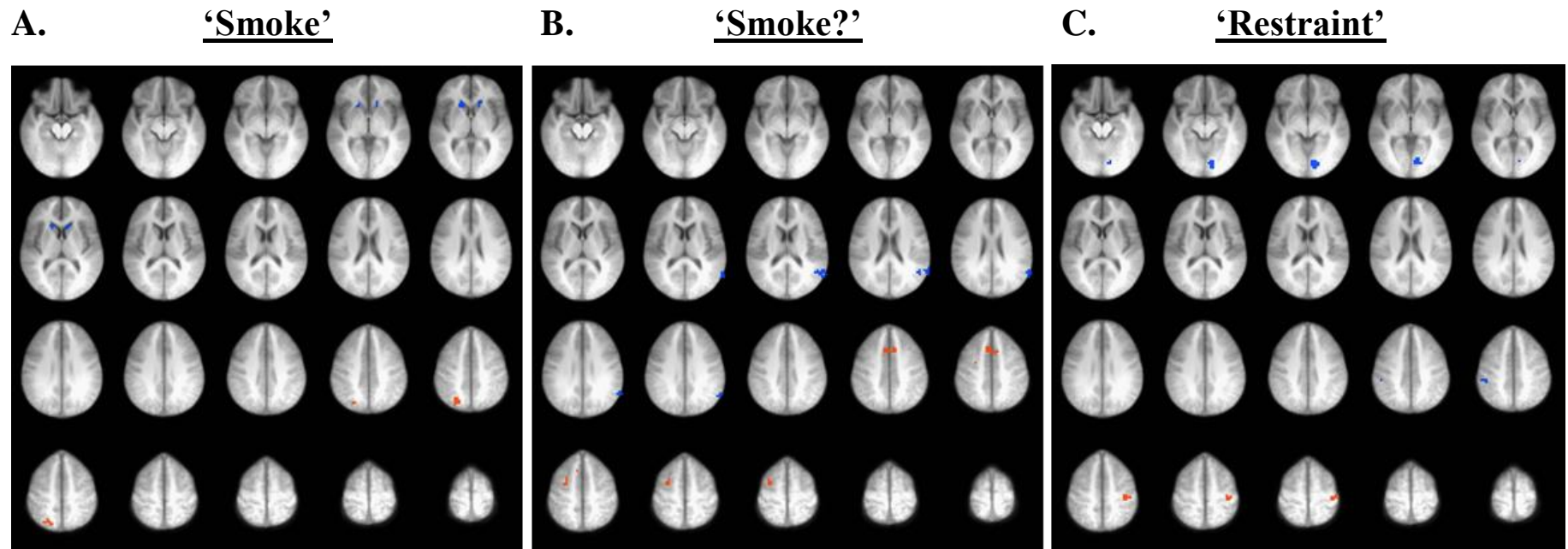
Supplementary Figure 2. Voxel-wise contrasts of each choice condition (Inelastic, Elastic, Suppressed) to visually-matched rest stimuli during the *Consider* epoch. Contrasts are thresholded at $p < .0001$ and cluster sizes of ≥ 5 voxels, reflecting an $\alpha < .05$. Panel A presents activation during Inelastic choices (i.e., the individual's maximum consumption choices). Panel B presents activation during Elastic choices (i.e., choices for less than maximum cigarettes, reflecting partial suppression of consumption by price). Panel C presents activation during Suppressed choices (i.e., zero consumption, reflecting price completely abolishing consumption).



Supplementary Figure 3. Voxel-wise contrasts of each choice condition (Inelastic, Elastic, Suppressed) to visually-matched rest during the *Choose* epoch. Contrasts are thresholded at $p < .0001$ and cluster sizes of ≥ 5 voxels, reflecting an $\alpha < .05$. Panel A presents activation during Inelastic choices (i.e., the individual's maximum consumption choices). Panel B presents activation during Elastic choices (i.e., choices for less than maximum cigarettes, reflecting partial suppression of consumption by price). Panel C presents activation during Suppressed choices (i.e., zero consumption, reflecting price completely abolishing consumption).



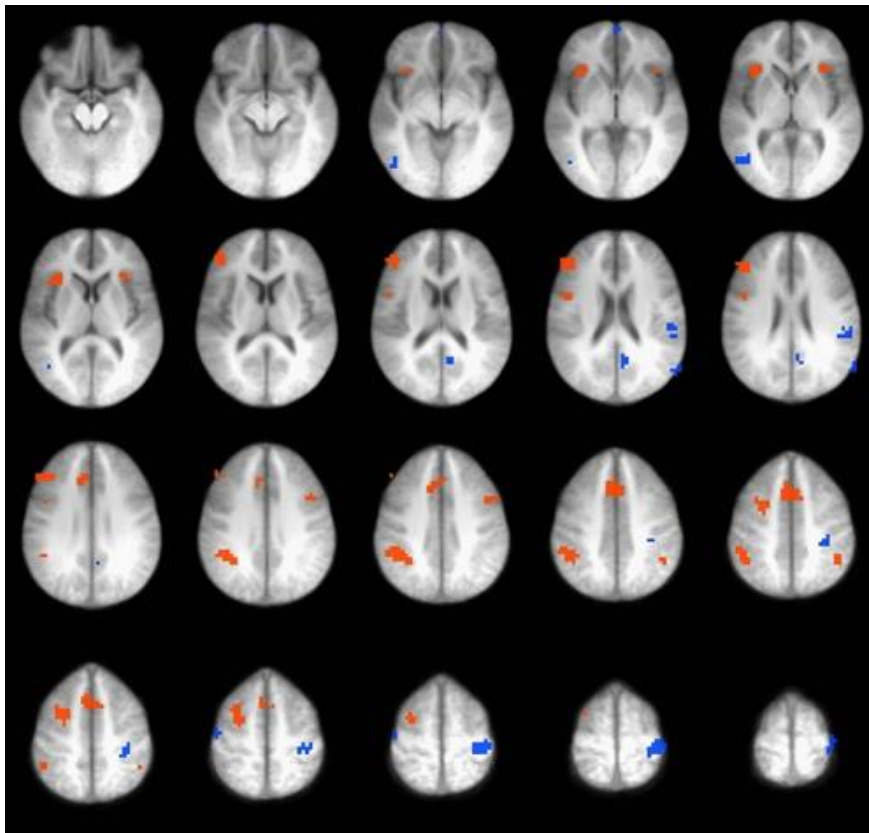
Supplementary Figure 4. Montage of *Consider* contrasts for ‘Smoke’, ‘Smoke?’ and ‘Restraint’ patterns. Panel A presents the ‘Smoke’ contrast (i.e., Inelastic/Elastic \neq Suppressed). Orange indicates Suppressed choices elicited significantly greater activity. Blue indicates Suppressed choices elicited significantly less activity. Panel B presents the ‘Smoke?’ contrast (i.e., Elastic \neq Inelastic/Suppressed). It also includes R MFG from ‘Distinct’ because the pattern of activation is comparable to the other ‘Smoke?’ regions. Orange indicates Elastic choices elicited significantly greater activity. Blue indicates Elastic choices elicited significantly greater deactivation. Panel C presents the ‘Restraint’ contrast (i.e., Inelastic \neq Elastic/Suppressed). Orange indicates Inelastic choices elicited significantly greater activity. Blue indicates Inelastic choices elicited significantly less activity.



Supplementary Figure 5. Montage of *Choose* contrasts for ‘Smoke?’ and ‘Restraint’ patterns. Panel A presents the ‘Smoke?’ contrast (i.e., Elastic \neq Inelastic/Suppressed). It also includes L MFG, L PCG, and R PCG from ‘Distinct’ because the pattern of activation is comparable to the other ‘Smoke?’ regions. Orange indicates Elastic choices elicited significantly greater activity. Blue indicates Elastic choices elicited significantly less activation or significantly greater deactivation. Panel B presents the ‘Restraint’ contrast (i.e., Inelastic \neq Elastic/Suppressed). Orange indicates Inelastic choices elicited significantly greater activity. Blue indicates Inelastic choices elicited significantly less activity.

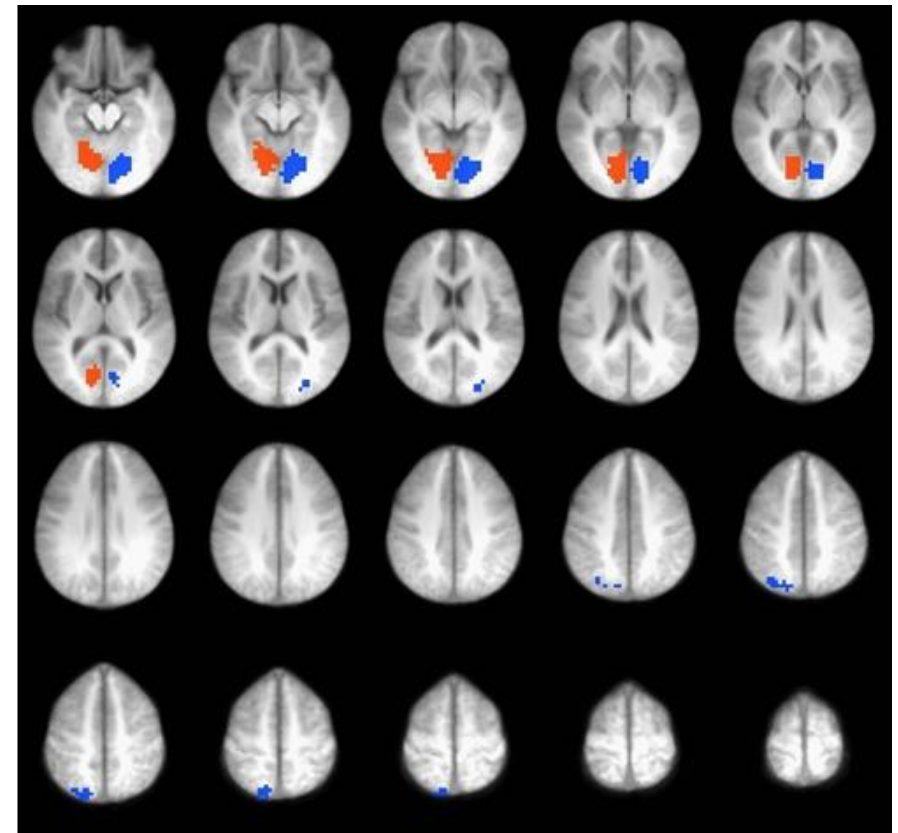
A.

‘Smoke?’

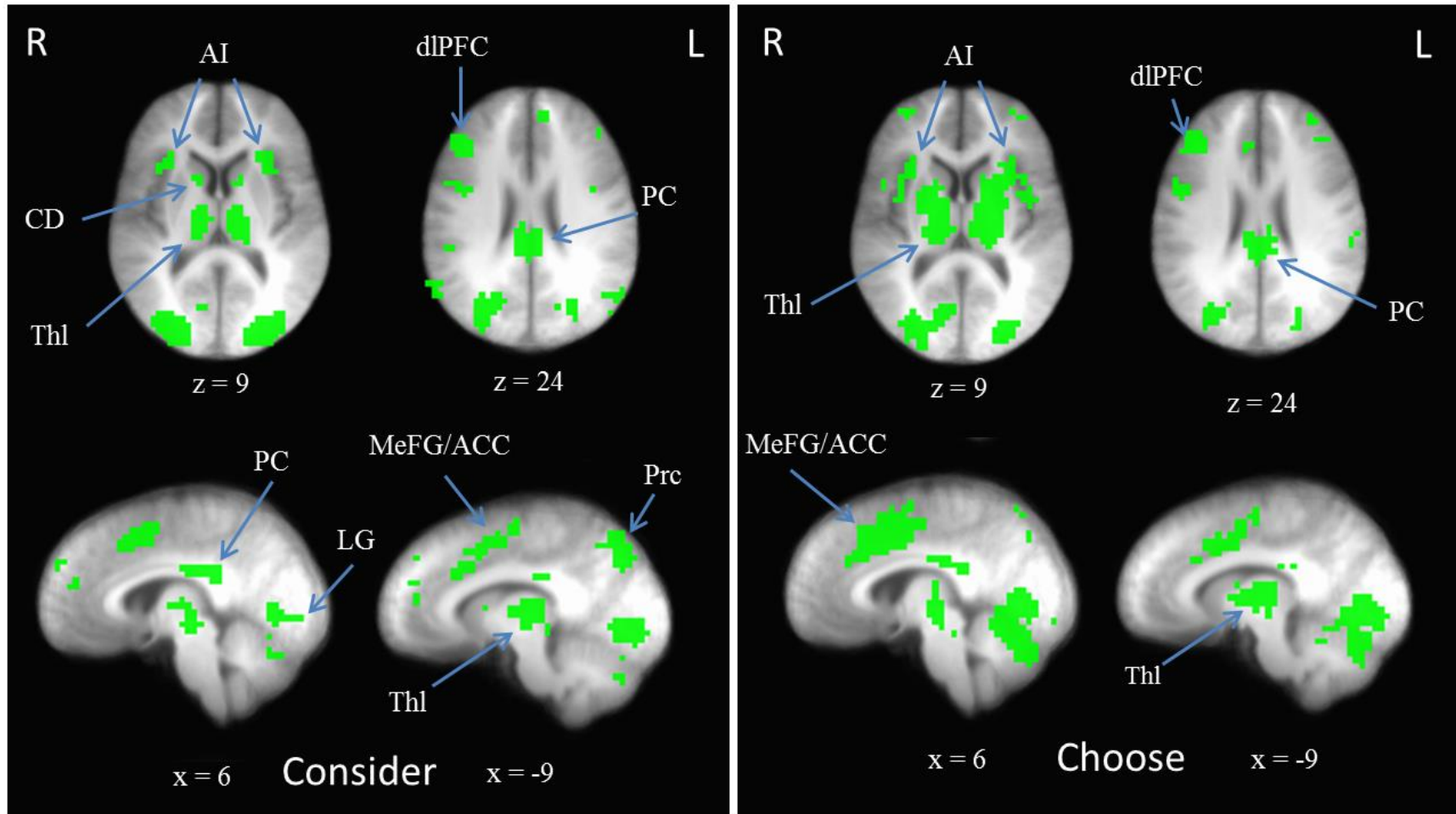


B.

‘Restraint’



Supplementary Figure 6. Conjunction masks of overlapping voxels between the Cigarette Purchase Task fMRI paradigm and the Alcohol Purchase Task fMRI paradigm during the *Consider* (left) and *Choose* (right) epochs ($N = 59$; $p < .0001$, minimum cluster size = 5 voxels). Radiological conventions are used and side of brain is indicated by R or L (right, left). AI = anterior insula; CD = caudate; Thl = thalamus; dlPFC = dorsolateral prefrontal cortex; MeFG = medial frontal gyrus; ACC = anterior cingulate cortex; PC = posterior cingulate; Prc = precuneus; LG = lingual gyrus.



2. Supplementary Tables

Supplementary Table 1. Cigarette Purchase Task fMRI paradigm price sequences.

Trial #	Price per cigarette			
	Run 1	Run 2	Run 3	Run 4
1	\$0.01	\$0.04	\$0.40	\$0.14
2	\$0.05	\$0.20	\$2.50	\$0.04
3	\$0.15	\$0.01	\$0.10	\$0.21
4	\$0.25	\$0.40	\$0.00	\$0.29
5	\$0.50	\$0.10	\$0.09	\$0.34
6	\$2.50	\$0.30	\$0.15	\$1.00
7	\$0.22	\$0.21	\$0.25	\$0.02
8	\$0.02	\$0.26	\$0.34	\$0.19
9	\$2.00	\$0.35	\$10.00	\$0.24
10	\$0.28	\$2.00	\$0.10	\$0.22
11	\$5.00	\$0.00	\$0.28	\$0.35
12	\$0.19	\$2.50	\$0.35	\$0.01
13	\$0.00	\$0.14	\$0.26	\$0.50
14	\$5.00	\$0.22	\$0.02	\$2.00
15	\$0.40	\$0.29	\$0.19	\$0.30
16	\$0.09	\$0.50	\$0.30	\$10.00
17	\$0.20	\$1.00	\$0.23	\$0.05
18	\$0.24	\$0.04	\$0.14	\$0.00
19	\$0.34	\$0.05	\$0.20	\$0.09
20	\$0.26	\$0.23	\$0.29	\$0.15
21	\$1.00	\$0.24	\$0.28	\$0.25
22	\$0.21	\$10.00	\$5.00	\$0.23

Supplementary Table 2. Consider epoch ROIs revealing differential activation by choice type.

Voxel size (3.5 mm ³)	X	Y	Z	Region	<i>p</i>	INE vs. ELA <i>p</i>	INE vs. SUP <i>p</i>	ELA vs. SUP <i>p</i>
14	-16	-18.8	3.2	R caudate ('Smoke')	4.42E-6	.123	3.57E-4	9.56E-6
11	11.3	-19.7	3.3	L caudate ('Smoke')	4.76E-6	.110	1.89E-4	1.36E-5
19	-23.3	65.3	45.6	R superior parietal lobule ('Smoke')	3.77E-5	.055	3.08E-6	.017
29	-0.3	-15.7	42.6	BL medial frontal gyrus ('Smoke?')	4.15E-7	2.34E-5	.153	9.62E-5
6	29.8	59.3	-30.8	L cerebellar tonsil ('Smoke?')	4.76E-6	7.24E-6	.977	1.34E-4
46	55.7	54.4	20.3	L superior temporal gyrus ('Smoke?')	1.09E-8	4.97E-9	.358	2.64E-5
16	-27.6	1.4	51.6	R middle frontal gyrus ('Distinct')	3.78E-6	7.93E-6	.001	.047
35	10.1	74.5	-4.4	L lingual gyrus ('Restraint')	5.24E-7	3.37E-5	4.34E-6	.477
5	-46.5	33.2	44.3	R inferior parietal lobule ('Restraint')	1.72E-5	2.80E-4	1.75E-5	.846
20	37.5	25.8	51.7	L postcentral gyrus ('Restraint')	1.20E-5	3.53E-5	.001	.258

Supplementary Table 3. Choose epoch ROIs revealing differential activation by choice type.

Voxel size					INE vs. ELA	INE vs. SUP	ELA vs. SUP
(3.5 mm ³)	X	Y	Z	Region	<i>p</i>	<i>p</i>	<i>p</i>
54	-44.6	-33.5	21.5	R middle frontal gyrus ('Smoke?')	6.02E-7	1.22E-5	1.000
47	-28	-1.5	49.8	R middle frontal gyrus ('Smoke?')	9.86E-7	5.24E-5	.616
11	-46.3	-5	21.5	R inferior frontal gyrus ('Smoke?')	5.14E-6	2.56E-4	.723
30	-33.4	-19.8	3.2	R anterior insula ('Smoke?')	1.11E-5	5.92E-5	.883
12	30.6	-21.5	3.6	L anterior insula ('Smoke?')	2.36E-4	.001	.792
91	-3.2	-17.8	41.1	BL medial frontal gyrus/ anterior cingulate cortex ('Smoke?')	5.58E-7	3.02E-6	.773
84	-42.5	42.8	37.8	R inferior parietal lobule ('Smoke?')	2.18E-8	5.21E-6	.838
11	42.2	46.8	43.7	L inferior parietal lobule ('Smoke?')	4.81E-5	.001	.965
15	50.5	28.3	22.4	L inferior parietal lobule ('Smoke?')	1.37E-5	2.38E-5	.763
15	-44.5	62.6	1.1	R middle temporal gyrus ('Smoke?')	8.04E-6	2.61E-5	.283
9	55.8	62.8	22.1	L superior temporal gyrus ('Smoke?')	1.01E-6	3.82E-5	.263
14	6.5	54.5	20.8	L posterior cingulate cortex ('Smoke?')	3.91E-5	.004	.101
5	-1	-56.4	-2.6	BL medial frontal gyrus ('Smoke?')	1.40E-4	1.70E-5	.709
13	43.8	-9	34.2	L middle frontal gyrus ('Distinct')	8.91E-6	.004	.023
62	34.9	28.6	54.7	L postcentral gyrus ('Distinct')	1.01E-6	8.11E-7	.006
6	-45.5	15.6	53.2	R postcentral gyrus ('Distinct')	1.59E-5	1.50E-4	.012
255	-13.8	63	-6	R lingual gyrus ('Restraint')	1.12E-12	6.10E-9	1.87E-8
187	12.2	70.2	-6.6	L lingual gyrus ('Restraint')	1.82E-12	5.81E-10	2.39E-8
47	-19.5	69.6	48.2	R precuneus ('Restraint')	4.22E-7	1.40E-6	3.07E-4
14	23.8	77.8	13.8	L middle occipital gyrus ('Restraint')	3.17E-5	4.82E-4	4.95E-4