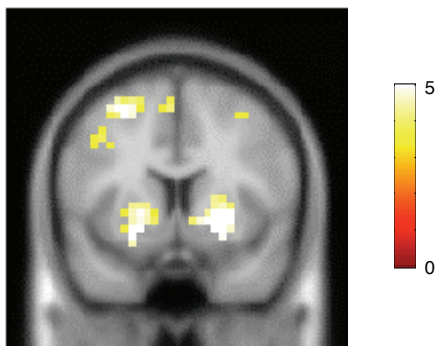


Supplementary Figure S1.

Neural response to TD error



Non-smokers
(N = 31)

Figure S1. Non-smokers' neural response to TD error. Individual subjects' experiential errors were computed as the ongoing difference between z- scored rewards already gained (\tilde{g}_t) and z- scored rewards expected (\tilde{b}_t), where the subjects' bets serve as a proxy for expected reward ($TD_t = \tilde{g}_t - \tilde{b}_t$). The thresholded SPM2 t-statistic map of the TD regressor indicates that the neural TD error signal is present in bilateral putamen of non-smokers ($p < .001$, uncorrected; cluster size ≥ 5 ; random effects analysis; $n = 31$ non-smokers from Lohrenz et al., 2007; $y = 8$).

Supplementary Figure S2.

a

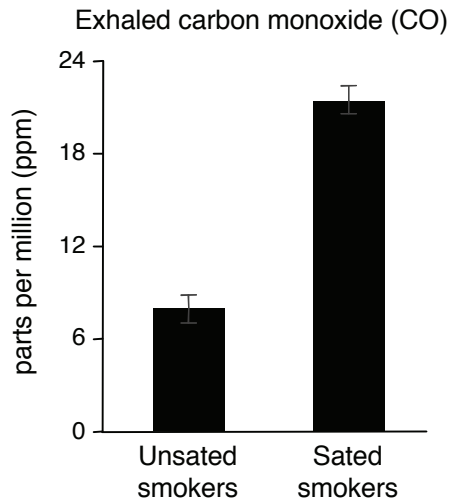


Figure S2a. Expired carbon monoxide (CO) in Unsated and Sated smokers. Upon arrival at the laboratory for both sessions, exhaled carbon monoxide was obtained as an objective assay of satiety and blood nicotine saturation in smokers (E50 Smokerlyzer, Bedford USA).

b

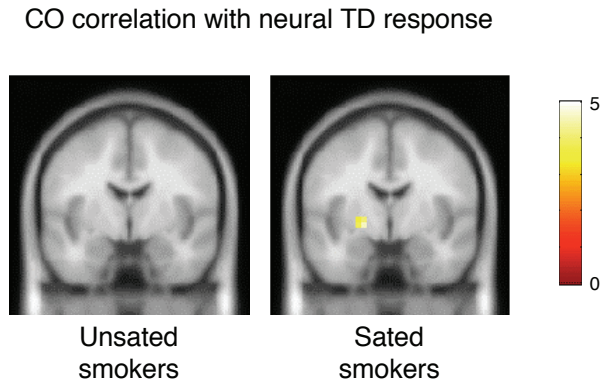


Figure S2b. Correlation of expired CO with neural response to TD error in smokers. Sated smokers show a significant correlation in left putamen ($p < 0.001$, uncorrected; cluster size ≥ 5) of neural TD effect size with expired CO level.

Supplementary Tables S1a and S1b

Table S1a.

Results of linear multiple regressions for key market and investment variables predicting subjects' next bets (df = 17661)

	Coefficient	Estimate	Std.Error	t-value	p-value
Nonsmokers (N = 31)					
<i>NONSMOKER</i>		-0.0477	0.0148	-3.235	0.0012
<i>NONSMOKER · \tilde{b}_t</i>		0.5476	0.0129	42.386	< .0001
<i>NONSMOKER · r^+</i>		5.6101	0.4134	13.570	< .0001
<i>NONSMOKER · r^-</i>		-2.0681	0.3756	-5.506	< .0001
<i>NONSMOKER · $b_t \cdot r^+$</i>		-3.7351	0.7995	-4.672	< .0001
<i>NONSMOKER · $b_t \cdot r^-$</i>		-1.3113	0.7358	-1.782	0.0747
Unsated smokers (N = 31)					
<i>UNSATD</i>		-0.0538	0.0147	-3.650	0.0003
<i>UNSATD · \tilde{b}_t</i>		0.5149	0.0125	41.212	< .0001
<i>UNSATD · r^+</i>		4.5393	0.3794	11.966	< .0001
<i>UNSATD · r^-</i>		-1.8944	0.3500	-5.413	< .0001
<i>UNSATD · $b_t \cdot r^+$</i>		-0.9627	0.8311	-1.158	0.2467
<i>UNSATD · $b_t \cdot r^-$</i>		-1.0849	0.7328	-1.481	0.1387
Sated smokers (N = 31)					
<i>SATED</i>		-0.0525	0.0148	-3.550	0.0004
<i>SATED · \tilde{b}_t</i>		0.4926	0.0126	39.232	< .0001
<i>SATED · r^+</i>		5.3522	0.3897	13.733	< .0001
<i>SATED · r^-</i>		-2.3010	0.3395	-6.778	< .0001
<i>SATED · $b_t \cdot r^+$</i>		-1.3406	0.8446	-1.587	0.1125
<i>SATED · $b_t \cdot r^-$</i>		-2.5096	0.7390	-3.396	0.0007

Table S1b.

Smoker versus Non-smoker between - group contrast estimates for $b_t \cdot r_t^+$.

Contrast	Estimate	Std.Error	t-value	p-value	df
<i>UNSATD · $b_t \cdot r_t^+$ - NONSMOKER · $b_t \cdot r_t^+$</i>	2.7724	1.1532	2.404	0.0162	17652
<i>SATED · $b_t \cdot r_t^+$ - NONSMOKER · $b_t \cdot r_t^+$</i>	2.3945	1.1630	2.059	0.0395	17652

Supplementary Tables S2a and S2b

Table S2a. Results of linear multiple regression for TD predicting subjects' next bets (df = 17661)

	Coefficient	Estimate	Std.Error	t-value	p-value
Unsated smokers (N = 31)					
<i>UNSATD</i>		-0.0085	0.0110	-0.7790	0.4357
<i>UNSATD · \tilde{b}_t</i>		0.6935	0.0151	45.8070	< .0001
<i>UNSATD · TD_t</i>		0.1902	0.0107	18.1900	< .0001
Sated smokers (N = 31)					
<i>SATED</i>		-0.0305	0.0110	-2.7690	0.0056
<i>SATED · \tilde{b}_t</i>		0.6916	0.0149	46.4620	< .0001
<i>SATED · TD_t</i>		0.2377	0.0108	21.9350	< .0001
Non-smokers (N = 31)					
<i>NONSMOKER</i>		-0.0271	0.0110	-2.4570	0.0140
<i>NONSMOKER · \tilde{b}_t</i>		0.6937	0.0149	46.4080	< .0001
<i>NONSMOKER · TD_t</i>		0.1902	0.0111	17.1190	< .0001

Table S2b. Between - group contrast estimates for TD predicting next bets

	Contrast	Estimate	Std.Error	t-value	p-value	df
	<i>UNSATD · TD_t - SATED · TD_t</i>	-0.0423	0.0153	-2.771	0.0056	17661
	<i>UNSATD · TD_t - NONSMOKER · TD_t</i>	0.0052	0.0155	0.337	0.7361	17661
	<i>SATED · TD_t - NONSMOKER · TD_t</i>	0.0475	0.0155	3.0598	0.0022	17661

Supplementary Table S3**Table S3.**

Areas of neural activation positively associated with fictive and TD error in non-smokers and unsated & sated smokers.
(SPM2 Talairach coordinates in MNI space)

region	laterality	cluster size	x	y	z	t
Fictive error						
<u>Non-smokers</u>						
caudate	R	21	12	4	4	4.74
caudate head	L	53	-8	4	4	5.17
superior parietal lobule	L	27	-20	-68	56	6.23
precuneus	R	34	20	-64	56	5.61
<u>Unsated smokers</u>						
caudate head	R	52	8	4	4	6.51
	L		-8	4	0	5.43
middle occipital gyrus	R	48	28	-88	4	6.22
cuneus	L	20	-16	-96	8	5.27
middle temporal gyrus	R	10	48	-64	4	4.6
insula	L	8	-36	16	-4	4.52
superior parietal gyrus	L	8	28	-64	52	4.19
cingulate gyrus	C	9	0	16	40	4.18
superior temporal gyrus	R	5	48	12	-4	4.1
precuneus	R	6	20	-76	44	4.04
	L	40	-24	-72	52	5.11
<u>Sated smokers</u>						
caudate head	R	32	8	12	0	5.33
	L	9	-12	12	-4	4.69
middle occipital gyrus	R	65	28	-92	4	6.06
cuneus	L	50	-12	-96	4	6.05
superior parietal lobule	L	48	-32	-60	56	5.5
precuneus	R	20	28	-80	36	5.49
	L	10	16	-64	52	4.19
anterior cingulate	R	16	4	40	4	3.92
TD error						
<u>Non-smokers</u>						
putamen	R	84	20	12	-8	7.47
	L	5	-28	-16	4	3.94
	L	66	-24	8	-12	5.67
inferior parietal lobule	L	134	-40	-56	44	9.26
middle frontal gyrus	L	226	-28	16	52	7.61
	L	104	-36	48	-8	5.99
precentral gyrus	R	49	40	20	40	5.39
	L	5	-52	-36	-8	4.3
cingulate gyrus	L	54	-4	-44	36	5.31
precuneus	R	15	16	-72	52	4.65
<u>Unsated smokers</u>						
angular gyrus	L	105	-48	-68	32	6.36
middle frontal gyrus	L	53	-28	56	12	5.88
inferior parietal lobule	R	41	60	-52	40	4.68
precuneus	R	45	12	-48	32	4.51
	L	5	-16	-68	44	3.86
middle temporal gyrus	L	10	-60	-40	-4	4.45
superior temporal gyrus	L	6	-56	-16	8	3.92
<u>Sated smokers</u>						
putamen	R	94	20	8	-4	6.08
	L	57	-16	12	-4	6.94
	L	5	-28	-20	8	4.25
inferior parietal lobule	L	105	-48	-60	48	5.66
superior frontal gyrus	L	141	-32	36	36	5.59
precuneus	R	10	20	-64	52	5.14
middle frontal gyrus	R	31	36	24	48	5
inferior frontal gyrus	L	17	-56	12	12	4.89
superior parietal lobule	L	22	-16	-68	56	4.75
paracentral lobule	C	8	0	-28	52	4.5
postcentral gyrus	R	6	56	-24	16	3.91
	L	14	-60	-28	36	4.07

Supplementary Information for

Smokers' brains compute but ignore a fictive error signal in a sequential investment task

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Supplementary Methods

General Linear Model (GLM) analyses

The following regressors were present in all models and were entered in a general linear model as separate regressors constructed by convolving punctate stimulus onset events with the canonical hemodynamic response function in SPM2:

- 1) Market Type Screen: Stimulus onset indicating "Live" (L) or "Not Live" (NL)
- 2) Clear Screen 1: Market Type Screen stimulus offset.
- 3) Initial Reveal NL: Initial segment of market history is displayed in the NL condition.
- 4) First Reveal NL: First market reveal in NL condition after initial reveal.
- 5) Reveal NL: Market Reveals 2- 19 in NL condition.
- 6) Final Reveal NL: 20th market reveal in the NL condition.
- 7) ClearScreen2NL: Final stimulus offset in markets in the NL condition.
- 8) Initial Reveal L: Initial segment of market history is revealed in the L condition.
- 9) First Reveal L: First market reveal in the L condition after the initial reveal.
- 10) Reveal L: Market reveals 2- 19 in the L condition.
- 11) Final Reveal L: 20th market reveal in the L condition.
- 12) ClearScreen2L: Final stimulus offset in markets in the L condition.
- 13) Keypress: All keypresses toggles during the investment decision period. Keypresses less than 2 seconds apart were collapsed into the first keypress.

Regressors for the actual bet submission and 'Bar on' (bar going from gray to red, indicating beginning of decision period) were not explicitly included as they occurred within 750 ms of the Market Reveal stimuli. A PosMktNL regressor, constructed by convolving the RevealNL regressor with market values on positive market fluctuations (0 otherwise), was also included in all models. As detailed in the main text, TD and fictive error regressors were added to the basic model. All regions of activation positively associated with TD and fictive error in the non-smoker, unsated smoker and sated smoker groups are presented in Table S3 (SPM2 Talairach coordinates in MNI space).