SUPPLEMENTARY MATERIALS:

Appetitive and aversive goal values are encoded in the medial orbitofrontal cortex at the time of decision-making

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SUPPLEMENTS DATA ANALYSIS

Study 1

We analyzed the fMRI data using two different models.

Model 1. The data analysis proceeded in three steps. In the first step we estimated general linear models with AR(1) and the following independent variables for each of the two sessions:
(R1) Indicator variable for item presentation during free bid trials,
(R2) Indicator variable for item presentation during free bid trials modulated by free bid,
(R3) Indicator variable for item presentation during forced bid trials,
(R4) Indicator variable for item presentation during forced bid trials modulated by the free bid for that item,
(R5) Indicator variable for response time during free bid trials,
(R6) Indicator variable for response time during forced bid trials,
(R7) Indicator variable for item presentation during missed-bid trials,
(R8) Indicator variable for response screen during missed-bid trials,
(R9-R16) Movement regressors & session constants for each session.

Note several points:
1. An indicator variable for an event takes a value of 1 while the event is on, and a value of zero otherwise.
2. The bid value modulators are constructed subject by subject.
2. According to the definitions above, the presentation of the food pictures were modeled using 4s events, whereas the bid responses were modeled as events with a duration equal to the reaction time for that trial.
3. Missed-bid trials represent trials in which subjects did not respond within the allotted maximum response time of 4 seconds (less than 3% of all trials).
4. Each of the regressors of interest was convolved with a canonical hemodynamic response function (HRF), which models the hemodynamic response as the difference between two gamma functions (Friston et al., 2007 ; Friston et al., 1998; Glover, 1999; Lazar, 2008).

Second, we calculated the following first-level single-subject contrasts: (1) Free bid trials while exposed to the item modulated by free bid (R2), (2) Forced bid trials while exposed to the item modulated by the free bid for that item (R4), and (3) R2 minus R4.

Third, we computed group random effect estimates using the whole brain and region-of-interest techniques described below. All anatomical localizations were carried out by overlaying the t-maps on a normalized structural image averaged across subjects, and with reference to an anatomical atlas (Duvernoy, 1999).

*Whole brain analysis***.** We calculated random effects group estimates contrasts using a one sample t-tests over the single subject contrast statistics (Friston et al., 2007). For inference purposes we used a threshold of $p<0.001$ uncorrected and an extent threshold of 5 voxels. Supplementary Tables 1 to 3 denote the results of these analyses. For expositional purposes only, all of the activation maps in the paper are drawn at the more liberal threshold of $p<0.005$ uncorrected and an extent threshold of 5 voxels.

*ROI analysis***.** For the reasons described in the main text, we also carried out a region of interest analysis on the following five regions based on *a priori* hypotheses about areas that are involved in valuation in related contexts:

1. Bilateral mOFC. The center of the ROI mask for mOFC was taken from those reported in Plassmann et al. 2007, a previous study that investigated brain areas that correlate with appetitive goal values using a similar design. The coordinates were transformed into MNI space (x=4, y=32, z=-20; x=-2, y=32, z=-20). We then defined the ROI mask as a 8mm sphere around that center.
2. Right DLPFC. The center of the ROI mask for DLPFC was also taken from Plassmann et al. 2007 and transformed into MNI space (x=44,y=35,z=22). As before, we then defined the ROI mask as a 8mm sphere around the center.
3. Bilateral Insula. Given that there is significant variation in the areas of insula that have been identified in the relevant previous studies, we decided to take a conservative approach and set the ROI mask for the right and left insula based on the AAL atlas (Tzourio-Mazoyer et al., 2002).
4. Lateral OFC. The center for the ROI (x=28, y=60, z=-6) was taken from O'Doherty et al. 2001 (O'Doherty et al., 2001), which is an fMRI study that identifies areas where the BOLD signal correlates with the magnitude of aversive stimuli at the time of consumption. We defined the ROI mask as a 8mm sphere around the center.
5. Ventral Striatum. The center for the ROI (x=15, y=21,z= -6; x=-15, y=21,z= -6) was taken from Hare et al. 2008 that is an fMRI study that indentified BOLD signal in this area to

correlate with prediction errors. We defined the ROI mask as a 8mm sphere around the center.

We calculated random effects group estimates contrasts using one-sided t-tests over the single subject contrast statistics (Friston et al., 2007) restricting our statistical analysis to the above described Regions-of-Interest. All of the statistics reported below are small volume false discovery rate (SVFDR) corrected at the $p<0.01$ level. This procedure is based small volume random field corrections described in Worsley et al. 1996. The results of these analyses are also shown in Supplementary Tables 1 to 3.

Model 2. In order to create the beta bar graphs for the ROIs shown in Figure 4 we estimated an additional general linear model with AR(1) and the following independent variables for each of the two sessions (all omitted details are as in model 1):
(R1) Indicator variable for item presentation during low $ free bid trials ($0 & $1),
(R2) Indicator variable for item presentation during high $ free bid trials ($2 & $3),
(R3) Indicator variable for item presentation during low $ forced bid trials ($0 & $1),
(R4) Indicator variable for item presentation during high $ forced bid trials ($2 & $3),
(R5) Indicator variable for response time during free bid trials,
(R6) Indicator variable for response time during forced bid trials,
(R7) Indicator variable for item presentation during missed bid trials,
(R8) Indicator variable for response screen during missed bid trials,
(R9-R16) Movement regressors & session constants for each session.

Note several points:
1. The bid values used to defined the regressors are subject dependent.
2. According to the definitions above, the presentation of the food pictures were modeled using 4s events, whereas the bid responses were modeled as events with a duration equal to the reaction time for that trial.
3. Each of the regressors of interest was convolved with a canonical HRF.

Figures 4c,d show the average betas (across subjects) for high vs. low bid in free bid trials in the mOFC (at location x=4,y=32,z=-20) and the DLPFC (at location x=44,y=35,z=22). Note that the location of these voxels was given by the center of our ROIs and thus is independent of the

analyses for model 1. For each subject an average beta was computed using an anatomical spherical mask centered on the MNI coordinates listed above with a 8mm radius.

Study 2

We analyzed the fMRI data using three different models.

Model 3. The analysis for this model is basically identical to Model 1. The only difference is that now the bid during the free trials can be either a positive number (denoting that the item is appetitive), zero (denoting that the item is neutral), or negative (denoting that the item is aversive). The results of the whole brain and the ROI analyses are described in Supplementary Tables 4 to 6.

Model 4. In order to create the beta bar graphs shown in Figure 6 we estimated an additional general linear model with AR(1) and the following regressors for each of the three sessions (omitted details are as in Model 3):
(R1) Indicator variable for item presentation during negative $ free bid trials ($-3, $-2, $-1),
(R2) Indicator variable for item presentation during zero $ free bid trials ($0),
(R3) Indicator variable for item presentation during positive $ free bid trials ($1, $2, $3),
(R4) Indicator variable for item presentation during negative $ forced bid trials ($-3, $-2, $-1),
(R5) Indicator variable for item presentation during zero $ forced bid trials ($0),
(R6) Indicator variable for item presentation during positive $ forced bid trials ($1, $2, $3),
(R7) Indicator variable for response time during free bid trials,
(R8) Indicator variable for response time during forced bid trials,
(R9) Indicator variable for item presentation during missed bid trials,
(R10) Indicator variable for response screen during missed bid trials,
(R11-R18) Movement regressors & session constants for each session.

Note several points:
1. The bid values used to defined the regressors are subject dependent.
2. According to the definitions above, the presentation of the food pictures were modeled using 4s events, whereas the bid responses were modeled as events with a duration equal to the reaction time for that trial.
3. Each of the regressors of interest was convolved with a canonical HRF.

Figures 6b-c show the average betas (across subjects) for high vs. low free bid amounts in free bid trials in the mOFC (at location x=4,y=32,z=-20) and the DLPFC (at location x=44,y=35,z=22). Note that the location of these voxels was given by the center of our ROIs and thus is independent of the analyses for model 1. For each subject an average beta was computed using an anatomical spherical mask centered on the MNI coordinates listed above with a 8mm radius.

Model 5. The data analysis proceeded in three steps. In the first step we estimated a general linear models with AR(1) and the following independent variables for each of the three sessions:
(R1) Indicator variable for item presentation during non-negative free bid trials,
(R2) Indicator variable for item presentation during non-negative free bid trials modulated by free bid,
(R3) Indicator variable for item presentation during non-negative forced bid trials,
(R4) Indicator variable for item presentation during non-negative forced bid trials modulated by the free bid for that item,
(R5) Indicator variable for item presentation during negative free bid trials,
(R6) Indicator variable for item presentation during negative free bid trials modulated by free bid,
(R7) Indicator variable for item presentation during negative forced bid trials,
(R8) Indicator variable for item presentation during negative forced bid trials modulated by the free bid for that item,
(R9) Indicator variable for response time during free bid trials,
(R10) Indicator variable for response time during forced bid trials,
(R11) Indicator variable for item presentation during missed-bid trials,
(R12) Indicator variable for response screen during missed-bid trials,
(R13-R18) Movement regressors & session constants for each session.

Note several points:
1. The bid value modulators are constructed subject by subject.
2. According to the definitions above, the presentation of the food pictures were modeled using 4s events, whereas the bid responses were modeled as events with a duration equal to the reaction time for that trial.
3. Each of the regressors of interest was convolved with a canonical hemodynamic response function HRF.

We then calculated the following first-level single-subject contrasts: (1) Non-negative free bid trials while exposed to the item modulated by free bid minus negative free bid trials while exposed to the item modulated by free bid, (2) Non-negative free minus forced bid trials while exposed to the item modulated by free bid minus negative free minus forced bid trials while exposed to the item modulated by free bid, (3) Non-negative free bid trials while exposed to the item modulated by free bid, and (4) Negative free bid trials while exposed to the item modulated by free bid. We used these contrasts to carry out whole brain and ROI analyses as described above.

Supplementary Tables 7 to 10 describe the results of these analyses. For expositional purposes only, all of the activation maps in the paper are drawn at the more liberal threshold of $p<0.005$ uncorrected and an extent threshold of 5 voxels.

Conjunction Analysis

We performed a conjunction analysis to determine overlaps between areas that correlated with appetitive goal values in Plassmann et. al. 2007 during the free trials, areas that correlated negatively with aversive goal values in Study 1 (Supplementary Table 1), and areas that correlated positively with goal values in Study 2 (Supplementary Table 4). The conjunction was performed as follows. First, we created a mask for the areas of medial OFC and right DLPFC that correlated significantly with bids during free bid trials in Plassmann et al., 2007, at a level of $p<.005$ uncorrected and an extent threshold of 5 voxels. Second, we carried out a conjunction of areas in Study 1 that correlated negatively with the bids during the free bid trials, and of areas in Study 2 that correlated positively with the bids during the free bid trials. This conjunction was carried out by entering the contrast images for Study 1 and Study 2 (selected at $p<.005$ uncorrected and an extent threshold of 5 voxels) into an additional second-level analysis that treated the images as being independent in the sphericity correction procedure. We then applied a false discovery rate small volume correction using the mOFC and rDLPFC masks described above. The results of the conjunction exercise are shown in Supplementary Table 11 and Figure 7.

SUPPLEMENTS EXPERIMENTAL DESIGN AND POTENTIAL CONCERNS

A potential concern with our results is that items that received higher bids were also likely to be

more familiar. Familiarity ratings collected at the end of Study 2 showed that this was indeed the case ($r=0.8510$ $p<.00001$). This raises a natural question: Are the correlations with value in mOFC and DLPFC that we have identified just a response to familiarity? Fortunately, our experimental design allowed us to address this question. Note that subjects had to compute values in free trials, but not in forced trials. In contrast, the perception of familiarity was equal in both types of trials. As a result, an area in which activity correlated with values more in free than in forced trials is likely to be involved in computations of value, instead of just reflecting a mere correlation with familiarity.

Another limitation of our study is that we did not collect any information about which aspects of the stimuli (e.g., look, retrieved memories, etc.) might have generated appetitive or aversive reactions in the subjects. As a result, our studies cannot address the important question of which are the specific inputs that are used to compute appetitive and aversive values, and what are their neural substrates.

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Supplementary Table 1. Study 1. Areas exhibiting BOLD activity that is decreasing on the size of the bid during free bid trials. No areas exhibited increased activation at a threshold of p<0.001 uncorrected and an extent threshold of five voxels. Also, none of the regions of interest exhibited correlation with BOLD activity at a small value discovery rate correction of p<0.01. *Brain areas in italic show results of the ROI analysis.*

MNI-coordinate (x, y, z)	**Region of activation**	**Side**	**BA**	**T**
-21, 20, 52	Middle frontal gyrus	L	8	4.21*
6, 56, 28	Superior frontal gyrus	R	9	4.07*
6, 19, 22	Anterior cingulate cortex	R	33	3.92*
-46, 35, 14	Inferior /medial frontal gyrus, DLPFC	L	46	3.86*
-33, 11, -20	Inferior frontal gyrus/superior temporal gyrus	L	47/38	3.85*
-2, 32, -14	*Medial frontal gyrus, mOFC*	*L*	*11*	*3.79*+*
42, -10, 4	*Posterior insula*	*R*	*13*	*3.73*+*
45, -1, -8	Superior temporal gyrus	R	13	3.70*
39, 41, 22	*Middle frontal gyrus, DLPFC*	*R*	*10/46*	*3.66*+*
3, 32, -17	*Medial frontal gyrus, mOFC*	*R*	*11*	*3.41+*
-36, -7, 7	*Posterior insula*	*L*	*13*	*3.38+*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels
+Survives q<0.01 small volume false discovery rate (SVFDR) corrected for masks defined in text
Height threshold: T=2.88
Extent threshold: k=5 voxels

Supplementary Table 2. Study 1. Areas exhibiting BOLD activity that is increasing on the size of the free bid for that item during the forced bid trials. No areas exhibited decreased activation at a threshold of $p<0.001$ uncorrected and an extent threshold of five voxels. Also, none of the regions of interest exhibited correlation with BOLD activity at a small value discovery rate correction of $p<0.01$.

MNI-coordinate (x, y, z)	**Region of activation**	**Side**	**BA**	**T**
-1, -46, -43	Brain stem, medulla	L		6.95*
44, 8, -32	Middle temporal gyrus	R	21	3.94*

*Survives Height threshold: $T = 3.61$, $p < 0.001$(unc.),
Extent threshold: $k = 5$ voxels

Supplementary Table 3. Study 1. Areas exhibiting a stronger negative correlation between the BOLD signal and the free bid during the free bid trials than during the forced bid trials. *Brain areas in italic show results of the ROI analysis.*

MNI-coordinate (x, y, z)	**Region of activation**	**Side**	**BA**	**T**
3, -49, 16	Posterior cingulate cortex	R	30/23	5.49*
-51, 32, 16	Inferior/middle frontal gyrus, DLPFC	L	46	5.28*
3, 56, 25	Medial frontal gyrus	R	10	4.22*
51, -13, 16	Superior temporal gyrus/ posterior insula	R	13	4.14*
42, 8, -29	Superior/middle temporal gyrus	R	21	4.06*
-3, -10, -2	Brainstem, midbrain	L		4.06*
51, -28, -26	Fusiform gyrus	R	20	4.00*
33, -25, -17	Parahippocampal gyrus	R		3.92*
-39, -1, -8	*Posterior insula*	*L*	*13*	*3.36+*
45, 41, 25	*Inferior/middle frontal gyrus, DLPFC*	*R*	*10/46*	*3.30+*
2, 32, -23	*Medial frontal gyrus, mOFC*	*R*	*11*	*3.12+*
42, -13, 1	*Posterior insula*	*R*	*13*	*2.97+*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels
+Survives q<0.01 small volume false discovery rate (SVFDR) corrected for masks defined in text
Height threshold: T=2.88
Extent threshold: k=5 voxels

Supplementary Table 4. Study 2. Areas exhibiting BOLD activity that is increasing on the size of the bid during free bid trials. No areas exhibited decreased activation at a threshold of p<0.001 uncorrected and an extent threshold of five voxels. *Brain areas in italic show results of the ROI analysis.*

MNI-coordinate (x, y, z)	**Region of activation**	**Side**	**BA**	**T**
12, -87, -3	Lingual gyrus	R	17	5.51*
9, 45, 0	Anterior cingulate cortex	R	32	5.15*
4, 30, -13	*Medial frontal gyrus, mOFC*	*R*	*11*	*4.55*+*
18, 27, 48	Superior frontal gyrus	R		4.43*
-9, -81, 0	Lingual gyrus	L	18	4.34*
-15, 36, 48	Superior frontal gyrus	L		3.78*
-3, 31, -12	*Medial frontal gyrus, mOFC*	*L*	*11*	*3.44+*
49, 30, 27	*Middle frontal gyrus, DLPFC*	*R*	*46*	*2.88+*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels
+Survives q<0.01 small volume false discovery rate (SVFDR) corrected for masks defined in text
Height threshold: T=2.88
Extent threshold: k=5 voxels

Supplementary Table 5. Study 2. A) Areas exhibiting BOLD activity that is increasing on the size of the free bid for that item during the forced bid trials. B) Areas exhibiting BOLD activity that is decreasing on the size of the free bid for that item during the forced bid trials. None of the regions of interest exhibited correlation with BOLD activity at a small value discovery rate correction of $p<0.01$.

A

MNI-coordinate (x, y, z)	Region of activation	Side	BA	T
9, -93, 0	Cuneus	R	17	5.43*
-9, -84, 0	Lingual gyrus	L		3.92*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels

B

MNI-coordinate (x, y, z)	Region of activation	Side	BA	T
-32, -41, -13	Parahippocampal gyrus/fusiform gyrus	L	37	4.44*
42, 0, -24	Temopral lobe, sub-gyral	R		4.43*
32, -45, -15	Parahippocampal gyrus/fusiform gyrus	R	37	4.39*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels

Supplementary Table 6. Study 2. Areas exhibiting a stronger positive correlation between the BOLD signal and free bids during the free bid trials than during the forced bid trials. *Brain areas in italic show results of the ROI analysis.*

MNI-coordinate (x, y, z)	**Region of activation**	**Side**	**BA**	**T**
30, -27, -24	Parahippocampal gyrus	R	36	4.93*
61, -25, -26	Inferior temporal gyrus	R	20	4.20*
6, 30, -12	*Medial frontal gyrus, mOFC*	*R*	*11*	*3.48+*
50, 30, 21	*Middle frontal gyrus, DLPFC*	*R*	*46*	*3.38+*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels
+Survives q<0.01 small volume false discovery rate (SVFDR) corrected for masks defined in text
Height threshold: T=2.88
Extent threshold: k=5 voxels

Supplementary Table 7. Study 2. Areas exhibiting a stronger positive correlation between the BOLD signal and free bids during the non-negative free bid trials than during negative free bid trials. No areas exhibited a stronger positive correlation between the BOLD signal and the free bid during the negative free bid trials than during non-negative free bid trials at a threshold of p<.001 uncorrected and a 5 voxel extent threshold. *Brain areas in italic show results of the ROI analysis.*

MNI-coordinate (x, y, z)	**Region of activation**	**Side**	**BA**	**T**
-33, 0, 18	*Insula*	*L*	*13*	*4.83*+*
12, 39, 18	Medial frontal gyrus/ anterior cingulate cortex	R	9/32	4.16*
9, 54, 15	Medial frontal gyrus	R	10	3.69*
33, 6, 15	*Insula*	*R*	*13*	*3.50+*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels
+Survives q<0.01 small volume false discovery rate (SVFDR) corrected for masks defined in text
Height threshold: T=2.88
Extent threshold: k=5 voxels

Supplementary Table 8. Study 2. Areas exhibiting a positive correlation between the BOLD signal and free bids during the non-negative free bid trials. *Brain areas in italic show results of the ROI analysis.*

MNI-coordinate (x, y, z)	**Region of activation**	**Side**	**BA**	**T**
12, 39, 18	Medial frontal gyrus/ anterior cingulate cortex	R	9/32	4.97*
-39, -30, -18	Parahippocampal gyrus	L	36	4.29*
3, 30, -12	*Medial frontal gyrus, mOFC*	*R*	*11/25*	*4.01*+*
12, -87, 3	Cuneus	R	17	3.98*
-33, 1, 18	*Insula*	*L*	*13*	*3.12+*
33, 6, 15	*Insula*	*R*	*13*	*3.01+*
49, 33, 24	*Middle frontal gyrus, DLPFC*	*R*	*46*	*2.98+*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels
+Survives q<0.01 small volume false discovery rate (SVFDR) corrected for masks defined in text
Height threshold: T=2.88
Extent threshold: k=5 voxels

Supplementary Table 9. Study 2. Areas exhibiting a positive correlation between the BOLD signal and free bids during the negative free bid trials. *Brain areas in italic show results of the ROI analysis.*

MNI-coordinate (x, y, z)	**Region of activation**	**Side**	**BA**	**T**
44, 45, 21	*Middle frontal gyrus, DLPFC*	*R*	*46/11*	*6.18*+*
-45, 45, 21	*Middle frontal gyrus, DLPFC*	*L*	*46/11*	*4.12*+*
3, 18, 45	Cingulate gyrus	R	32	4.03*
2, 32, -12	*Medial frontal gyrus, mOFC*	*R*	*11*	*2.97+*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels
+Survives q<0.01 small volume false discovery rate (SVFDR) corrected for masks defined in text
Height threshold: T=2.88
Extent threshold: k=5 voxels

Supplementary Table 10. Study 2. A) Results for the contrast non-negative free minus forced bid trials while exposed to the item modulated by free bid minus negative free minus forced bid trials while exposed to the item modulated by free bid. B) Results for the contrast negative free minus forced bid trials while exposed to the item modulated by free bid minus non-negative free minus forced bid trials while exposed to the item modulated by free bid. *Brain areas in italic show results of the ROI analysis.*

A

MNI-coordinate (x, y, z)	**Region of activation**	**Side**	**BA**	**T**
-33, 0, 18	*Insula*	*L*	*13*	*4.25*+*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels
+Survives q<0.01 small volume false discovery rate (SVFDR) corrected for masks defined in text
Height threshold: T=2.88
Extent threshold: k=5 voxels

B

MNI-coordinate (x, y, z)	**Region of activation**	**Side**	**BA**	**T**
-42, 42, 9	Inferior/Middle frontal gyrus	L	46/10	5.51*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels
+Survives q<0.01 small volume false discovery rate (SVFDR) corrected for masks defined in text
Height threshold: T=2.88
Extent threshold: k=5 voxels

Supplementary Table 11. Conjunction analysis**.** Areas in non-italic font show the results of whole brain analysis, whereas brain areas in italics show results of the ROI analysis.

MNI-coordinate (x, y, z)	**Region of activation**	**Side**	**BA**	**T**
3, 36, -18	*Medial frontal gyrus, mOFC*	*R*	*11*	*4.43*+*
42, 42, 15	*Middle frontal gyrus, DLPFC*	*R*	*10/46*	*4.29*+*
-3, 42, -9	Anterior cingulate cortex	L	11	3.97*

*Survives Height threshold: T = 3.61, p < 0.001(unc.),
Extent threshold: k = 5 voxels
+Survives q<0.01 small volume false discovery rate (SVFDR) corrected for masks defined in text
Height threshold: T=2.88
Extent threshold: k=5 voxels

Appendix 1– Instructions Study 1

The goal of this experiment is to study food preferences. The next few screens provide detailed instructions about the experiment.

It is very important that you understand the instructions, since additional rewards from participating in the experiment will depend on your ability to make good decisions.

At the end of the experiment, about 60 minutes from now, we will ask you to sit in an adjacent room for a few minutes. During this time we will ask you to eat a small snack. Which snack you get to eat will be determined by your actions during the experiment.

Most subjects dislike the snacks that we have selected (e.g. baby food, canned sauerkraut). The fact that these are disliked foods is a crucial component of the experiment. If you agree to participate in the experiment, then you are agreeing to eat the snack that is selected according to the rules described below even if you do not like it. The only valid reasons to refuse to eat an item at the end of the experiment are medical reasons such as allergies.

How does your decisions determine which food you eat?

At the end of the experiment one of 100 trials will be selected at random and you will have to eat the item selected in that trial unless you have purchased from us the right NOT to have to eat it.

Next to your computer station is an envelope with three one-dollar bills. You will be allowed to use this money to bid how much you are willing to pay NOT to eat particular foods. In particular, we will show you pictures of 50 different snacks, each one on a separate trial. After each presentation, you will be allowed to bid either $0, $1, $2, or $3 dollars for the right NOT to have to eat the item.

NOTE:
1. The bid indicates that you DON'T WANT to eat that food at the end of the experiment, and a higher amount number indicates a stronger dislike.
2. A zero bid indicates that you are indifferent between eating and not eating the food.

IMPORTANT: Although you will make 100 decisions only one of the trials will count. At the end of the experiment we will select a trial at random by picking a ball from an urn. That will be only trial that counts. Since you don't know which trial it will be, you should treat every trial as if it were the only one.

In fact, as you will see in a moment, whenever given a choice the best thing you can do is to always bid the number that is CLOSEST to your true valuation for NOT eating that food (and only that food) at the end of the experiment.

Forced vs. Free Bid Trials

The experiment is divided into two types of trials: "Free Bid" Trials and "Forced Bid" Trials.

In Free Bid Trials you choose how much you want to bid for not eating the food item. As you will see in a moment, your best strategy is to bid your true value. In Free Bid Trials you will see a question mark below to the item.

In contrast, in Forced Bid Trials we will tell you how much to bid and YOU HAVE NO CHOICE BUT TO BID THAT AMOUNT. In particular, in Forced Bid Trials you will see a number below to the item and you will HAVE TO bid that amount when the time to bid comes. In this case your decision is simpler and more

mechanical: see the item, see the bid, and then bid that amount. Note that the forced bids might be above or below your true value. In either case we ask you to enter that bid.

Importantly, BOTH types of trials count towards the purchase decision. If a forced trial is selected at the end of the experiment, you will still get to play the auction described below, but your bid will be given by the amount of the "forced bid".

About Free Bid Trials.

Note that, since we will only have to eat at most one food, you do not have to worry about spreading your $3 dollar budget over the different items. Every trial you should ask yourself how much of the $3 dollars you want to spend for NOT eating that food since that may be the only trial that counts.

There is a rule that determines the price you will end up paying for NOT eating the food. The rule is a bit unusual, but its implications are straightforward: there is no way of gaming the rule, and thus the BEST thing that you can do in every trial is to ask yourself how much you would be willing to pay NOT to eat THAT item at the end of the experiment, and then bid the number closest to that value.

What is the rule? At the end of the experiment, after the trial that counts has been selected, you will choose a ball from an urn with four balls. The balls are marked $0, $1, $2, and $3.

If your bid is greater than or equal to the ball that you draw, you will NOT have to eat the food and you will need to pay us an amount equal to the number in the ball.

If your bid is less than the number that you draw, you will HAVE to eat the food item, and won't have to pay ANY money at all from your $3 budget.

Optimal strategy

Why is it in your interest to bid the number closes to your true value for NOT eating the item at the end of the experiment?

You might think that your best strategy is to bid less than not having to eat the item is worth to you. This is INCORRECT.

The price that you pay is determined by the ball that you draw and NOT by your bid. Thus, if you lower your bid you would not be able to affect the price that you pay, but might end up losing the opportunity of not having to eat the item at a "good" price.

For example, suppose that having the chance to avoid eating the snack at the end the experiment is worth $2 for you. If you bid your true value, you will not have to eat the item if the ball is $2 or less and pay that amount. It follows that by bidding your true value you make a "profit" since you might end up paying less than avoiding to eat the item is worth to you.

Clearly, you should never bid more than your true value.

What happens if you bid less than you true value? For example, suppose that you bid $0 even though your true value is $2. In this case you decrease your chances to avoid to eat the item, which is not a good strategy since, when you bid your true value, you might end up paying less than avoiding to eat the item is worth to you.

Overview

Don't let the details of the experiment confuse you, things are actually very simple:

1. You will make bids for purchasing a snack on 100 trials, but one of those trials will count.

2. You should treat each decision as if it were the only one.

3. In Free Bid Trials your best strategy is to always bid the number closest to your true value for NOT eating that item, and only that item, at the end of the experiment.

4. For Forced Bid Trials, you are asked to bid the amount that we tell you to, regardless of whether or not this is a good deal for you. Look at the screen, notice the item and bid, and then enter that bid when the time comes.

Quiz:

Do you have ay questions relating to the instructions? If so, please ask the experimenter

If not please answer the following questions:

Imagine your true value for avoiding to eat an item is $2. Which amount should you bid?

1) $1
2) $2

Circle 1 or 2 according to your answer

Under which of the following two conditions will you have to eat the item?

1) When you bid 2$ and a ball marked $1 is drawn from the urn

2) When you bid 2$ and a ball marked $3 was drawn from the urn

Circle 1 or 2 according to your answer

Appendix 2– Instructions Study 2

The goal of this experiment is to study food preferences. The next few screens provide detailed instructions about the experiment.

It is very important that you understand the instructions, since additional rewards from participating in the experiment will depend on your ability to make good decisions.

At the end of the experiment, about 60 minutes from now, we will ask you to sit in an adjacent room for another 30 minutes. During this time we will ask you to eat at a small snack. Which snack you get to eat will be determined by your actions during the experiment.

Most subjects find about half of the snacks appetizing (e.g. chocolate) but dislike the other half of the snacks (e.g. baby food). The presence of both types of foods is a crucial component of the experiment. If you decide to participate in the experiment, you agree to eat the snack that is selected according to the rules described below even if you do not like it. The only valid reasons NOT to eat the item are medical reasons such as allergies.

How does your decisions determine which food you eat?

Next to your computer station is an envelope with 3 one-dollar bills. During the experiment you will be allowed to use this money to bid for the right of eating or avoiding to eat particular foods. Whatever money you do not spend is yours to keep.

During the experiment we will show you pictures of 60 different snacks, each one on a separate trial. After each presentation, you will be allowed to bid either -$3, -$2, -$1, $0, $1, $2, or $3 dollars for the item.

Note that both positive and negative bids are allowed. A positive bid indicates that you would LIKE to eat that food at the end of the experiment, and larger bids indicate a stronger preference. A negative bid indicates that you would DISLIKE to eat that food at the end of the experiment, and a more negative number indicate a stronger dislike. A zero bid indicates that you are indifferent between eating and not eating the food.

Note also that a positive bid indicates that you are willing to pay that amount for eating the food at the end of the experiment, whereas a negative bid indicates that you require a compensation equal to the negative amount bid to eat the food. Thus, for example, a bid of $2 indicates that eating the food is worth $2 for you, whereas a bid of -$2 indicates that you are willing to pay $2 to avoid eating the food.

We will show you each picture twice.

Although you will make 120 decisions, on 60 different foods, only one of the trials will count. At the end of the experiment we will select a trial at random by picking a ball from an urn. That will be only trial that counts.

Since you don't know which trial it will be, you should treat every trial as if it were the only one.

In fact, as you will see in a moment, whenever given a choice the best thing you can do is to always bid the number that is CLOSEST to your true valuation for eating that food (and only that food) at the end of the experiment.

Forced vs. Free Bid Trials

The experiment is divided into two types of trials: "Free Bid" Trials and "Forced Bid" Trials.

In Free Bid Trials you choose how much you want to bid for the food item. As you will see in a moment, your best strategy is to bid your true value for the item. In Free Bid Trials you will see a question mark below to the item.

In contrast, in Forced Bid Trials we will tell you how much to bid and YOU HAVE NO CHOICE BUT TO BID THAT AMOUNT. In particular, in Forced Bid Trials you will see a number below to the item and you will HAVE TO bid that amount when the time to bid comes. In this case your decision is simpler and more mechanical: see the item, see the bid, and then bid that amount.
Note that the forced bids might be above or below your true value. In either case we ask you to enter that bid.

Importantly, both types of trials count towards the purchase decision. If a forced trial is selected at the end of the experiment, you will still get to play the auction described below, but your bid will be given by the amount of the "forced bid".

About Free Bid Trials.

Note that, since we will only sell you at most one food, you do not have to worry about spreading your $3 dollar budget over the different items. Every trial you should ask yourself how much of the $3 dollars you want to spend in that food since that may be the only trial that counts.

In every auction there is a rule that determines the price at which the items are sold. This auction is no different.

The rule is a bit unusual, but its implications are straightforward. There is no way of gaming the auction, the BEST thing that you can do in every trial is to ask yourself how much you would be willing to pay to eat/avoid eating THAT item at the end of the experiment, and then bid the number closest to that value.

What is the rule? At the end of the experiment, after the trial that counts has been selected, you will choose a ball from an urn with seven balls. The balls are marked -$3, -$2, -$1, $0, $1, $2, and $3.

In case the ball drawn is positive, if your bid is greater or equal than the ball that you draw, you will get the snack for a price equal to the number in the ball. Note that if the ball drawn is negative, you will pay that own and you will not have to eat the item.

If your bid is less than the number that you draw and the number is positive, you will NOT get the snack, and won't have to pay any money. In the negative case you can keep the money and you will have to eat the food item.

Optimal strategy

Why is it in your interest to bid the number closes to your true value for eating the item at the end of the experiment?

You might think that your best strategy is to bid less than the item is worth to you, and in particular to bid a negative amount for every item. This is INCORRECT.

The price that you pay is determined by the ball that you draw and NOT by your bid. Thus, if you lower your bid you would not be able to affect the price that you pay, but might end up losing the opportunity of getting the item at a "good" price.

For example, suppose that having the chance to eat the snack at the end the experiment is worth $2 for you. If you bid your true value, you will get the item if the ball is $1 or less and pay/receive that amount.

You will not get the item if the ball is $2, or $3. It follows that by bidding your true value you make a "profit" since you always end up paying/receiving less than the item is worth to you.

Clearly, you should never bid more than your true value.

What happens if you bid less than you true value? For example, suppose that you bid -$3 even though your true value is $2. In this case you never get the item, which is not a good strategy since, when you bid your true value, you always end up paying less than the item is worth to you!

Another attractive property of the auction

Note that conditional on getting the item (i.e, conditional on the number on the ball being less or equal to your bid), the price that you pay is on average given by

$$\frac{\text{Bid - \$3}}{2}$$

Thus, if you follow your best strategy and always bid the true value, on a typical Free Bid Trial you will get to buy the item for a much lower price that is worth to you, and you might even receive a compensation!

Overview

Don't let the details of the experiment confuse you things are actually very simple:

1. You will make bids for purchasing a snack on 120 trials, but one of those trials will count.

2. You should treat each decision as if it were the only one.

3. In Free Bid Trials your best strategy is to always bid the number closest to your true value for eating that item, and only that item, at the end of the experiment.

4. For Forced Bid Trials, you are asked to bid the amount that we tell you to, regardless of whether or not this is a good deal for you. Look at the screen, notice the item and bid, and then enter that bid when the time comes.

Control

Do you have ay questions relating to the instructions? If so, please ask the experimenter

If not please answer the following questions:

Imagine your true value for an item is $2. Which amount should you bid?

1) $1
2) $2

Press 1 or 2 according to your answer

Imagine your true value for an item is -$1. Which amount should you bid?

1) $1

2) -$1

Press 1 or 2 according to your answer

Under which of the following two conditions will you get the item?

1) When you bid 2$ and a ball marked $1 is drawn from the urn

2) When you bid 2$ and a ball marked $3 was drawn from the urn

Press 1 or 2 according to your answer