

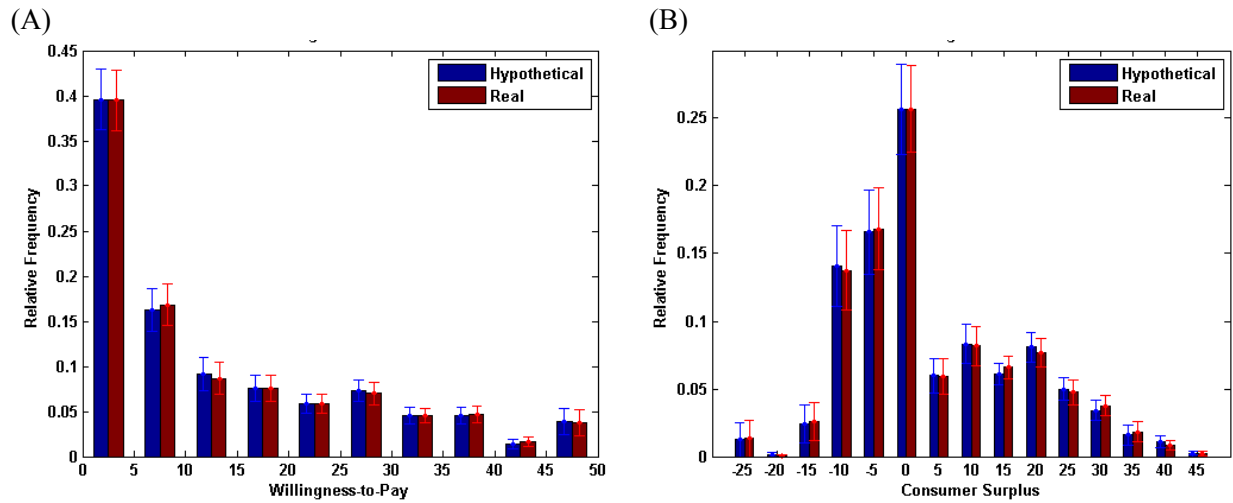
Supplemental Material for

**Hypothetical and real choice differentially
activate common valuation areas**

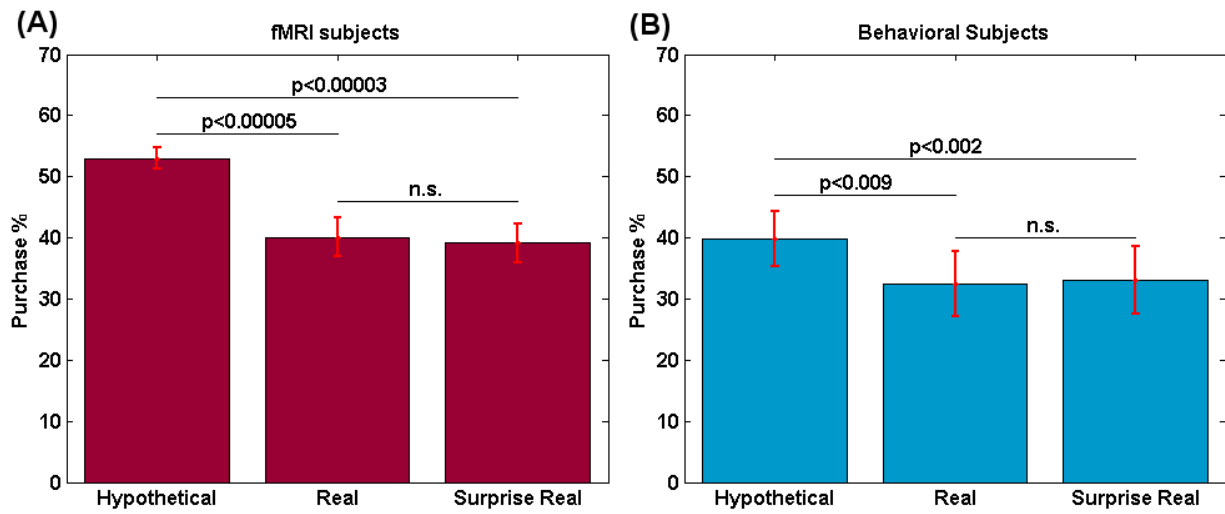
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Supplemental Figures
Supplemental Tables

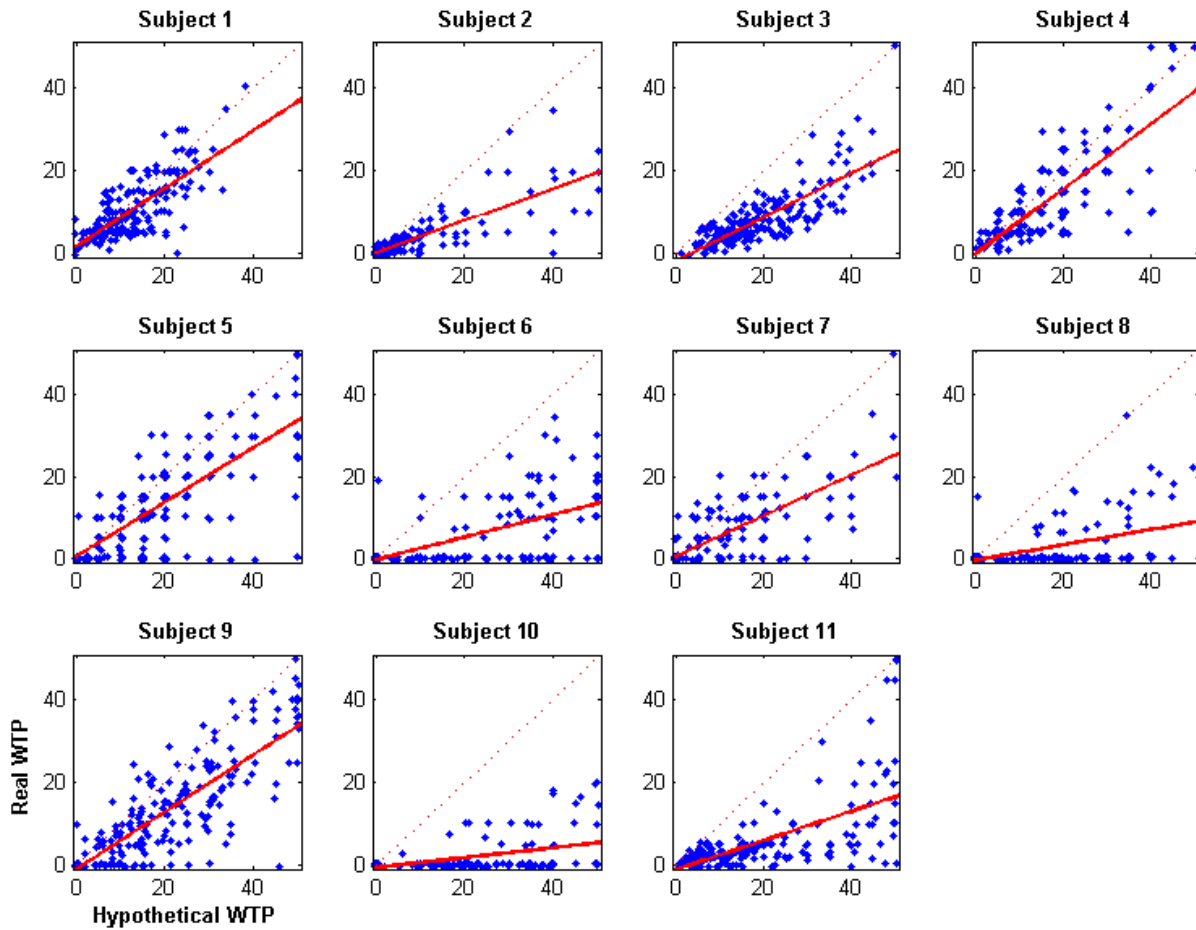
Supplemental Figures



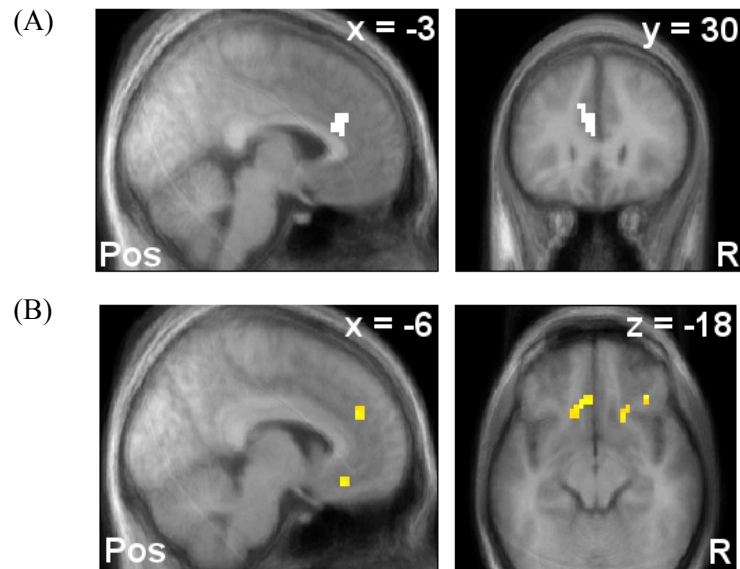
Supplemental Figure 1. (A) Distribution of Willingness-to-Pay by trial type. Bin size = 5, center = [2.5, 7.5, ..., 47.5]. (B) Distribution of decision values by trial type. Bin size = 5, bin center = [-25, -20, ..., 40, 45].



Supplemental Figure 2. Purchase Percentage by Trial Type. Subjects exhibited a hypothetical bias regardless of the order of the trials (paired two sample t-tests, two-sided). (A) fMRI participants. (B) Behavioral study participants.



Supplemental Figure 3. Real WTP vs. Hypothetical WTP. Subjects consistently over-reported hypothetical WTP. Blue dots indicate hypothetical and real WTP for the same product (x -axis: hypothetical WTP, y -axis: real WTP). In the figure, real and hypothetical WTP are both jittered by adding uniform random numbers over the interval $[-0.4, 0.4]$ to convey data density. Solid red lines are fitted regression lines of real WTP on hypothetical WTP. If an individual does not exhibit hypothetical bias, the red line should be equal to the dotted 45° line. Estimates of regression coefficients are reported in Supplementary Table 11.



Supplemental Figure 4. PPI Analysis. (A) ACC mask used to identify individual seed regions. (B) The regions showing stronger functional connectivity with the ACC in real trials than in hypothetical trials. $p < 0.001$, uncorrected, extent threshold $k = 15$ voxels.

Supplemental Tables

Supplemental Table 1. List of 200 consumer products used in the study. The retail price of the products ranged from \$20 to \$100. Approximately 300 products were initially collected by the experimenters and ~100 of the most unpopular items were screened out by a pilot study, leaving 200 products used in the study.

Product Name	Product Name
90's Decade Box Gift Basket - Classic 90's Candy	Logitech Quickcam for Notebooks Deluxe
Abercrombie and Fitch Boxers - Set of 2	Lomographic Fisheye Number 2 Camera
Abercrombie and Fitch Canvas And Rubber Flip Flops	M-51 Engineers Field Bag - Military Style
Abercrombie and Fitch Cap New York	Math Formula Tie
Abercrombie and Fitch Kilburn Low Rise Boot Jean	Maxtor - OneTouch 4 Mini 120GB External Hard Drive
Abercrombie and Fitch Short Sleeve Tee Hopkins Trail	Megatech Hydro-Fly 18" Radio Controlled Land/Air/Sea Vehicle
Accudart Classic Bristle Dartboard	Microsoft Natural Ergo Keyboard
Adidas 3-Stripes Dazzle Tearaway Mens Warm-up Pants	Millafleur Glass Electric Guitar Lamp
AeroBed® Sport Minute Twin airbed	Monopoly Deluxe Edition
Age of Empires III-Windows	Motorized Bumper Boat
Allied 180-pc. Household Tool Set	Motorola 25 Mile, 22 Channel 2-Way Radios (Pair)
Andy Mac Zon Complete Skateboard	Mrs. Fields Soho 12 Cookie Box
Antworks - Space Age Ant Habitat	Nikon Action 8x40 Binocular
Apple 1 GB iPod Shuffle AAC/MP3 Player	Nintendo Game Boy Advance
Arrested Development - The Complete Series (Seasons 1, 2, 3) (2003)	Nintendo Game Boy Micro
Audio X Rocker with built-in subwoofer and speakers	Northface Campus Backpack
Austin Bazaar 38" Black Guitar with Carrying Bag and Accessories	Northface M Amp Hybrid Jacket
Bach Tie	Northface Utility Waist – Sport Hiker
Banner American Desktop Work Station	Number Pad Mouse
Black and Decker 12 cup SmartBrew plus Coffeemaker	Obus Forme Memory Foam Travel Pillow
Black and Decker 15.6 Volt HEPA Cyclonic DustBuster	Olympus 128 MB Digital Voice Recorder with PC Link
Black and Decker 4-Slice Stainless Steel Toaster Oven	Omron Digital Premium Pedometer
Boss Seating Fabric Adjustable Task Chair	Oral B Professional Care Power Toothbrush
Braun Electric Water Kettle	Oregon Scientific ExactSet Projection Clock with Cable-Free Weather Forecaster
Braun Smart Control 3 Shaver	Organic Nut Harvest Basket
Brookstone 12-Language Translator	Oster Egg Cooker
Brookstone 9-in-1 Multi Tool with LED	Pail of Treats - Mrs. Fields 48 bite-sizes cookies and 18 brownie bites
Brookstone Digital Camera Keychain	Panasonic Upper Arm Blood Pressure Monitor
Brookstone Laptop Essentials Kit	Periodic Table Shower Curtain
Brookstone Lighted Lap Desk	Perpetual Calendar
Brookstone MP3 Stereo Speaker	Philips Norelco Rechargeable Razor
Brookstone Rechargeable Booklight	Philips Progressive-scan DVD Player
Brookstone Wireless FM Transmitter	Planet Earth - The Complete BBC Series (DVD)
Brother Personal Labeler	Plantronics Wireless Bluetooth Headset
Bushnell ImageView 7x18 VGA Pocket Digital Camera Binocular	PowerBar® Performance The Original Energy Bar, Peanut Butter (Pack of 24)
Calvin Klein - Men's Bamboo Dress Socks 2 Set of 3-Pack (6 pairs)	Premium Diamond Suited Poker Chip Set

Canon Color Image Scanner	Prodikeys MIDI Keyboard
Casio 2.7" Shock Resistant Portable LCD TV	Puma - Men's Quarter Crew Socks 2 Set of 3-Pack (6 pairs)
Casio Mens G-Shock Classic Watch	Ravensburger Oceanic Wonders 3000 Piece Jigsaw Puzzle
Celestron ExploraScope 80mm Reflector Telescope	Raytek MiniTemp No-Contact Thermometer with Laser Sighting
Classic Pillow by Tempur Pedic	Razor A Kick Scooter
Clif Bar Nutrition Bars, Variety Pack 2.4-Ounce Bars (Pack of 24)	RCA Small Wonder Digital Next Generation Camcorder
Coby 7" Widescreen Digital Photo Frame with MP3 Player	Real Theater Popcorn Kit - 20 Pack
Coca-Cola Personal Fridge	Roll-Up Keyboard
Columbia Sportswear Men's Trail Hiking Boot	Roller Slide - Ab Slider with Computer LCD Read-out
Columbia Sportswear's Men's Steens Mountain Sweater	SanDisk Sansa 2GB Photo MP3 Player
Columbia The Zone 0° Mummy Sleeping Bag	See's Candies - Toffee-Ettes and Almond Royal
Cooler Master NotePal Notebook Cooler	Seinfeld - Seasons 1 and 2 (1993)
Cranium (Board game)	Sharper Image All-In-One Games Set - chess, checkers, backgammon, and poker
Deluxe Turntable Scrabble	Sharper Image Atomic Projection Clock with Indoor Temperature
Desktop Organizer, 5/8" Wood, Corner Radius, Three-Way Use	Sharper Image Bright As Day Power-Port Desk Lamp
Desktop Personal Air Conditioner	Sharper Image Digital 130X USB Microscope Camera
Digital WiFi Detector	Sharper Image Sports Duffle Bag
Dymo LabelWriter 400 Label Printer	Sharper Image Turbo Ear and Nose Hair Trimmer
Fold-Away Wooden Chess Set	Sigma PC 15 Heart Rate Monitor
Fossil Men's Texas Multifunction Watch	Smallville - The Complete First Season (2001)
Fossil Mens Rimless Sunglasses - Rider - Polarized	SolidTek DigiMemo 6"x9" Digital Notepad with Memory
Gaiam Abs Ball Workout Kit	Sony CD/Cassette Portable Boombox
Garmin eTrex Handheld GPS Navigator	Sony DJ Style Monitor Series Headphones
GODIVA 1lb Milk Chocolate Dipped Pretzel Canister	Sony Micro Vault Tiny GB USB Flash Drive with Virtual Expander
GODIVA 50 pc. Biscuit Assortment Gift Tin	Sony Quick Battery Charger with 4 AA Batteries
GODIVA Biscuit Collection Gift Tin (50 pc)	Sony Stereo CD Clock Radio with Dual Alarm
GODIVA Chocoiste Solid Milk Chocolate Bars (24 pc)	Sony Water-Resistant Weather Band Shower Radio
GODIVA Spring Milk Chocolate Gift Box (22 pc)	Sony Wireless Headphone System
GODIVA Thankyou Ballotin (70pc)	Spinmaster Air Hogs Battling Havoc R/C Helicopters
GPX Karaoke System with Integrated 5-1/2" Black and White Monitor	Star Wars Episode VI - Return of the Jedi (1983, 2004 Versions, 2-Disc)
Green Laser Pointer (5 mW, Class IIIa Laser Product)	Star Wars Trilogy (with Bonus Disc) (1977)
Guitar For Dummies (Lifestyles Paperback)	Starwars R2-D2 mimobot® 2GB USB Drive
Gundam X: G-Falcon Unit Double X Model Kit 1/100 Scale	SuperPen Graphics Tablet
Hamilton Beach Pump Espresso/Cappuccino maker	Swiss Gear 7x7-Foot 3-Person Sport Dome Cheval Tent
Hamilton Beach TrueAir Plug-Mount Odor Eliminator	T-Fal Avante Deluxe 4-Slice Toaster
Harbinger Pro Series Workout Glove	Tangle DNA Speakers
Harry and David Fancy Fruit Buffet - Ready to Serve Dried Fruit Medley	Tanita Duo Scale with Body Fat/Water Monitor
Harry and David Super Moose Munch® Party Drum -Caramel Popcorn, Chocolates, S'Mores etc.	TAO 1.5" Digital Keychain Photo Frame
Heelys Men's Octane	Tempur-Pedic Neck Pillow
Hitch iPod2iPod USB Transfer Device	Texas Instruments TI-83 Plus Graphing Calculator
Hohner Meisterklasse Harmonica, Key of D	Thanko FM/MP3 Watch 1GB
Holmes Medium Room Cool Mist Humidifier	The Adventures of Indiana Jones - The Complete DVD Collection (1981)
HoMedics Therapist Select Quad-Action Percussion Massager	The Complete Idiot's Guide to Weight Training and Body Sculpting (2 Paperbacks)
HoMedics Therapist Select Shiatsu Massaging Cushion	The Lord of the Rings - The Motion Picture Trilogy (Platinum Series Special Extended Edition) (2004)

Honeywell .54-Cubic-Foot Shelf and Floor Anti-Theft Safe with Digital Keypad	The Office - Season One (2005)
Honeywell Platinum Air Purifier	The Simpsons - The Complete Tenth Season (1989)
Hoover Tempo Widepath Bagged Upright Vacuum	Timberland Men's Chest Logo Full Zip Sweatshirt
HP Photosmart Printer	Timberland Men's Lexington Sport Oxford
imation 2GB USB 2.0 Clip Flash Drive with Carabineer and Rubberized Shell	Timberland Stratham Claremont Laptop Messenger Bag
iNeed™ Lumbar Massage Pillow	Timberland Treeline Travel Gear Back Pack Large
James Bond Ultimate Edition - Vol. 1	Timex Men's Chrono Alarm Watch
KEM Playing Cards (Paisley, 100% Cellulose Acetate Plastic)	Tortuga Original Caribbean Rum Cake, 33 Ounce Cake
Kensington DomeHub USB 2.0 (7 ports) Weighted Hub	Tripod Speaker for MP3 Player
Kodak EasyShare 6.2MP Digital Camera with 3X Optical Zoom	Valeo Yoga Kit
Koolatron Kool Fridge	Victorinox Hanging Toiletry Kit by Swiss Army
KORG Digital Metronome and Instrument Tuner	Victorinox Swiss Army Credit Card-Size Multi-Tools with LED Light
LAMPS PLUS Blue and Yellow Silver Base Lava Lamp	Victorinox Swiss Army Explorer Multitool Knife
Latin Percussion Mini Tunable Wood Conga	Victorinox Travel Wallet First Class by Swiss Army
Levi's Relaxed Straight 559 Jeans	Video Watch with OLED Screen
Levitating Desktop Globes	VIOLight Ultraviolet Toothbrush Sanitizers
Linksys Wireless-G Router	VIOLight Ultraviolet Travel Toothbrush Sanitizers
Logitech 2.4 GHz Cordless Presenter with Laser Pointer	Water Powered Multifunction Alarm Clock
Logitech Cordless Laser Mouse	Welcom WearEver Deluxe Aluminum Hi-Back Backpack Chair
Logitech Gaming Keyboard	Zelco Bookmark Dictionary

Supplemental Table 2. Results of random-effects logistic regression analysis for hypothetical dummy specification. We pooled the data of hypothetical/real/surprise real trials and incorporated dummy variables for the hypothetical and the surprise real trials. Hence the model includes purchase decision as a dependent variable (yes=1, no=0), and DV, Hypothetical Dummy (1 if a given trial is hypothetical; 0 otherwise), Surprise Real Dummy (1 if a given trial is surprise real; 0 otherwise) as independent variables with subject random effects. Note that only the hypothetical dummy variable is significant—subjects’ purchase behavior in the surprise real trials was not significantly different from that in the real trials. The trials with missed responses (purchase decisions) were removed, leaving 3590 trials, instead of 3600.

	Coefficient	S.E.	z	p-value	95% Confidence Interval	
DV	0.182	0.006	29.14	<0.0001	0.169	0.194
Hypothetical Dummy	1.139	0.120	9.51	<0.0001	0.904	1.373
Surprise Real Dummy	0.066	0.119	0.55	0.58	-0.167	0.299
Constant	-1.352	0.100	-13.49	<0.0001	-1.548	-1.156

Supplementary Table 3. Individual Differences in Hypothetical Bias. The following regression model was estimated at an individual subject level: $Real\ WTP = \alpha + \beta \times Hypothetical\ WTP + \varepsilon$. The estimated parameters are reported in the table below. Subjects' real WTP for a product was substantially reduced compared to the hypothetical WTP, but the degree of reduction varied across subjects.

Subject	β	α
1	0.698	1.706
2	0.386	0.173
3	0.529	-1.834
4	0.783	-0.065
5	0.660	0.503
6	0.273	-0.320
7	0.496	0.502
8	0.185	-0.441
9	0.688	-0.961
10	0.119	-0.650
11	0.351	-1.103
Mean	0.470	-0.226
Median	0.496	-0.320

Supplemental Table 4. Areas showing activity in the contrast of the parametric regressor for hypothetical decision making (Hypothetical*mDV).

Region	Laterality	BA	MNI coordinates			Z	Voxels
Caudate, Lentiform Nucleus	L		-6	3	6	4.12	54
<i>Extra-Nuclear</i>	L		-12	-2	-12	3.75	
Anterior Cingulate	L	32	-3	30	-9	3.98	47
<i>Medial Frontal Gyrus,</i>	L	10/11	-6	39	-6	3.80	
<i>Medial OFC</i>							
<i>Subcallosal Gyrus</i>	L		-12	21	-15	3.17	
Thalamus	L		-3	-6	3	3.79	14
Medial Frontal Gyrus, Medial OFC	L	10	12	33	-12	3.40	6
Caudate Head	R		6	15	0	3.34	8

Height threshold: $T_{(23)} = 3.485$, $p < 0.001$ (uncorrected); extent threshold, $k = 5$ voxels. L: left; R: right.

Supplemental Table 5. Areas showing activity in the contrast of the parametric regressor for real decision making (Real*mDV).

Region	Laterality	BA	MNI coordinates			Z	Voxels
Medial Frontal Gyrus, Medial OFC	L	10	-9	36	-6	4.95	223
<i>Anterior Cingulate</i>	R	32	9	33	-9	4.12	
Caudate Head, Putamen, Thalamus	R		12	15	-3	4.49	522
<i>Sub-lobar</i>	R		9	0	-9	4.30	
<i>Anterior Cingulate, Corpus Callosum</i>	L	32	-6	33	12	4.30	
Inferior Frontal Gyrus	L	13/47	-33	18	-12	4.47	107
Middle Frontal Gyrus	L		-24	48	3	3.55	7
Anterior Cingulate	R	32	12	27	30	3.37	9

Height threshold: $T_{(23)} = 3.485$, $p < 0.001$ (uncorrected); extent threshold, $k = 5$ voxels. L: left; R: right.

Supplemental Table 6. Conjunction analysis: areas showing conjointly significant activations modulated by mDV in both real and hypothetical decision making.

Region	Laterality	BA	MNI coordinates			Z	Voxels
Anterior Cingulate	L	32	-6	30	-9	3.86	43
<i>Medial Frontal Gyrus</i>	L	10	-6	39	-6	3.80	
Sub-lobar	L		-3	3	-6	3.66	28
Medial Frontal Gyrus, Medial OFC	R	11	9	36	-12	3.35	6
Caudate Head	R		9	15	0	3.34	7

Height threshold, $T_{(23)} = 3.485$, $p < 0.001$ (uncorrected); extent threshold, $k = 5$ voxels. L: left; R: right.

Supplemental Table 7. Areas showing activity in the contrast of the DV parametric regressor for hypothetical decision making (Hypothetical*DV).

Region	Laterality	BA	MNI coordinates			Z	Voxels
Sub-lobar	L		-6	3	-3	4.03	98
<i>Caudate</i>	L		6	9	-9	3.92	
Medial Frontal Gyrus, Medial OFC	L	10/32	-6	30	-12	3.97	74
<i>Anterior Cingulate</i>	L	32	0	42	-6	3.70	
<i>Subcallosal Gyrus</i>	L		-12	21	-15	3.47	

Height threshold: $T_{(23)} = 3.485$, $p < 0.001$ (uncorrected); extent threshold, $k = 5$ voxels. L: left; R: right.

Supplemental Table 8. Areas showing activity in the contrast of the DV parametric regressor for real decision making (Real*DV).

Region	Laterality	BA	MNI coordinates			Z	Voxels
Anterior Cingulate, Medial OFC	L		-6	33	-9	5.14	962
<i>Anterior Cingulate</i>	L		-6	33	12	4.93	
<i>Medial Frontal Gyrus</i>	L		-12	30	33	4.64	
Insula	L	47	-36	18	-9	4.98	145
<i>Inferior Frontal Gyrus</i>	L	47	-21	24	-18	4.78	
Insula	R	13	30	18	-9	3.84	25
<i>Inferior Frontal Gyrus</i>	R	47	27	24	-18	3.55	

Height threshold: $T_{(23)} = 3.485$, $p < 0.001$ (uncorrected); extent threshold, $k = 5$ voxels. L: left; R: right.

Supplemental Table 9. Conjunction analysis: areas showing conjointly significant activations modulated by DV in both real and hypothetical decision making.

Region	Laterality	BA	MNI coordinates			Z	Voxels
Medial Frontal Gyrus, Medial OFC	L	32/10	-6	30	-12	3.97	66
<i>Anterior Cingulate</i>			0	42	-6	3.70	
Medial Globus Pallidus	L		-9	0	-6	3.79	77
Sub-lobar	R		6	3	-6	3.58	
Caudate Head	R		9	15	-3	3.50	

Height threshold, $T_{(23)} = 3.485$, $p < 0.001$ (uncorrected); extent threshold, $k = 5$ voxels. L: left; R: right.

Supplemental Table 10. Areas showing activity in the contrast of real vs. hypothetical decision making.

Region	Laterality	BA	MNI coordinates			Z	Voxels
Anterior Cingulate, Medial OFC	L	11/32	-3	39	-9	3.74	16
Subgenual/ Subcallosal Gyrus	L	25	0	12	-9	3.64	8
Frontal Lobe Sub-Gyral	R		27	30	15	3.49	13
Medial Frontal Gyrus	L	25	-12	36	-12	3.37	5

Height threshold: $T_{(23)} = 3.485$, $p < 0.001$ (uncorrected); extent threshold, $k = 5$ voxels. L: left; R: right.

Supplemental Table 11. Areas showing activity in the difference of the parametric regressors (Real*mDV – Hypothetical*mDV).

Region	Laterality	BA	MNI coordinates			Z	Voxels
Anterior Cingulate, Medial OFC	L	11/32	-12	33	-3	4.36	56
Caudate Head	R		12	15	-6	4.05	22
Corpus Callosum	R		12	24	12	3.81	8
Inferior Frontal Gyrus	L	47	-27	9	-18	3.8	39
Caudate Head	R		3	3	3	3.59	11
Middle Frontal Gyrus	L		-30	48	9	3.54	5
Anterior Cingulate	L	32	-6	30	24	3.53	42
Anterior Cingulate	R	32	6	36	24	3.22	8

Height threshold, $T_{(23)} = 3.485$, $p < 0.001$ (uncorrected); extent threshold, $k = 5$ voxels. L: left; R: right.

Supplemental Table 12. Areas showing activity in the difference of the parametric regressors (Real*DV – Hypothetical*DV).

Region	Laterality	BA	MNI coordinates			Z	Voxels
Anterior Cingulate	L	32/24	-12	33	-3	3.66	18
Insula, Inferior Frontal Gyrus	L	47	-27	21	-3	3.34	49
<i>Middle Frontal Gyrus,</i>	L	11/47	-24	24	-18	3.18	
<i>Orbital Gyrus</i>							
Medial Frontal Gyrus, Anterior Cingulate	L	9/32	-12	30	33	3.28	11
Caudate, Putamen	R	25	15	3	-9	3.22	27
	R		9	3	-15	2.95	
	R		12	18	-6	2.94	
Anterior Cingulate	R	32	12	36	27	3.17	38
Sublobar	L		-30	0	24	2.97	10
Anterior Cingulate, Middle Frontal Gyrus	R	32	15	33	0	2.96	10
Caudate	L		-3	0	-3	2.92	19
	R		6	3	3	2.87	
Caudate	R		18	12	15	2.89	6
Caudate Head	L		-9	18	6	2.89	9
Medial Frontal Gyrus, Medial OFC	L	11/25	-3	21	-21	2.88	6
Subcallosal Gyrus	L	34	-12	3	-12	2.78	5

Height threshold, $T = 2.81$, $p < 0.005$, uncorrected; extent threshold, $k = 5$ voxels. L: left; R: right.

Supplemental Table 13. PPI Analysis. Regions showing task related functional connectivity with the acc (differentially for Real > Hypothetical conditions).

Region	Laterality	BA	MNI coordinates			Z	Voxels
Middle Frontal Gyrus	L	10	-42	36	21	4.52	77
<i>Inferior Frontal Gyrus</i>	L	46	-39	30	9	3.87	
Medial Frontal Gyrus	R	9	6	39	27	4.11	62
Inferior Frontal Gyrus	L	47	-42	15	-3	4.01	35
Superior Frontal Gyrus	L	10	-24	39	30	3.87	44
Inferior Frontal Gyrus	R		24	24	-3	3.86	57
<i>Caudate Head, Subcallosal Gyrus</i>	R	25	9	6	-12	3.83	
Medial Frontal Gyrus, Medial OFC	L	11/47	-12	21	-15	3.82	22
Inferior Frontal Gyrus	R	11/47	27	24	-21	3.72	18
Caudate Head, Putamen	L		-12	9	-3	3.63	29

Height threshold, $T_{(23)} = 3.485$, $p < 0.001$ (uncorrected); extent threshold, $k = 15$ voxels. L: left; R: right.

Supplemental Table 14. Individual difference in sensitivity of choice probability to mDV. The following logistic regression model was estimated for hypothetical and real trials, respectively, at an individual subject level. $\text{Decision} = \alpha + \beta \times \text{mDV} + \varepsilon$, where decision is 1 if a subject chose to buy and 0 otherwise. β coefficients for real trials are larger than those for hypothetical trials (signed rank test, one-sided, p -value<0.032, z -value=1.860). Subject 1 was not included in the analysis since he used a cut-off rule in hypothetical trials and therefore his β coefficient for these trials could not be reliably estimated.

Subject	β for Real trials	β for Hypothetical trials
2	0.113	0.164
3	0.185	0.279
4	2.580	1.588
5	0.598	0.398
6	0.101	0.121
7	0.333	0.348
8	0.143	0.077
9	0.573	0.317
10	1.020	0.617
11	0.736	0.828
12	0.082	0.106
13	0.248	0.196
14	0.472	0.233
15	0.383	1.268
16	0.708	0.654
17	1.528	0.457
18	0.311	0.334
19	0.935	0.380
20	0.458	0.565
21	1.088	0.127
22	0.267	0.369
23	0.647	0.468
24	0.390	0.275
Median	0.458	0.348
Mean	0.604	0.442
Std. Dev	0.564	0.367