

**Course ID and Title:** PSYC 551  
Decision Neuroscience  
**Prerequisites:** Instructor Permission  
**Semester and day/time:** Spring 2018, Mon and Wed 2:00 PM-3:50 PM  
**Classroom:** GFS 201  
**Professor:** Antoine Bechara  
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Office hours: by appointment  
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### **Course Description**

Most of us are taught from early on that logical, rational calculation forms the basis of sound decisions. Emotion has no IQ, and it can only clouds the mind and interferes with good judgment. But what if these notions were wrong? What if sound, rational decision making in fact depended on prior accurate emotional processing? The studies of decision making in neurological patients who can no longer process emotional information suggest just that. This course covers how our knowledge about the neuroscience of decision-making, and more specifically how affect and emotion plays a role in influencing decisions, is beginning to be utilized to offer information about (a) expected investor behavior and risk taking; (b) to give marketers new ways to determine what products and services are likely to interest specific categories of investors; (c) to understand what makes people resist or seek new information technology; and (d) a few attempts have also been made to understand political behavior (i.e., why for example people vote the way they do). And not to forget that understanding the neuroscience of decision-making has a strong relevance to health, where many behaviors (e.g., substance addiction), or even making healthy choices (e.g., eating healthy) are better understood when we consider how the brain makes decisions. In this seminar course, open to all USC graduate students, and also senior undergraduates, we will review the latest results of research on this newly emerging field.

This course should be of interest to students in psychology, economics, neuroscience, information systems and technology, as well students enrolled in the political sciences, and social sciences, since all these disciplines have vested interest in understanding decision-making and how people make choices. This course will cover the most established neuroscientific theory of decision-making, namely the Somatic Marker Theory, in a lecture format, accompanied by presentations of latest research on the topic of decision neuroscience. The research articles that will be covered in this course will include neuroscience studies of decision-making at the individual level, including the brain mechanisms behind memory, risk, reward and punishment learning, valuation, motivation, and self-control. Experimental methodologies adopted in these studies will be primarily functional and/or structural neuroimaging, and human lesion (neurological/ neuropsychological) studies, but this will not exclude studies that may cover genetic profiling, psychopharmacological manipulations, psychophysiology (EMG, ERP, and EEG), blood chemistry (and hormone) analysis, and single neuron recording, among others.

### **Learning Objectives**

This seminar course will cover neuroscience theories (e.g., the Somatic Marker Theory) of decision-making that address the influential role of emotion in decision-making. Research articles that will be covered will include neuroscience studies of decision-making, risk, reward and punishment learning, valuation, motivation, and self-control from various disciplines (e.g., neurology, economics, marketing, information technology, etc.). Experimental methodologies

adopted in these studies will be primarily functional and/or structural neuroimaging, and human lesion (neurological/ neuropsychological) studies, but this will not exclude studies that may cover genetic markers, pharmacological manipulations, and psychophysiology (EMG, ERP, and EEG), among others. All these topics will be addressed through lectures, readings, presentations, and class discussions.

The key learning objectives are:

1. To enhance the student's understanding of how the brain makes decisions in real life, and particularly how emotion plays a key role.
2. To facilitate the student's ability to use knowledge from one field (e.g., the neuroscience of decision-making) and apply it to other fields (e.g., understanding consumer, investor, or voter behavior).
3. To learn about the contexts under which emotion could be helpful or disruptive to making advantageous decisions.

**Prerequisite(s)**

No prerequisites for graduate students. Undergraduates in senior year are allowed to enroll with instructor permission. No specific pre-requisites required, but priority is given to graduate students.

**Co-Requisite (s)**

None

**Concurrent Enrollment**

None

**Recommended Preparation**

None.

**Course Notes**

Course syllabus, slides from presentations in class, and reading assignments will be posted on Blackboard as the course progresses.

There is a collection of articles and reading assignments that are listed in the syllabus. PDFs of these articles will be posted on Blackboard, but it is also the responsibility of the student to locate and obtain a copy of the assigned articles. Slides used in class lectures, and in student presentations will be posted on Blackboard and accessible to registered students.

**Attendance and Student Responsibilities**

Students are held responsible for all topics covered in class. Students are also responsible for all announcements or schedule changes that are made in class. Attendance at examination is mandatory. Students must receive permission in advance from the Instructor to be excused from attending an examination at the scheduled time. A rescheduling of time to take the exam will be arranged.

**Technological Proficiency and Hardware/Software Required**

NA

**Required Readings and Supplementary Materials**

There are no required texts for the course, but there are recommended books for readings. All lecture slides presented in class will be posted on Blackboard and accessible to registered students. PDFs of articles and reading assignments will be provided as well, but it is the

responsibility of the student to locate and obtain a copy of the assigned articles. There are two recommended books that complement the neuroscience materials that will be covered in lectures:

1. Descartes' Error: Emotion, Reason, and the Human Brain. Author: Antonio R. Damasio, 1994.
2. The Hour Between Dog and Wolf: Risk Taking, Gut Feelings and the Biology of Boom and Bust. Author: John Coates, 2012.

### **Description and Assessment of Assignments**

The course will include (1) three presentations by each student throughout the course and leading the class discussion. Each presentation will consist of a choice of *(a) presenting the articles assigned for a given class (selected by the Instructor and listed in the syllabus below), or (b) researching on your own a recent article (more up-to-date than the ones listed) on the same topic addressed in the listed articles*. For each presentation, the student will make a power point presentation, will present the topic in a lecture style, and will lead the discussion in class; (2) there are assessments of participation in class discussions for all non-presenting students; (3) there is a term paper on decision-neuroscience due after Spring Break; and (4) one final exam.

1. Student presentations and leading class discussion: Each student will be asked to make three presentations during the course and lead the class discussion on a topic from the list of classes provided below. This presentation should include:

a) A summary of the key scientific information discussed in the article. The objective is to advance the student's training on how to clearly communicate scientific findings to audiences (i.e., in this case, their classmates). More specifically, each presentation should include:

- i. An introduction and background for the presentation, i.e., review some of the literature that led to the study. Most importantly, frame the problem, i.e., explain why the study is significant and important.
- ii. Description of the study (methods, results, or description of the theory/concept).
- iii. A critique of the study: what do you see as significant about the study? How do you think this line of research advancing the field/topic of the study you presented? How do you recommend a better way for pursuing the research in order to provide a better advancement of the field?

b) During the presentation, the student is expected to show an understanding of the scientific methods used in the article to analyze ideas and obtain and interpret data. If the article is a review paper, then the student is expected to master the concepts presented in the paper.

c) During the presentation, the student is expected to stimulate class discussion about the significance of the presented findings, and the hypotheses and theories that were tested, as well as their implications for society.

The student will be evaluated based on the overall assessment of the extent to which the presentation is clear, concise, organized, and reflects an understanding of both assigned course readings, and perhaps the student's own independent investigation of the literature on the topic. The grade will also reflect the extent to which the student is able to engage the class in a deep and useful discussion, and answer questions posed by other students in a thoughtful and responsive manner.

During the first week of classes, the course instructor will present an introduction to decision neuroscience, and the Somatic Marker Theory. This will provide a learning example for the students on how they should make their presentations and discussions in future classes. During the first week, students will be assigned the dates of their presentations. The order of selecting students will follow the alphabetical order of their last name. However, there is flexibility in that 2 students could swap the date of their presentation after informing the course instructor.

2. Participation in class discussion: Evaluation is based on the quality of comments, and engagement in discussions of each class presentation. High quality contributions will reflect both a depth and breadth of knowledge gained from the assigned readings, and they should be clearly stated and effectively communicated, and they also should be insightful and relevant to the issues under discussion. Although the quantity of comments is important, students should refrain from monopolizing discussions and should aim to be succinct. It is also important to note that while students who engage in the discussion receive the higher grade, those who only attend and listen still receive a grade. Those who skip classes may find their class participation grade as poor.

3. Term paper: It should be 14-15 pages in length, and it should be written in an APA style. The paper must be double-spaced, typed in Arial 11-point font, with 1" margins. Papers are due by e-mail to bechara@usc.edu by 5:00pm on the date indicated below. Each term paper will be a group project: **two students will be assigned to write one paper as a group**, and both will receive the same grade for their group effort. The topic of the paper is about "Decision Neuroscience", but each paper should cover the following topics:

- a. Conduct a review of the literature since the Somatic Marker Hypothesis and identify the theories/concepts that describe the functions of the prefrontal cortex and the neural networks that sub-serve decision-making. In conducting this review, make a critique of each theory/concept by answering the following questions:
  - i. Is the new theory/concept or proposed prefrontal cortex function similar to the notion of the Somatic Marker Hypothesis (SMH)?
  - ii. Is it similar to the SMH, except that it uses different terms and definitions so that it appears different from the SMH, but the fundamentals are the same?
  - iii. Is it fundamentally different from the SMH?

b. Write a section where you express your own opinion (but should be backed up by scientific citations whenever possible) on the following questions:

What do you think is the future of Neuroeconomics, or Neuromarketing, or any other social behavior field starting with "neuro-" (just pick one field), given our current knowledge about the neuroscience of decision-making?

How knowledge about the neuroscience of decision-making could help us advance the fields of Economics, or Marketing, or other "neuro-" fields?

To reiterate, while this part of the paper asks about your opinion, you do need to demonstrate how the opinion is supported by findings from science by citing relevant literature. You will be graded based on your argument, and use of scientific evidence.

4. A final exam: This will have short answers format. Questions will be based on the slides presented by the instructor in his lectures. You are not responsible for the slides presented by students in class. All exam questions will be based on information presented and discussed in class, and not on any outside materials.

## **Grading Breakdown**

The final grade in the course will be based on the following weights:

Class presentation/discussion leadership 1	15%
Class presentation/discussion leadership 2	15%
Class presentation/discussion leadership 3	15%
Participation in class discussion	10%
Term paper	25%
Final Exam	20%

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<b>Final Grade</b>	<b>100%</b>
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## **Assignment Submission Policy**

All papers must be double-spaced, typed in Arial 11 point font, with 1" margins. Papers are due by e-mail to bechara@usc.edu by 5:00pm on the date indicted below. Additional information about papers will be presented in class.

## **Additional Policies**

NA

## **Statement on Academic Conduct and Support Systems**

### **Academic Conduct**

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct/>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu/> or to the *Department of Public Safety* <http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>.

This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage [sarc@usc.edu](http://sarc@usc.edu) describes reporting options and other resources.

### **Support Systems**

A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* [http://sait.usc.edu/academicsupport/centerprograms/dsp/home\\_index.html](http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html) provides certification for students with disabilities and helps arrange the relevant

accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu/> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

**Course Schedule: A Weekly Breakdown**

	<b>Topics/Daily Activities</b>	<b>Readings and Homework</b>	<b>Deliverable/ Due Dates</b>
<b>Week 1</b> Dates: Class 1: 1/8/18	1. Course Introduction (1): Phineas Gage-Historical Overview	Lecture slides Chapters 1 and 2 of Descarte’s Error.	Participate in class questions and discussions.
Class 2: 1/10/18	2. Course Introduction (2): Applications of neuroscience to economics, marketing.	Lecture slides Chapters 3 and 4 of Descarte’s Error.	Participate in class questions and discussions.
<b>Week 2</b> Dates: Class 1: 1/15/18	1. Martin Luther King Holiday.		
Class 2: 1/17/18	2. The Neurology of Decision-Making: The Somatic Marker Hypothesis (SMH).	Lecture Slides Chapter 5 and 6 of Descarte’s Error.	Participate in class questions and discussions.

<b>Week 3</b> Dates: Class 1: 1/22/18	1. <u>Lecture:</u> Testing the SMH: -The Iowa Gambling Task (IGT).  <u>Student presentation (45 minutes).</u>	Lecture Slides Chapter 7 and 8 of Descarte’s Error.  See 3a below	Participate in class questions and discussions.  Presentation of assigned readings by student
Class 2: 1/24/18	2. <u>Lecture:</u> Testing the SMH: -Emotion biases decisions. -Biases do not need to be conscious.  <u>Student presentation (45 minutes).</u>	Lecture Slides Chapter 9 of Descarte’s Error.  See 3b below	Participate in class questions and discussions.  Presentation of assigned readings by student

<p><b>Week 4</b> Dates: Class 1: 1/29/18</p> <p>Class 2: 1/31/18</p>	<p>1. <u>Lecture:</u> Testing the SMH: -Other brain structures involved in DM.</p> <p><u>Student presentation</u> (45 minutes).</p> <p>2. <u>Lecture:</u> Testing the SMH: -Useful vs disruptive role of emotion in DM.</p> <p><u>Student presentation</u> (45 minutes).</p>	<p>Lecture Slides The Hour Between Dog and Wolf</p> <p>See 4a below</p> <p>Lecture Slides The Hour Between Dog and Wolf</p> <p>See 4b below</p>	<p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p> <p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p>
<p><b>Week 5</b> Dates: Class 1: 2/5/18</p> <p>Class 2: 2/7/18</p>	<p>1. <u>Lecture:</u> Testing the SMH: -Risk vs Ambiguity.</p> <p><u>Student presentation</u> (45 minutes).</p> <p>2. <u>Lecture:</u> Testing the SMH: -Role of Gender, left vs right lesions.</p> <p><u>Student presentation</u> (45 minutes).</p>	<p>Lecture Slides The Hour Between Dog and Wolf</p> <p>See 5a below</p> <p>Lecture Slides The Hour Between Dog and Wolf</p> <p>See 5b below</p>	<p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p> <p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p>
<p><b>Week 6</b> Dates: Class 1: 2/12/18</p> <p>Class 2: 2/14/18</p>	<p>1. <u>Lecture:</u> Testing the SMH (4): -Criticisms of the SMH.</p> <p><u>Student presentation</u> (45 min).</p> <p>2. <u>Lecture:</u> Testing the SMH (4) cont'd: -Criticisms of the SMH.</p> <p><u>Student presentation</u> (45 min).</p>	<p>Lecture Slides</p> <p>See 6a below</p> <p>Lecture Slides</p> <p>See 6b below</p>	<p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p> <p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p>

<p><b>Week 7</b> Dates: Class 1: 2/19/18</p> <p>Class 2: 2/21/18</p>	<p><b>1. President's Day Holiday</b></p> <p>2. <u>Lecture:</u> - Decisions and behaviors not covered by the SMH (1): habits.</p> <p><u>Student presentation (45 min).</u></p>	<p>Lecture Slides</p> <p>See 7b below</p>	<p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p>
<p><b>Week 8</b> Dates: Class 1: 2/26/18</p> <p>Class 2: 2/28/18</p>	<p>1. <u>Lecture:</u> - Decisions and behaviors not covered by SMH (2): self-control.</p> <p><u>Student presentation (45 min).</u></p> <p>2. <u>Lecture:</u> - Decisions and behaviors not covered by SMH (2): urge.</p> <p><u>Student presentation (45 min).</u></p>	<p>Lecture Slides</p> <p>See 8a below</p> <p>Lecture Slides</p> <p>See 8b below</p>	<p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p> <p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p>
<p><b>Week 9</b> Dates: Class 1: 3/5/18</p> <p>Class 2: 3/7/18</p>	<p>1. <u>Lecture:</u> -More specific processes of DM: gain vs loss, time, ambiguity vs risk.</p> <p><u>Student presentation (45 min).</u></p> <p>2. <u>Lecture:</u> -More specific processes of DM: gain vs loss, time, ambiguity vs risk (cont'd).</p> <p><u>Student presentation (45 min).</u></p>	<p>Lecture Slides</p> <p>See 9a below</p> <p>Lecture Slides</p> <p>See 9b below</p>	<p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p> <p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p>



<b>Spring Break March 12-16</b> <b>Term Paper is due at the beginning of Week 10</b>			
<b>Week 10</b> Dates: Class 1: 3/19/18  Class 2: 3/21/18	1. <u>Lecture</u> : Applications to behavioral addictions: pharmacological.  <u>Student presentation (45 min).</u>	Lecture Slides  See 10a below	Participate in class questions and discussions.  Presentation of assigned readings by student.
	2. <u>Lecture</u> : Applications to behavioral addictions: behavioral.  <u>Student presentation (45 min).</u>	Lecture Slides  See 10b below	Participate in class questions and discussions.  Presentation of assigned readings by student.

<b>Week 11</b> Dates: Class 1: 3/26/18  Class 2: 3/28/18	1. <u>Lecture</u> : Topics in Neuroeconomics: uncertainty, loss aversion.  <u>Student presentation (45 min).</u>	Lecture Slides  See 11a below	Participate in class questions and discussions.  Presentation of assigned readings by student.
	2. <u>Lecture</u> : Topics in Neuroeconomics: intertemporal choice.  <u>Student presentation (45 min).</u>	Lecture Slides  See 11b below	Participate in class questions and discussions.  Presentation of assigned readings by student.

<b>Week 12</b> Dates: Class 1: 4/2/18  Class 2: 4/4/18	1. <u>Lecture:</u> Topics in Neuroeconomics: moral judgment and corrupt behavior.  <u>Student presentation (45 min).</u>	Lecture Slides  See 12a below	Participate in class questions and discussions.  Presentation of assigned readings by student.
	2. <u>Lecture:</u> Topics in Neuroeconomics: emotional intelligence (EQi).  <u>Student presentation (45 min).</u>	Lecture Slides  See 12b below	Participate in class questions and discussions.  Presentation of assigned readings by student.

<b>Week 13</b> Dates: Class 1: 4/9/18  Class 2: 4/11/18	1. <u>Lecture:</u> Topics in Neuromarketing.  <u>Student presentation (45 min).</u>	Lecture Slides  See 13a below	Participate in class questions and discussions.  Presentation of assigned readings by student.
	2. <u>Lecture:</u> Topics in Neuromarketing (cont'd).  <u>Student presentation (45 min).</u>	Lecture Slides  See 13b below	Participate in class questions and discussions.  Presentation of assigned readings by student.

<p><b>Week 14</b> Dates: Class 1: 4/16/18</p> <p>Class 2: 4/18/18</p>	<p>1. <u>Lecture</u>: Topics in NeuroLaw: Decision-making gone awry.</p> <p><u>Student presentation</u> (45 min).</p> <p>2. <u>Lecture</u>: Open discussions of prior topics.</p> <p><u>Student presentation</u> (45 min).</p>	<p>Lecture Slides</p> <p>See 14a below</p> <p>See 14b below</p>	<p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p> <p>Presentation of assigned readings by student.</p>
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<p><b>Week 15</b> Dates: Class 1: 4/23/18</p> <p>Class 2: 4/25/18</p>	<p>1. Developmental Aspects of the Brain and Behavior: Why teenagers do crazy things? What happens when we get older?</p> <p><u>Student presentation</u> (45 min).</p> <p>2. Catch up on student presentations. -Open questions and answers. -Reviews for final</p>	<p>Lecture Slides</p> <p>See 15a below</p>	<p>Participate in class questions and discussions.</p> <p>Presentation of assigned readings by student.</p>
<p><b>FINAL</b> Date</p>			<p>Date: For the date and time of the final for this class, consult the USC <i>Schedule of Classes</i> at <a href="http://www.usc.edu/soc">www.usc.edu/soc</a>.</p>

## **Readings and Homework**

### **Decision Neuroscience in Economics (Neuroeconomics):**

**Readings for 3a:** Overview of the field of neuroeconomics.

Safney et al., Neuroeconomics: cross-currents in research on decision-making. *TRENDS in Cognitive Sciences* Vol.10 No.3 March 2006.

**Readings for 3b:** Prospect Theory and Risk as Feelings theories of decision-making.

Lowenstein, G. F., Hsee, C., Weber, E. U. and Welch (2001), Risk as feelings, *Psychological Bulletin*, 127:2, 267-286.

Trepel et al. Prospect theory on the brain? Toward a cognitive neuroscience of decision under risk. *Cognitive Brain Research* vol 23, p. 34-50, 2005.

**Readings for 4a:** Research on neural basis of economic games

Glimcher et al. Neuroeconomics: The Consilience of Brain and Decision. *Science* 306, 447, 2004.

**Readings for 4b:** Research on financial risk taking; neural basis of gains versus loss, and loss aversion.

Dickhaut, J. 2009. The Brain as the Original Accounting Institution. *The Accounting Review* 84 (6): 1703-1712.

Kuhnen, C. M. and Knutson, B. (2005), The neural basis of financial risk-taking, *Neuron* 47:5, 763-770.

Tom, S. M., Fox, C. R., Trepel, C. and Poldrack, R. A. (2007), The neural basis of loss aversion in decision making under risk, *Science*, 315, 515-518.

**Readings for 5a:** Inter-temporal choice and delay discounting.

McClure, S. M., Laibson, D. I., Loewenstein, G. and Cohen, J. D. (2004). Separate neural systems value immediate and delayed monetary rewards, *Science*, 306, 503-507.

Xu, L, Liang, ZY, Wang, K, Li, S, and Jiang, T (2009). Neural mechanism of intertemporal choice: From discounting future gains to future losses. *Brain Research*, 1261:65-74.

**Readings for 5b:** The framing effect.

Benedetto De Martino, et al. Frames, Biases, and Rational Decision-Making in the Human Brain. *Science* 313, 684 (2006);

Deppe et al. Evidence for a neural correlate of a framing effect: Bias-specific activity in the ventromedial prefrontal cortex during credibility judgments. *Brain Research Bulletin* 67 (2005) 413-421.

**Readings for 6a:** Expectancy and experience of monetary gains and losses.

Breiter, H. C., Aharon, I., Kahneman, D. et al (2001), Functional imaging of neural response to expectancy and experience of monetary gains and losses, *Neuron*, 30, 619-639.

Knutson et al. Distributed Neural Representation of Expected Value. *The Journal of Neuroscience*, May 11, 2005 • 25(19):4806-4812

**Readings for 6b:** Reward prediction error.

Bayer and Glimcher. Midbrain Dopamine Neurons Encode a Quantitative Reward Prediction Error Signal. *Neuron*, Vol. 47, 129–141, July 7, 2005.

Schultz et al. A Neural Substrate of Prediction and Reward. *SCIENCE*, VOL. 275, 1997.

**Readings for 7b:** Neural correlates of valuation.

Sugrue, L. P., Corrado, G. S., and Newsome, W. T. (2005), Choosing the greater of two goods: neural currencies for valuation and decision making, *Nature Reviews Neuroscience*, 6, 363-375.

Montague, P. R., and Berns, G. S. (2002), Neural economics and the biological substrate of valuation, *Neuron*, 36, 265-284.

**Readings for 8a:** Neural correlates of risk versus ambiguity.

Huettel, S. A., Stowe, C. J., Gordon, E. M. (2006), Neural signature of economic preferences for risk and ambiguity, *Neuron*, 49, 765-775.

Hsu, M., Bhatt, M., Adolphs, R. et al (2005), Neural responding to degrees of uncertainty in human decision making, *Science*, 310, 1680.

### **Decision Neuroscience in Marketing (Neuromarketing):**

**Readings for 8b:** Neural correlates of branding.

McClure, S. M., Li, J., Tomlin, D. et al (2004), Neural Correlates of Behavioral Preference for Culturally Familiar Drinks, *Neuron*, 44, 379-387.

Ratnayake, N., A. J Broderick, and R. L.C Mitchell. 2010. A Neurocognitive Approach to Brand Memory. *Journal of Marketing Management* 26 (13-14): 1295-1318.

**Readings for 9a:** Neural correlates of the attraction effect.

Hedgcock, W., and A. R Rao. 2009. Trade-off Aversion as an Explanation for the Attraction Effect: A Functional Magnetic Resonance Imaging Study. *Journal of Marketing Research* 46 (1): 1-13.

Commentaries and Rejoinder to 'Trade-Off Aversion as an Explanation for the Attraction Effect: Huettel, S. and A. J. W Payne. 2009. A Functional Magnetic Resonance Imaging Study'. Integrating Neural and Decision Sciences: Convergence and Constraints. *Journal of Marketing Research* 46 (1): 14-24.

**Readings for 9b:** Neural predictors of purchases.

Knutson et al. Neural Predictors of Purchases. *Neuron* 53, 147–156, January 4, 2007.

**Readings for 10a:** Neural responses to ads and commercials.

Plassmann H, Ambler T, Braeutigam S & Kenning P. (2007). What can advertisers learn from neuroscience? *International Journal of Advertising*, 26 (2).

**Readings for 10b:** Neuroscience of consumer behavior (1).

Mishra, A., and H. Mishra. 2010. We Are What We Consume: The Influence of Food Consumption on Impulsive Choice. *Journal of Marketing Research* 47 (6): 1129-1137.

**Readings for 11a:** Neuroscience of consumer behavior (2).

Reimann et al. Leveraging the Happy Meal Effect: Substituting Food With Modest Nonfood Incentives Decreases Portion Size Choice. *Journal of Experimental Psychology: Applied*, Vol. 21, No. 3, 276–286, 2015.

Reimann et al. Can Smaller Meals Make You Happy? Behavioral, Neurophysiological, and Psychological Insights into Motivating Smaller Portion Choice. *JACR*, volume 1 (1), 71-91, 2016

Reimann et al. Can Smaller Meals Make You Happy? Appendix from JACR and Supplemental materials, 2016.

### **Decision Neuroscience in Information Systems & Technology:**

**Readings for 11b:** NeuroIS.

Dimoka, A., P. A Pavlou, and F. D Davis. 2011. NeuroIS: The Potential of Cognitive Neuroscience for Information Systems Research. *Information Systems Research* 22: 687-702.

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