There is mounting recognition, across a variety of disciplines from philosophy to the cognitive sciences, about the importance of physical embodiment and skilled motor behavior for understanding cognition and experience. One rather direct consequence of this theoretical shift has been to question a traditional assumption concerning the relationship between perception and action—the idea that perception merely supplies inputs to autonomous cognitive and motor systems—and replace it with a view that emphasizes their complex interplay. In this course we will explore a range of philosophical and scientific issues as they pertain to understanding the manifold relationships between perception and motor action.

After reviewing some historically predominant theoretical approaches to visual perception and motor action in the literature, and the conceptions and theoretical assumptions of independence that underlie them, we will turn to consider several contemporary theories of visual perception that countenance a much tighter connection between visual perception and motor behavior. We will then go on to address some current debates about the plausibility of these views, especially in the light of recent empirical data coming from the neurosciences about the separate neural pathways or systems underlying conscious visual perception, on the one hand, and visuomotor control, on the other. Finally, we will end by considering a related matter—how an understanding of sensorimotor control and its neural substrates might help to shed light on the nature of representation in the brain more generally. Readings will be drawn from philosophy, psychology, and the neurosciences.

Mechanics:
This is an interdisciplinary course—drawing on philosophy, psychology and the neurosciences—however, the overall approach taken and means of student assessment will be more closely aligned with the discipline of philosophy. The ability to produce good philosophy starts with an ability and willingness to read good philosophical texts in a
careful manner. Accordingly, each session of the seminar will likely be focused on a
discussion of one or at most several articles and often we will spend more than one
session on a single piece. Lectures will serve to highlight the central issues relevant to the
target article or topic under consideration and situate the readings within a broader
context. will provide the necessary background for the interactive group discussion in the
session or sessions to follow. For graduate students, I will also specify one or more
supplementary pieces closely related to the target paper that should be read.

Each seminar participant will be required to read the target piece, and post a short (1
page) discussion paper, which has three main components. You will need to (1) identify
what you think is the most important insight/claim in the reading and say why; (2) identify
what aspect of the reading you take to be the most problematic, controversial, most
vulnerable to criticism and say why; and finally (3) list any additional points that you think
warrant further consideration and should be raised in the seminar discussion. Discussion
paper submission is to be done no later than 8:00PM the night before the class meeting.
No late papers will be accepted, although students can miss one discussion paper without
it affecting their grade. The discussion paper requirement will ensure that our class time is
optimally spent and that everyone comes to the discussion well prepared to be an active
discussion participant. In addition, these posted discussion papers will be available for the
entire class to read as well as respond to, providing another venue for exchange of ideas.
Each participant will also be required to lead the discussion during one class, maybe more,
depending on how many participants we have. These presentations will involve highlighting
the main claims of the target article, providing some critical analysis, and engaging the
other students’ posted commentaries.

In addition to these requirements, a short (5-7 page) paper (due earlier in the semester)
and a final paper of roughly 10-12 pages (due at latest at the official final examination time)
are required. Students should plan on submitting a 1-page outline of their final paper topic
roughly 1 month in advance of the due date, to ensure that each student has a workable
topic for the paper. Ideally, this outline would describe the main argumentative structure of
the paper. Students may also be able to turn in a draft of the paper for comments and
feedback, but this is not required. All written assignments, including the final paper, should
demonstrate critical engagement with the readings and subject matter and the ability to
articulate and defend some of your own thoughts on the topic under consideration. There
will also be a cumulative final exam to assess how well students have grasped the core
concepts and ideas covered throughout the course.

**Assessment:**
Each student will be responsible for leading at least one seminar discussion, worth 10%.
There will be a final exam worth 20% of the grade. The written component of the
assessment accounts for the remaining 70%, divided between the short 5-page paper,
worth 20%; the final paper, worth 40%; and weekly discussion papers will cumulatively be
worth 10% of the grade. Although the submission of papers will allow for anonymous
grading, expectations for graduate students will differ.
SCHEDULE OF READINGS: (*subject to change)
Traditional conceptions and debates about perception and action: philosophical and empirical (Weeks 2-5)

Introduction (Week 1)
Readings:
Noë and Thompson, “Introduction” [V&M]

Supplemental:
Wheeler, M. Reconstructing the Cognitive World, Chapter 1 (“Setting the Scene”).

PART 1: SEPARATE AND UNEQUAL?
Traditional conceptions and debates about perception and action: philosophical and empirical (Weeks 2-5)

Perception: Traditional philosophical conceptions and debates (Week 2)
Readings:
Dretske, F. “Sensation and Perception”.
Merleau-Ponty, M. “The ‘Sensation’ as a Unit of Experience”. [V&M]
Ben-Zeev, A. “The Passivity Assumption of the Sensation-Perception Distinction”.
Snowdon, P. “How to Interpret ‘Direct Perception’.

Supplemental:
Sense data and the objects of perception:
Russell, B. Chapter 1, Problems of Philosophy, “Appearance and Reality”
http://www.ditext.com/russell/rus1.html
Bermudez, J.L. “Naturalized Sense Data”
Firth, R. “Sense Data and the Percept Theory”
Crane, T. “The Problem of Perception”.
http://plato.stanford.edu/entries/perception-problem/
Pappas, G. “On Some Philosophical Accounts of Perception”.

Direct/indirect realism:
Wikipedia entry “Philosophy of Perception”.

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Sensation-Perception Distinction:
Atherton, M. “The Origins of the Sensation/Perception Distinction”.

**Perception: Orthodoxy in Psychology: Inferential Approaches (Week 3)**

**Readings:**
Gregory, R. “Perception as Hypotheses”. [V&M]
Hatfield, G. “Perception as Unconscious Inference”.

**Supplemental:**
Rock, I. “Inference in Perception”.
Stich, S. “Beyond Inference in Perception”.
Howe, C. et al. “Comparison of Bayesian and Empirical Ranking Approaches to Visual Perception”.

**Perception: Orthodoxy in Computational Vision and Visual Neuroscience:**
**Feature-detection-and-representation (Week 4)**

**Readings:**
Marr, D. Selections from *Vision*. [V&M]
Barlow, H.B. “Single Units and Sensation: A Neuron Doctrine for Perceptual Psychology?”
Teller, D. “Linking Propositions” [V&M]
Churchland, P.S. “Is the Visual System as Smart as it Looks?”

**Supplemental:**
Computational Vision:
Marr, D. “Artificial Intelligence—A Personal View”.
Kitcher, P. “Marr’s Computational Theory of Vision”.

Orthodox visual neuroscience:
Lettvin et al. “What the Frog’s Eye Tells the Frog’s Brain”.
D.H. Hubel & Wiesel, T.N. “Receptive Fields of Single Neurones in the Cat’s Striate Cortex”.
D.H. Hubel & Wiesel, T.N. “Receptive Fields and Functional Architecture of Monkey Striate Cortex”.
Martin, K.A.C. “A Brief History of the ‘Feature Detector’”.
Gross, C. “Genealogy of the Grandmother Neuron”.

BonJour, L. “Epistemological Problems of Perception”.
http://plato.stanford.edu/entries/perception-episprob/
Philosophy:
Churchland, “Neural Computation and Neural Representation”
Churchland, P.S. and Churchland, P.M. “Stalking the Wild Epistemic Engine”.
Churchland, P.S. “A Strategy for Mind-Brain Research”.

**Action: Traditional philosophical and empirical conceptions and debates (Week 5)**

**Readings:**
Rosenbaum, D. “The Cinderella of Psychology”.
Kandel, E. “Brain and Behavior”.

Philosophy:
Bratman, M. “The Two Faces of Intentional Action”.
Churchland, P.M. “The Logical Character of Action Explanations”.
Davidson, D. “Action, Reasons, and Causes”.

Motor Neuroscience:
Wolpert and Jordan “Computational Motor Control”.
Kandel et al. Ghez and Krakauer “Organization of Movement” and “Voluntary Movement”.
Rosenbaum and Jordan “Motor control”.
Rosenbaum, D.A. “Motor Control”.

**PART 2: TOGETHER AT LAST**

Anatomical and behavioral evidence for perception-action coupling and subsequent theoretical developments (Weeks 6-8)

**Anatomical and Behavioral Evidence (Week 6)**

**Readings:**
Felleman, D.J. Van Essen, D.C. “Distributed Hierarchical Processing in the Primate Cerebral Cortex”.

Supplemental:
Ballard, D. “Animate Vision”.
Ballard, D. “Deictic Codes for the Embodiment of Cognition”.
Land, M.F. “Motion and Vision: Why Animals Move Their Eyes”.
Land, M.F. & McLeod, P. “From Eye Movements to Actions: How Batsmen Hit the Ball”.

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Land, M.F. & Furneaux, S. “The Knowledge Base of the Oculomotor System”.

**Theoretical Developments (Weeks 7-8):**

**Readings:**
- Gibson “A Theory of Direct Visual Perception” [V&M]
- Ben-Zeev, A. “J.J. Gibson and the Ecological Approach to Perception”.
- Evans “Molyneux’s Question”. [V&M]
- Grush, R. “Skill and Spatial Content”.
- Aizawa, K. “Understanding the Embodiment of Perception”.
- Block, N. “Review of Action in Perception”.

**Supplemental:**
- Cussins, A. “Content, Conceptual Content, and Nonconceptual Content”.

**PART 3: THE PARTIAL SEPARATION AND OTHER THEORETICAL CONSEQUENCES**

**Recent debates and complications for sensorimotor views (Weeks 9-15)**

**Readings:**
- Gibson, J.J. “A Theory of Affordances”.
- Chemero, A. ‘An Outline of a Theory of Affordances”.
- Scarantino, A. “Affordances Explained”.
- Fodor, J. & Pylyshyn, Z. “How Direct is Direct Perception?”.

**Dual Visual Processing Streams and Sensorimotor Views (Week 10)**

**Readings:**
- Goodale, M. & Milner, D. *Sight Unseen*.
- Clark, A. “Visual Experience and Motor Action: Are the Bonds Too Tight?”

**Supplemental:**
- Goodale, M.A. & Milner, A.D. “Separate Visual Pathways for Perception and Action”.
- Ingle, D. “Two Visual Systems in the Frog”.
- Trevarthen, C.B. “Two Mechanisms of Vision in Primate”.

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Weighing the Empirical Evidence and Alternative Theoretical Interpretations (Weeks 11-12)

Readings:
Clark, A. “What Reaching Teaches”.
Aglioti, S. DeSouza, J.F.X., Goodale, M.A. “Size-Contrast Illusions Deceive the Eye but not the Hand”.
Wolpert, D.M., Ghahramani, Z., Jordon, M.I. “Perceptual Distortion contributes to the Curvature of Human Reaching Movements”.
Glover, S. “Visual Illusions Affect Planning but not Control”.
Johnson, H. & Haggard, P. “Motor Awareness without Perceptual Awareness”.

Supplemental:
Empirical:
Ganel T, Goodale MA: “Visual Control of Action but not Perception Requires Analytical Processing of Object Shape”.
Hu, Y. & Goodale, M.A. “Grasping After a Delay Shifts Size-Scaling from Absolute to Relative Metrics”.
Ellis, R., Flanagan, J. & Lederman, S. "The Influence of Visual Illusions on Grasp Position".
Wong, E. & Mack, A. “Saccadic Programming and Perceived Location”.

Theoretical:
Jeannerod, M. & Jacob, P. "Visual cognition. A new look at the two visual systems model".
Obhi, S.S. & Haggard, P. “Free Will and Free Won’t”.

Sensorimotor Control and the Nature of Representation: Robotics (Week 13)

Readings:
Brooks, R. “Intelligence Without Representation”.
Chemero, A. “Representation and ‘Reliable Presence’”.

Supplemental:
Kirsh, D. “Today the Earwig, Tomorrow Man?”
Sensorimotor Control and the Nature of Representation: Human Motor Behavior (Week 14)

Readings:
Van Gelder, T. “Dynamics and Cognition”.
Grush, R. “In defense of Some ‘Cartesian’ Assumptions Concerning the Brain and Its Operation”.

Supplemental:
Van Gelder, T. “What Might Cognition Be If Not Computation?”
Van Gelder, T. “The Dynamical Hypothesis in Cognitive Science”.
Grush, R. “The Emulation Theory of Representation”.
Grush, R. “The Architecture of Representation”.
Clark, A. “Being, Computing, Representing”.
Chemero, A. “Anti-Representationalism and the Dynamical Stance”.
Miall et al. “Is the Cerebellum a Smith Predictor?”
Haselanger et al. “Representationalism vs. Antirepresentationalism: A Debate for the Sake of Appearance”.

Wrapping up (Week 15)
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