Conditioning and associative learning

バーナード・バレイン教授（シドニー大学）

2012.3.26（月）～29（木）

玉川大学大学研究室棟 B107＆B101

（小田急線「玉川学園前」駅より徒歩約10分）

定員:100名(事前申込不要・参加無料)

「学習研究」における第一人者
バーナード・バレイン教授が、
基礎から応用まで扱う集中講義を行います。
皆様のご参加をお待ちしております。

Bernard Balleine

Professor
Brain & Mind Research Institute,
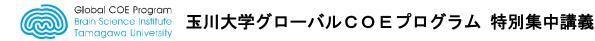**School of Medical Sciences**
The University of Sydney

Conditioning and associative learning

3／26（月）10:00-13:00 ＜大学研究室棟　B107＞
Lecture 1. **Basic learning processes**

3／27（火）10:00-13:00 ＜大学研究室棟　B107＞
Lecture 2. **Pavlovian excitatory and inhibitory conditioning**

3／28（水）10:00-13:00 ＜大学研究室棟　B101＞
Lecture 3. **Theories of Pavlovian conditioning**

3／29（木）10:00-13:00 ＜大学研究室棟　B107＞
Lecture 4. **Instrumental conditioning**

＊講義はすべて英語で行われます

Professor Bernard Balleine's research aims to understand the neural bases of the learning and motivational processes that control volitional, or goal-directed, action, an issue that has direct bearing on our developing understanding of the role that the integration of cognitive and emotional systems plays in executive functions and decision-making. He is particularly interested in the division between the essential systems and circuits that mediate goal-directed as opposed to reflexive or habitual actions and the role of primary motivation in reward and reinforcment processes. Professor Balleine received his BA with first class honours and the University Medal from the University of Sydney in 1987 and his Ph.D in comparative psychology from the University of Cambridge in 1993. He was elected to a Research Fellowship at Jesus College Cambridge in 1993 and, in 1996, appointed Assistant Professor at the University of California, Los Angeles. He was made Associate Professor in 2000 and full professor in 2004. In 2005 he was appointed Director of Research in the Brain Research Institute at UCLA. He won an inaugural Australian Laureate Fellowship in 2009, and is currently Laureate Professor and Director of the Behavioural Neuroscience Laboratory in the Brain & Mind Research Institute, Sydney University.

Lectures on Conditioning and Associative Learning

Professor Bernard Balleine
Brain & Mind Research Institute, University of Sydney

2012.03.26-29 玉川大学大学研究室棟　Ｂ104 ＆ Ｂ107

3／26 (mon) 10:00-13:00　Lecture 1. **Basic learning processes**

3／27 (tue)　10:00-13:00　Lecture 2. **Excitatory and inhibitory conditioning**

3／28 (wed) 10:00-13:00　Lecture 3. **Theories of conditioning**

3／29 (thu) 10:00-13:00　 Lecture 4. **Instrumental conditioning**

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Lecture 1. **Basic learning processes**

Outline.
- Introduction to the series
- Overview of learning processes and some terminology

- Introduction to lecture 1.
- Assumptions behind associative learning
- The nature of events
- Theoretical issues relating to event representation
- Evaluative vs. predictive learning

In this lecture I will first provide an overview of basic learning processes, particularly of two forms of conditioning; classical, or Pavlovian, conditioning and instrumental (sometimes called operant) conditioning. I will then introduce the associative analysis of these forms of learning and consider some of the fundamental assumptions such analyses make, particularly those relating to the processing of events, the general process assumption and assumptions relating to the adaptive significance of conditioning and the representation of causal relations. Consideration of these issues brings to the fore two other forms of learning that are not usually given as much central consideration, notably the effects of simple exposure to environmental events generally, and the effect of exposure to biologically significant events in particular. I will consider phenomena such as habituation, sensitization and evaluative conditioning during the course of this assessment and discuss issues surrounding the appropriate control conditions for studies of learning based on these phenomena.

General References:

Dickinson, A. (1980). Contemporary Animal Learning Theory. Cambridge: Cambridge University Press.

Macintosh, N.J. (1983). Conditioning and Associative Learning. Oxford: Oxford University Press.

References for this lecture:

Balleine, B. W. (2004). Incentive Behavior. *The Behavior of the Laboratory Rat: A Handbook With Tests*. I. Q. Whishaw and B. Kolb. Oxford, Oxford Univeristy Press**:** 436-446.

Hollis, K.L. (1997) Contemporary research on Pavlovian conditioning: A new functional perspective. American Psychologist, 52, 956-965.

Rankin, C.H. et al (2009). Habituation revisited: An updated and revised description of the behavioral characteristics of habituation. Neurobiology of Learning and Memory, 2, 125-126.

Rescorla, R.A. 9!988). Pavlovian conditioning: Its not what you think it is. American Psychologist, 43, 151-160.

Lecture 2. **Excitatory and inhibitory conditioning**

Outline.
- Appetitive and aversive conditioning
- What is learned in excitatory conditioning?
- On the relationship between the CR and UR
- Konorski's theory of conditioning
- Conditioned inhibition and extinction
- Contextual control of extinction
- What is learned in conditioned inhibition?

This lecture will summarize fundamental observations in Pavlovian excitatory and inhibitory conditioning. Beginning with excitatory conditioning, examples of appetitive and aversive conditioning will be presented. I will then assess evidence for what is learned in Pavlovian conditioning, contrasting behavioral stimulus-response theory against a cognitive, stimulus-stimulus, alternative. This evidence supports a description of conditioning based on Pavlov's stimulus-substitution theory. However, much needs to be added to that theory to correctly characterize excitatory conditioning. Most notably, the Pavlovian conditioned response often doesn't resemble the unconditioned response. Generally, however, it is sufficient to note that the Pavlovian US is not a simple event and much of the variability in the CR -UR identity can be ascribed to inadequately specifying the UR conditioned to the CS in many situations. I will then go on to review Konorski's theory of Pavlovian excitatory conditioning and, subsequently, inhibitory conditioning and describe current views of conditioned inhibition and the tests required to observe it. This assessment will focus on the feature-negative situation and on extinction. With regard to the latter, I will describe experiments demonstrating the context dependency of inhibition induced by extinction and some implications of that view for observing its inhibitory process. Finally, a general view of the structure of Pavlovian excitatory and inhibitory learning will be elaborated.

References:

Bouton, M.E. (2004). Context and behavioral processes in extinction. Learning & Memory, 11, 485-494.

Delamater, A. (2012). On the nature of CS and US representations in Pavlovian learning. Learning & Behavior, 40, 1-23.

Konorski, J. (1967). Integrative Activity of the Brain. Chicago: Chicago University Press

Recorla, R.A. (1988). Behavioral studies of Pavlovian conditioning. Annual Review of Neuroscience, 11, 329-352.

Pickens, C.L. & Holland, P.C. (2004). Conditioning and cognition. Neuroscience & Biobehavioral Reviews, 28, 651-661.

<u>Lecture 3</u>. **Theories of conditioning**

Outline.
- Contiguity and contingency
- Predictive validity
- Blocking and overshadowing
- US processing: Rescorla-Wagner theory
- Problems with US processing theories
- CS processing: Mackintosh and Pearce-Hall theories
- Problems with CS processing theories
- Wagner's SOP theory and variations
- Recent hybrid theories

I will review theories of Pavlovian conditioning starting with the notion that learning is driven by CS-US contiguity. Problems for contiguity theory prompted a variety of alternatives beginning with contingency and relative validity views that, based on evidence of associative competition from phenomena such as blocking and overshadowing, were ultimately formalized into a US processing approach, most notably the Rescorla-Wagner theory. This has been a highly successful theory that has generated a number of important predictions associated with overexpectation and conditioned inhibition. However, problems have also been identified providing the impetus for a range of alternative theories, notably the CS-processing theories of Mackintosh and of Pearce and Hall but also Wagner's Sometimes Opponent Process (SOP) theory. Although moderately successful, these views have also had difficulties explaining specific phenomena prompting still further revisions and the development of hybrid theories. There is currently no universally accepted theory of Pavlovian conditioning.

References:

LePelley, M. (2004). The role of associative history in models of associative learning: a selective review and a hybrid model. <u>The Quarterly Journal of Experimental Psychology</u>, 57, 193-243.

Mackintosh, N.J. (1975). A theory of attention: Variations in the associability of stimuli with reinforcement. <u>Psychological Review</u>, 82, 276-298.

Pearce, J.M. & Bouton, M.E. (2001). Theories of associative learning in animals. <u>Annual Review of Psychology</u>, 52, 111-139.

Pearce, J. M. & Hall, G. (1980). "A model for Pavlovian learning: variations in the effectiveness of conditioned but not of unconditioned stimuli." <u>Psychological Review</u>, 87, 532-552.

Rescorla, R. A. & Wagner, A.R. (1972). A theory of Pavlovian conditioning: Variations in the effectiveness of reinforcement and non-reinforcement. *In*<u>: Classical Conditioning II: Current Research and Theory</u>. A. H. Black and W. F. Prokasy. New York, Appleton-Century-Crofts: 64-99.

Wagner, A.R. (1981). SOP: A model of automatic memory processing in animal behavior. In N.E. Spear & R.R. Miller (Eds.), <u>Information processing in animals: Memory mechanisms</u> (pp. 5-47). Hillsdale, NJ: Erlbaum.

Lecture 4. **Instrumental conditioning**

Outline.
- Pavlovian vs. instrumental conditioning
- What is learned in instrumental conditioning?
- Stimulus control vs. action control
- Theories of instrumental learning
- The action-outcome contingency
- Loss of control: The development of behavioural autonomy
- Goal-directed vs. habitual actions
- Reward vs. reinforcement

Pavlovian conditioning allows animals to predict forthcoming events of biological significance. However, as stimulus-bound reflexes, Pavlovian conditioned responses are poorly suited to adapting to changes in environmental conditions to meet the challenges presented by predictive information. In order to do something new, animals have be able to exert control over their actions and to do so requires that they are sensitive to the relationship between actions and their consequences, a capacity that stems from their ability to engage in instrumental conditioning. In this lecture I will begin by reviewing the differences between Pavlovian and instrumental conditioning and the nature of instrumental conditioning experiments. I will then discuss issues in understanding what is learned in instrumental conditioning. Generally, evidence from outcome devaluation studies demonstrates that animals are able to encode the relationship between actions and their consequences and to use this information to develop a behavioural strategy. However, there are ways of explaining sensitivity to devaluation that do not require that animals use such highly cognitive abilities and that explains their behavior in reflexive terms by proposing a two process model composed of: (1) a stimulus-response learning process and (2) a Pavlovian stimulus-stimulus motivational process. Another alternative has proposed that Pavlovian *expectations* are the stimuli with which responses are associated. Recent evidence suggests that, although these alternatives ultimately fail to explain goal-directed instrumental actions, they could be used to explain the development of skills and, more importantly, habitual actions that develop with overtraining. I will consider the distinction between goal-directed actions and habits and go on to evaluate the learning and motivational processes that contribute to these forms of action control.

References

Balleine, B. W. (2001). Incentive processes in instrumental conditioning. Handbook of contemporary learning theories. R. M. S. Klein. Hillsdale, NJ, LEA**:** 307-366.

Colwill, R. M. and R. A. Rescorla (1986). Associative structures in instrumental learning. The psychology of learning and motivation. G. H. bower. Orlando FL, Academic Press. **20:** 55-104.

Dickinson, A. (1985). "Actions and habits: the development of behavioural autonomy." Philosophical Transactions of the Royal Society of London **B308**: 67-78.

Dickinson, A. (1994). Instrumental conditioning. Animal cognition and learning. N. J. Mackintosh. London, Academic Press**:** 4-79.