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ETH

Eidgenössische Technische Hochschule Zürich
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ZNZ Introductory Course in Neuroscience
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Mouse models of learning and memory

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Contents

Introduction

Mice are not small humans

- behavioral change as indirect measure of learning and memory
- How to motivate animals: aversively or appetitively motivated tasks
- disease models: face validity versus species-typical behavior

Mice are not small rats

- most rodent tests developed, validated and documented for rats
- different factors and limitations may be relevant to mice

Points to consider

- verify that necessary sensory and motor functions are intact
- changes of performance: consider differences in motivation
- changes of performance: consider altered expression of memory

Mouse models of nondeclarative memory

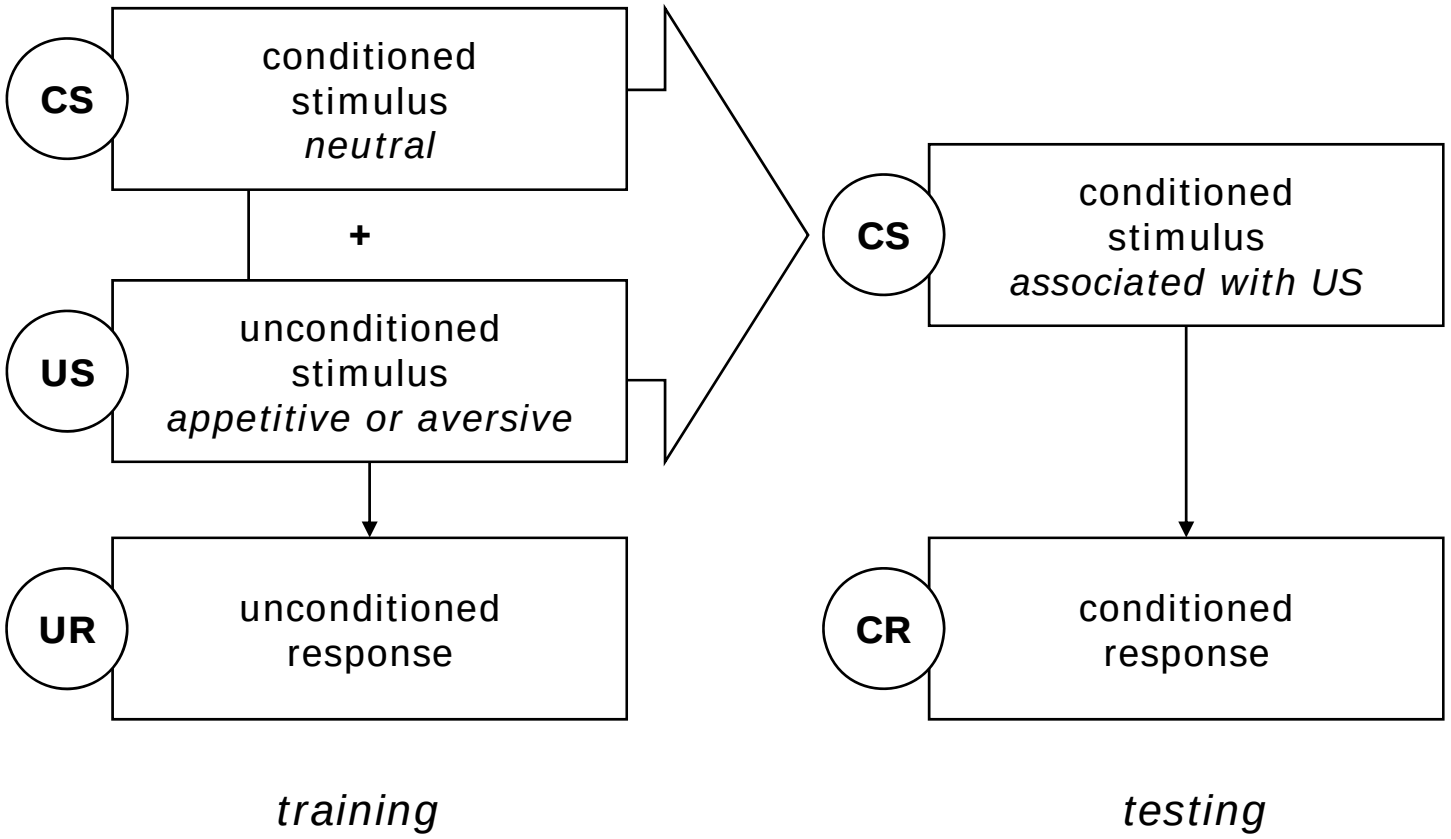
Associative

- classical (Pavlovian) conditioning: association of stimuli
  - fear conditioning (rats, mice - amygdala)
  - conditioned taste aversion (rats, mice – amygdala, cortex)
  - eye blink conditioning (rabbits, mice - cerebellum)
- operant conditioning: association of actions with outcomes
  - Skinner box (primates, birds, rats, mice - striatum)
  - Home cage testing environments (mice)

Nonassociative

- motor skill learning
  - rotarod, beam walking (rats, mice - motor system)
- habit learning
  - dry & water mazes, Skinner boxes (rats, mice - striatum)
- habituation, sensitization
  - startle reflex (rats, mice - brainstem)

Classical (Pavlovian) conditioning



Mouse models of declarative memory

- no assessment of conscious recollection or verbal expression in animals
- declarative memory defined indirectly through dependence on hippocampus
- no fully established model of episodic memory: “episodic-like” memory

Spatial reference and working memory

- place navigation in water-maze (rat, mouse)
- 8-arm radial maze (rat, mouse)
- T-maze alternation (rat, mouse)

Modified conditioning models

- contextual fear conditioning (rat, mouse)
- trace fear or eye blink conditioning (rabbit, rat, mouse)
- home cage testing environments (mouse)

Other models

- object recognition, D(N)MS = delayed (non) matching to sample (rat, primate)
- social recognition, social transmission of food preferences (rat, mouse)
- paired-associate tasks (rat, primates)

Newer approaches

Combining behavioral testing with in vivo microscopy

- imaging of cortical activity in behaving head-restrained mouse
- whisker stimulation and licking responses
- navigation in a virtual space

Touchscreen based tasks

- based on the principle of operant conditioning
- nosepoking at visual stimuli displayed on a touchscreen / tablet
- variation of stimulus similarity and attentional demands

Behavioral testing in the homecage

- home cage turned into operant conditioning chamber
- video-tracking of single housed animals (e.g. Noldus Phenotyper)
- transponder-tracking of socially housed animals (e.g. IntelliCage)