

Which animals feel pain?

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Introduction

- Aims:
 - understand criteria for pain perception
 - know which criteria for pain fish fulfil
 - understand consciousness and its importance
 - understand the importance of evolutionary theory
 - understand the arguments for and against pain in fish

A note on evolution

The picture shown in the lecture along with a very nice explanation of evolution can be found by using the link below.

[http://evolution.berkeley.edu/eosite/evo101/
VIIDTrends.shtml](http://evolution.berkeley.edu/eosite/evo101/VIIDTrends.shtml)

Definitions

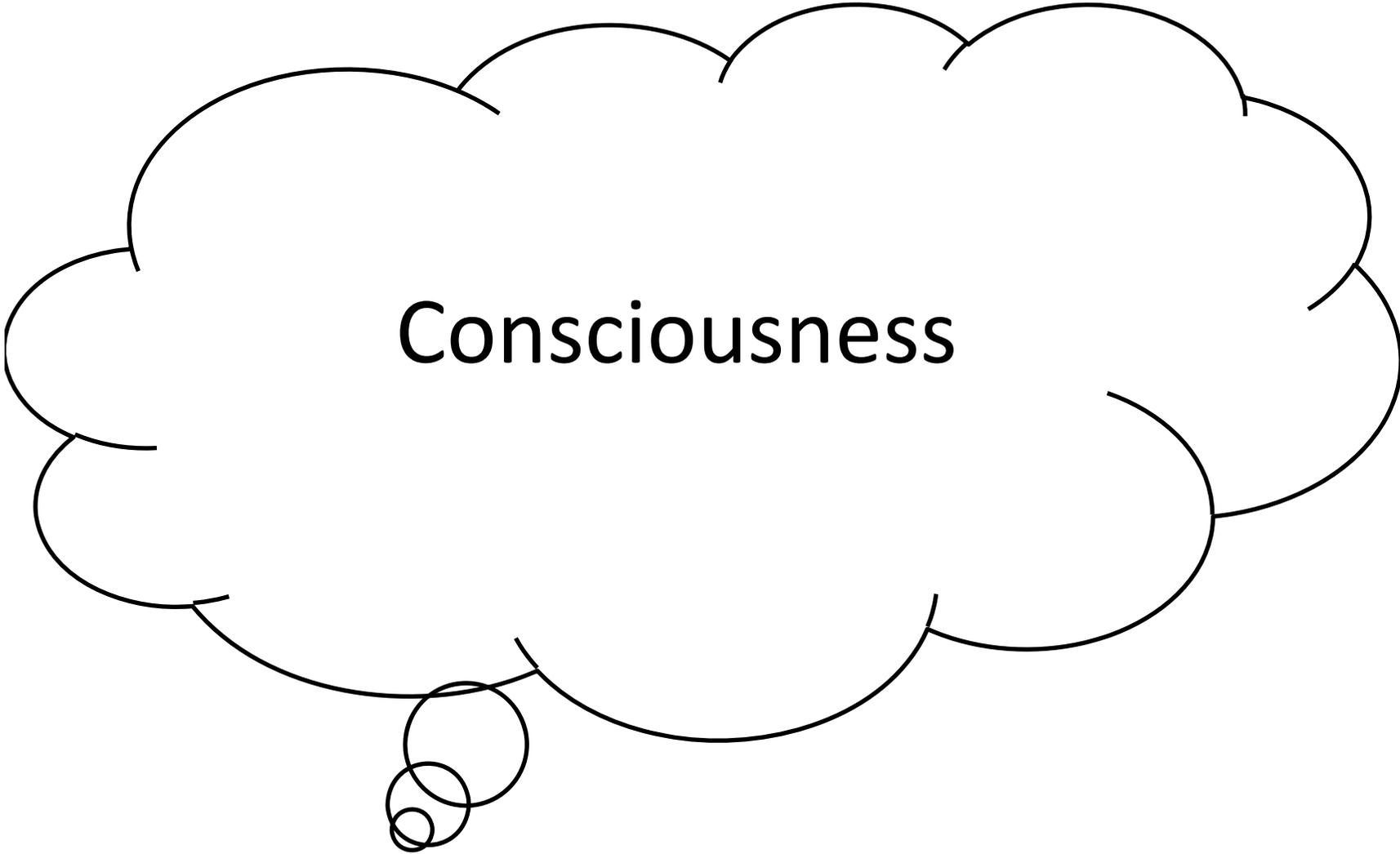
- Pain: “an unpleasant sensory and emotional experience associated with real or potential tissue damage, or described in terms of such damage”
- Nociception: “the neural processes of encoding and processing noxious stimuli”
- Nociceptor: “a sensory receptor that is capable of transducing and encoding noxious stimuli”
- Noxious stimulus: “an actually or potentially tissue-damaging event”

Operational definition

Dunstan et al. 1991; Bateson 1992

		FISH	CRUSTACEANS
1	Nociceptors	Yes	?
2	Brain areas with cortex-like function	Yes (but still discussed)	?
3	Neural pathways from nociceptor to cortex-like brain	Yes	?
4	Opioid receptors in the CNS	Yes	Yes
5	Analgesics modify responses to noxious stimuli + self-administration	Yes (self-administration not tested)	Yes (self-administration not tested)
6	Avoidance responses	Yes	Yes
7	Inelastic avoidance	Yes	Yes (?)
8	Persistent avoidance + associative learning	Yes	Yes

How can we approach the question of pain in animals?-what is the disagreement about?

A hand-drawn thought bubble with a scalloped border, containing the word "Consciousness" in a bold, black, sans-serif font. The bubble has three smaller circles attached to its bottom-left side, suggesting a trail of thought.

Consciousness

Consciousness

- General
 - Awareness of thoughts, memories, sensory input and feelings
 - Limited capacity: you are only conscious of few things at the time
- Definitions
 - *Phenomenal consciousness*: the experience of seeing, hearing, feeling pain, (= primary consciousness)
 - *Access consciousness*: the experience of being able to think about or report on a mental state either in the present or in the past (memory)
 - *Monitoring and self-consciousness*: the experience of thinking about one's own actions and their effects and if necessary modifying them.
- If we do not know whether an animal is conscious or not, then $P(\text{consciousness})=0.5$ (NOT 0)

Block, Dawkins, Braithwaite

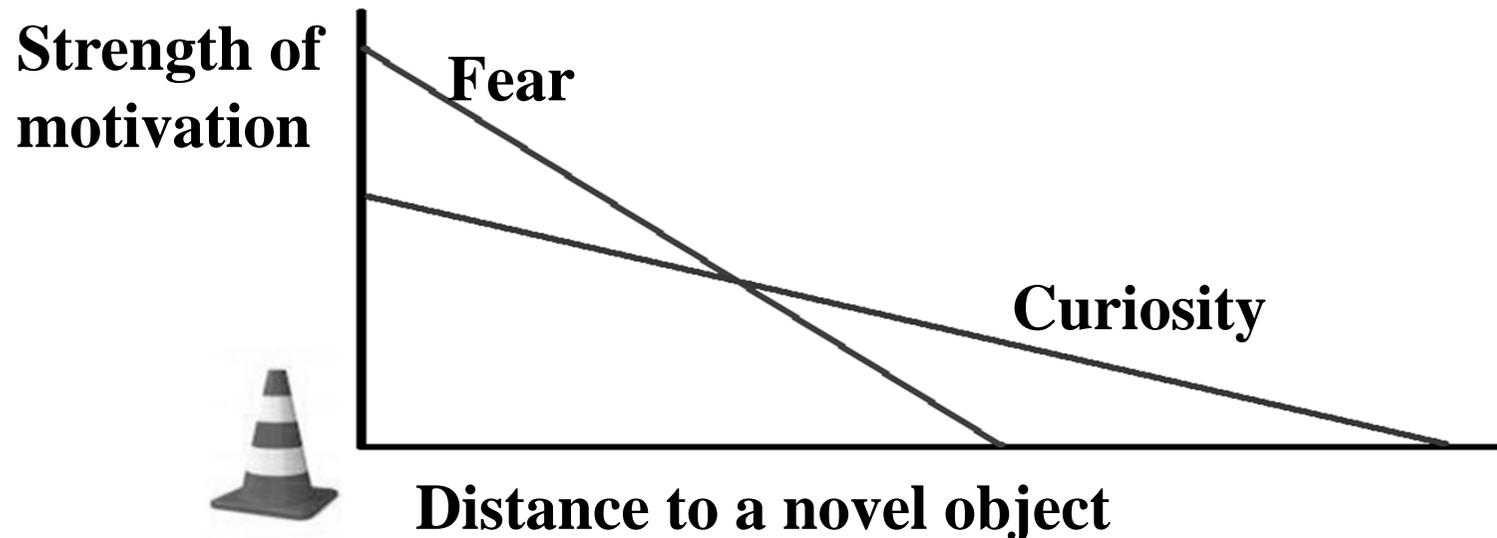
How can we know whether animals are conscious or not?

- Look for indicators of consciousness
 - we need to operationalize!

Operationalization

- We specify variables that we can measure as indicators of a non-measurable/non-observable phenomenon:
 - Novel object test: operationalization of fear

Millers model



Operationalization of pain

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Article

A Novel Behavioral Fish Model of Nociception for Testing Analgesics

Ana D. Correia ^{1,*}, Sérgio R. Cunha ², Martin Scholze ³ and E. Don Stevens ⁴

Operationalization of consciousness

- Is it possible?
- Balcombe 2009: '...let me point out the hypocrisy of any argument for the unprovability of animal conscious experience that nevertheless accepts its existence in humans. In the purest sense, human sentience is no more scientifically provable than is non-human sentience. Quite literally, one person cannot actually feel another's pain or pleasure. Do we thereby accept the non-existence of human sentience? No. We accept it, and with good reasonsThus, to accept the existence of sentience in humans while denying it in certain animals (say, birds) is scientifically and ethically inconsistent'

YES WE CAN!

Possible indicators of consciousness

- Neurophysiological correlates of consciousness
- Behavioural indicators of consciousness

Neurophysiology and neuroanatomy of fish compared to other vertebrates

- Old-fashioned view of vertebrate brain anatomy:
 - agnathans: olfactory brain
 - fish: olfactory brain + globus pallidus
 - amphibians: 'fish brain' + striatum
 - reptiles: 'amphibian brain' + primitive cortex
 - birds: 'reptile brain'-but more elaborate basal ganglia
 - mammals: 'reptile brain'-but more elaborated cortex
- Cortex-i.e. a laminated pallial telencephalon-is just one of many ways to organize a brain

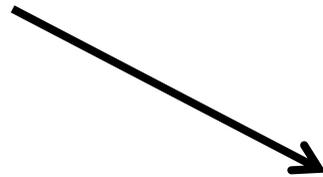
Opinion piece

**Non-laminar cerebral
cortex in teleost fishes?**

Consciousness in humans

- the type of activity may be more important than the specific anatomical structure
- beware of making general statements based on observations from one species:

humans are conscious and have a neocortex



consciousness requires a neocortex

- We do not yet understand consciousness in humans-Rose overinterprets the importance of the neocortex
- Merker 2005: The upper brainstem and midbrain are the essential structures for generating consciousness in vertebrates. The thalamocortical system of mammals adds new aspects to consciousness, but doesn't generate it.
- Convergent evolution should also be taken into account:
 - 'similarity between unrelated species occurs because of adaptation to similar environmental pressures'

Behavioural indicators of consciousness

1. The animal 'equivalent' to 'verbal report'
 - Language in parrots (Alex)

2. Behaviours/abilities that we think that only conscious animals can possess

- Mirror test (self-consciousness)
- Theory of mind
- **Declarative learning and memory: flexible behaviour in novel situations**
- **Goal-directed behaviour**

What is consciousness for?-a way to suggest behavioural indicators of consciousness

- Evolutionary adaptation
- Different theories
- Language? (Macphail)
- The link between learning and feelings?
(Dickinson & Balleine)

Finding corn:
learning

Eating corn:
good feeling

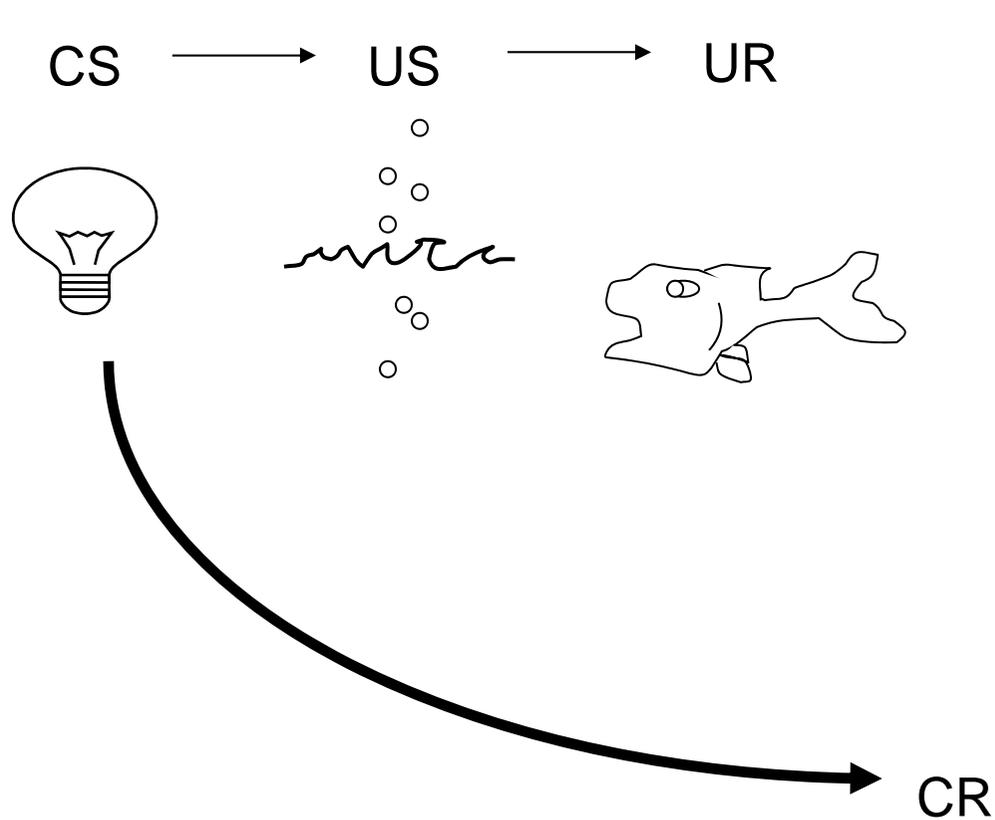
Phenomenal
consciousness:
linking feeling with learning

A fat, happy mouse that will have a lot of babies

Declarative learning

- Declarative learning/memory: knowledge of facts or events
- Flexible
- Dependent on consciousness

Classical conditioning



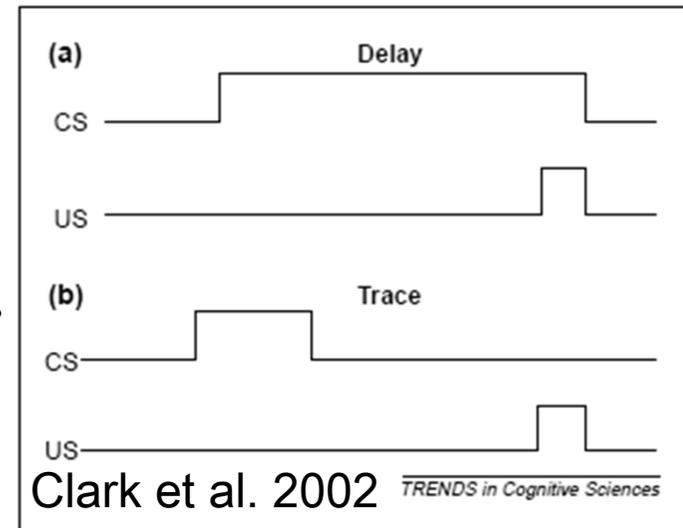
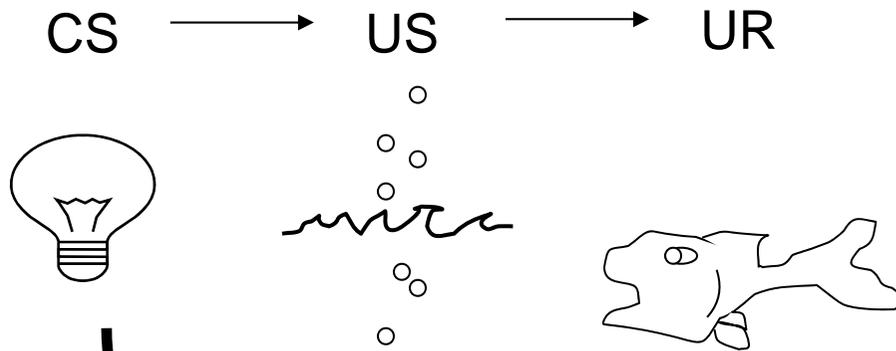
US=Unconditioned stimulus/ubetinget stimulus

CS=Conditioned stimulus/betinget stimulus

UR=Unconditioned response

CR=Conditioned response

Classical conditioning: what is actually learnt?



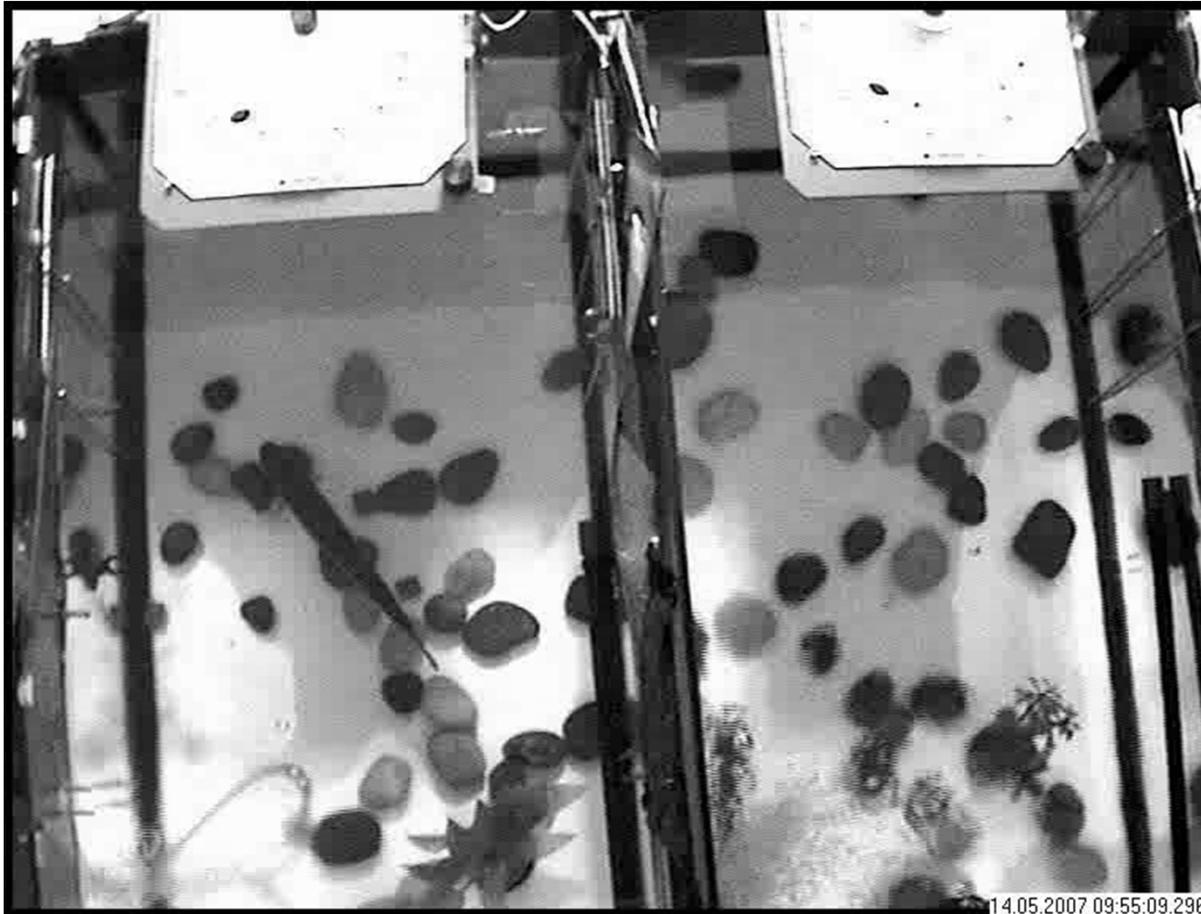
CR

Trace schedule: awareness of the CS+US contingency gives better score than non-aware and amnesics.

Delay schedule: consciousness of the CS+US contingency does not seem to influence the CR
(Clark et al. 2002)

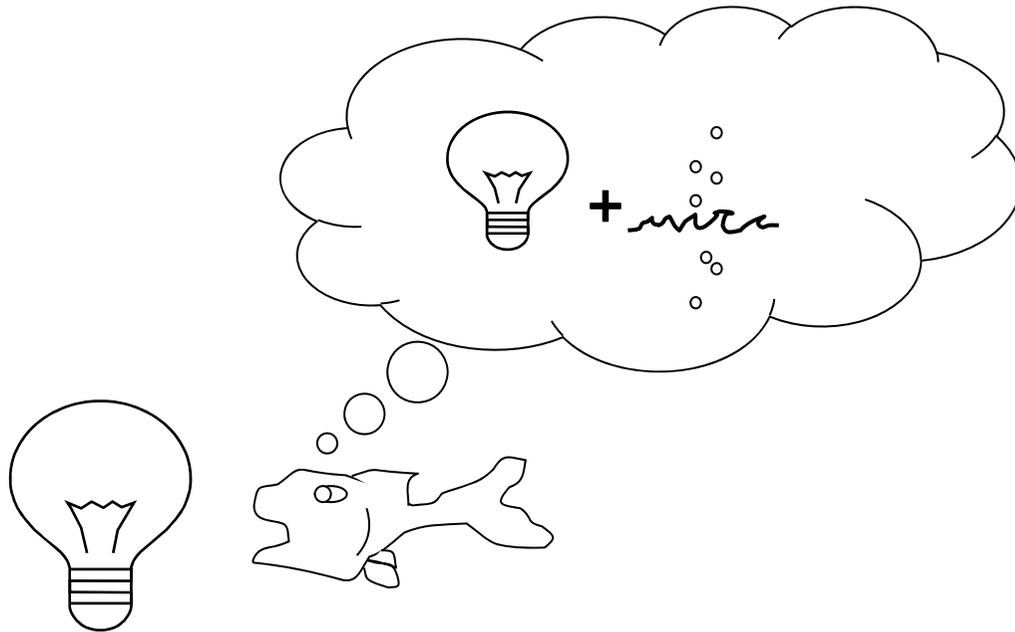
'Trace conditioning may provide a means for studying awareness in nonhuman animals' (Clark & Squire 1998)

Trace conditioning in rainbow trout (*Oncorhynchus mykiss*):
what do they learn?



Nordgreen et al. 2009

Conclusion



Trace conditioning is a declarative process
in rainbow trout

- A short discussion of fish behaviour:
 - Main claim (Rose et al. 2012): fish behaviour after surgery and tagging do not indicate pain
 - Implanting of radio transmitters in nest-guarding smallmouth bass-parental care resumed (Cooke et al. 2002)
 - Very few changes in behaviour after surgery that would be painful in humans (Rose et al. 2012)

Summary

- The main disagreement concerning pain in fish is over the question of consciousness in fish
- On the basis of neurophysiology and behaviour, the claims that fish lack both consciousness and pain are not supported
- Fish fulfil the operational criteria for pain perception, it is likely that they have consciousness: FISH FEEL PAIN
- There are a lot of things we do not know about consciousness in animals- fish included, but looking at consciousness as an evolutionary adaptation might help us ask relevant questions about it, and find good operational indicators for consciousness
- Animals in general hide signs of pain and illness, and fish are no exception. A good knowledge of behaviour is needed to detect subtle changes that might indicate pain
- '[Animals] do not speak as we do, but the scientific case that they have experiences is far stronger than the case that they do not' (Balcombe 2009)