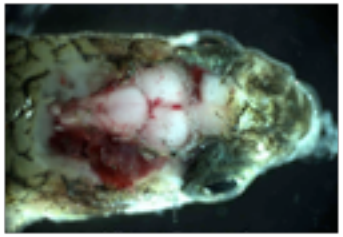

ON THE POSSIBLE REALIZERS OF PAIN IN FISHES

Colin Allen

University of Pittsburgh
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THE ARGUMENT

"there is as much evidence that fish feel pain and suffer as there is for birds and mammals"

"claims that fish feel pain remain unsubstantiated"

mild flu **Me, today**
a ~~pox~~ on both houses?

Proponents	Skeptics
similar behavior	deanthropomorphized behavior
+ neurological similarity	+ neurological *dis*similarity
=> fish pain	=> no fish pain

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REALIZERS OF *WHAT* ?

- "**Fish pain will not involve explicitly identifiable negative sensations**, generating fear, concern, and consciously organized protective behavior. Fish pain will be much less elaborate, involving **something *apprehended***, as an immediacy, **but not *comprehended***, as an unwelcome intrusion into the subjective being of fish."

- "**Any fish experience** will be part of a fragment, unconnected to a psychological self, and thus quite unlike our experiences. … [it] **should not be called pain** because it is **clearly far from the typical pain experience that we know**."

—Derbyshire 2016

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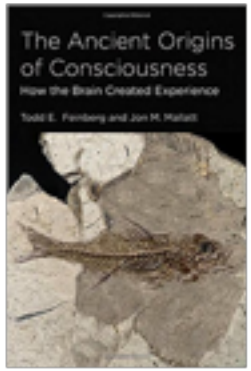
A PERIPHERAL ARGUMENT ABOUT FISH PAIN



Feinberg & Mallatt 2016

- "all of the jawed vertebrates could have fast, sharp pain"
- however, "fish seem to lack the pain associated with suffering"
  - based on reports of low C-fiber count

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PERIPHERAL FUNCTIONS

"It is reasonable to ask of **what functional significance** the **extremely small number of C fibers** might be in fishes. It appears **most logical to assume that** in teleosts, at least those species that have been studied, A-delta afferents serve to signal potentially injurious events rapidly, thereby triggering escape and avoidance responses, but that the paucity of C fibers that mediate **slow, agonizing, second pain and pathological pain** states (in organisms capable of consciousness) is **not a functional domain of nociception in fishes**."

—Rose et al. 2012

"IT APPEARS MOST LOGICAL TO ASSUME…"

Really?

- Unmyelinated C fibres associated with sensory systems besides nociception: warming, itching, etc.
- General sensory requirements very different for **terrestrial** than for **aquatic** animals
  - Air and gravity change almost everything: e.g., lower partial pressure of oxygen; rapid temperature fluctuations; balance and proprioception; stressed joints and broken bones
- The importance of timing:
  A (v. fast) fibers *vs.* A-delta (medium) fibers *vs.* C (slow) fibers

THE CENTRAL ARGUMENT

"The fundamental neural requirements for pain and suffering are now known. Fishes lack the most important of these required neural structures, and they have no alternative neural systems for producing the pain experience. Therefore, the reactions of fishes to noxious stimuli are nociceptive and without conscious awareness of pain."

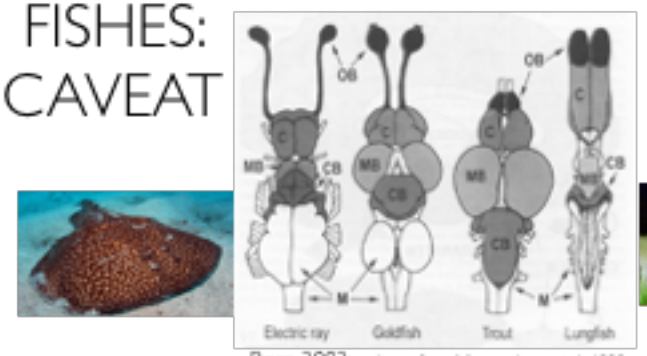

Reviews in Fisheries Science, 10(1): 1-38 (2002)

The Neurobehavioral Nature of Fishes and the Question of Awareness and Pain

James D. Rose

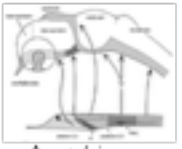
Department of Zoology and Physiology, University of Wyoming, Laramie, WY 82071

FISHES: CAVEAT



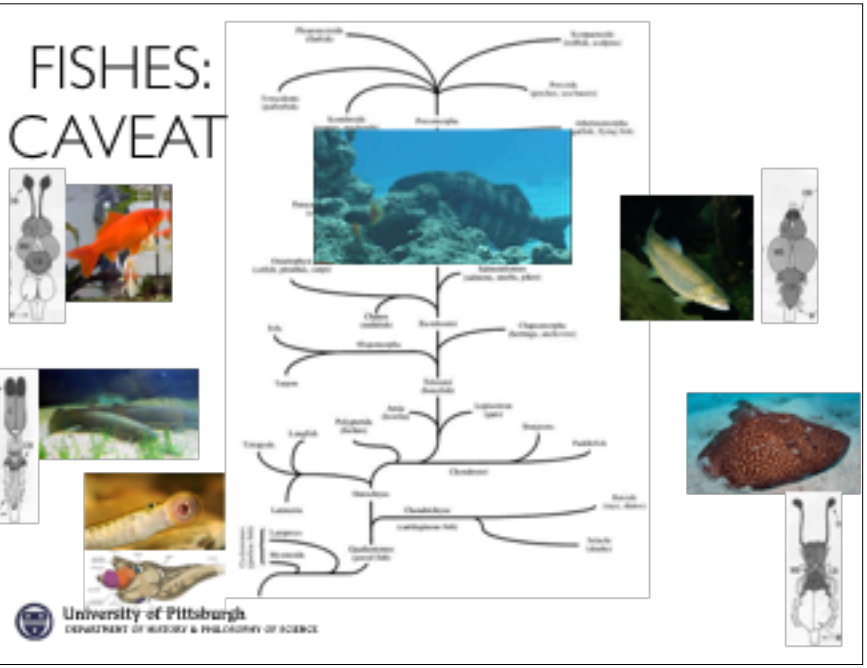
Rose 2002: redrawn from Nieuwenhuys et al., 1998

OB=Olfactory Bulb
C=Cerebrum
MB=Midbrain (tectum)
CB=Cerebellum
M=Medulla oblongata



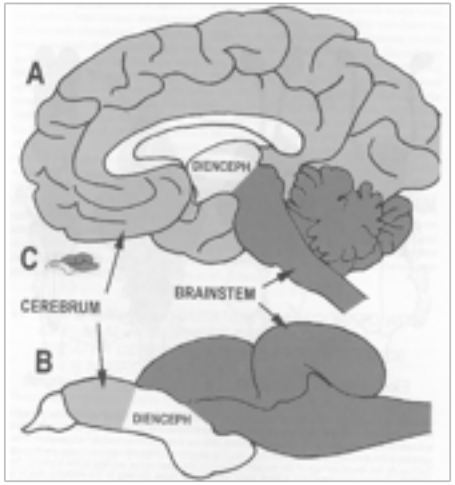
Amphioxus

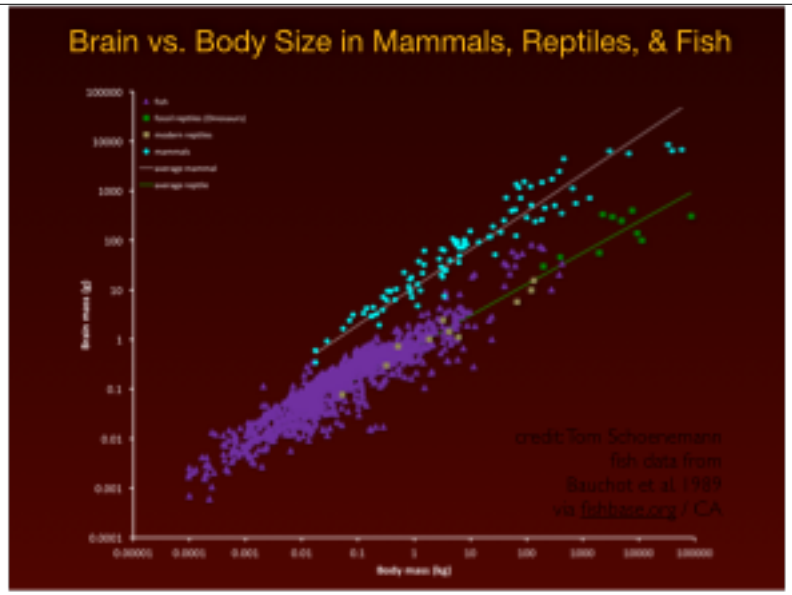
FISHES: CAVEAT



MATTERS OF BRAIN SIZE

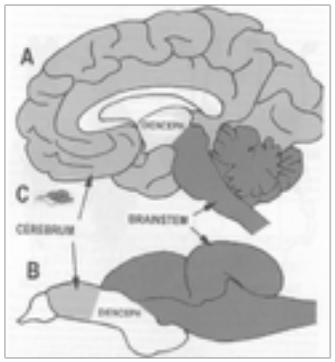
brain of 30cm rainbow trout
Rose 2002





BACK TO THE CENTRAL ARGUMENT

- Neocortical structures (e.g., ACC) are necessary for conscious pain.
- Fish lack neocortical structures.
- Therefore fish lack conscious pain.



Rose 2002

FRAMING THE CENTRAL ARGUMENT

"Perhaps nowhere is the truism 'structure defines function' more appropriate than for the brain. The architecture of different brain regions determines the kinds of computations that can be carried out, and may dictate whether a particular region can support subjective awareness."

Buzsaki (2007): used as epitaph by Rose et al. 2012

A RESPONSE TO THE CENTRAL ARGUMENT

- First premise should be amended to:
  - Neocortical structures (e.g., ACC) are necessary for conscious pain *in mammals*
- The amended premise blocks the conclusion if conscious pain can be realized in non-neocortical structures.

UPDATED CENTRAL ARGUMENT

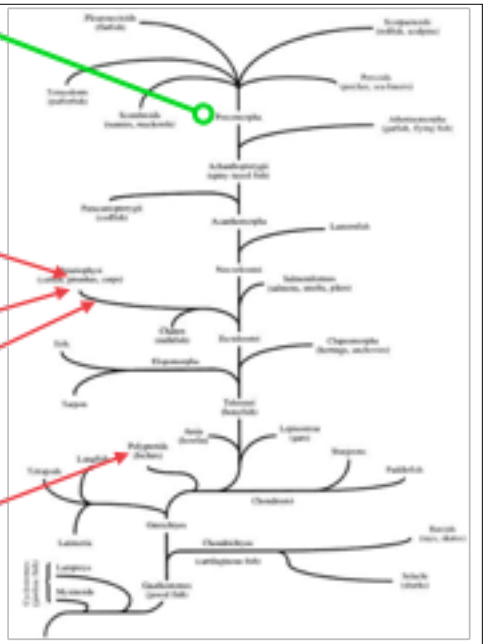
- **"fish lack the necessary neurocytoarchitecture, microcircuitry, and structural connectivity for the neural processing required for feeling pain."**
- **"fish lack the parcellation of the nervous system into distinct regions with architectures capable of performing pain-related computations; fish also lack a laminated and columnar organization of neural regions that are strongly interconnected by reciprocal feedforward and feedback circuitry."**

Why fish do not feel pain
Animal Sentience 2016.003
Brian Key
Biomedical Sciences
University of Queensland
Australia

gobies, *cleanerfish* tuskfish, *grouper*

KEY CITES

- Broglio et al. 2015 - review (mostly goldfish)
  (also, doesn't seem to say what Key says about feedforward circuits only)
- Ahrens et al. 2013 larval zebrafish
- Giassi et al. 2012 knife fish
- Northcutt et al. 2004 *polypterus* (bichir)



WHY NOT PAIN?

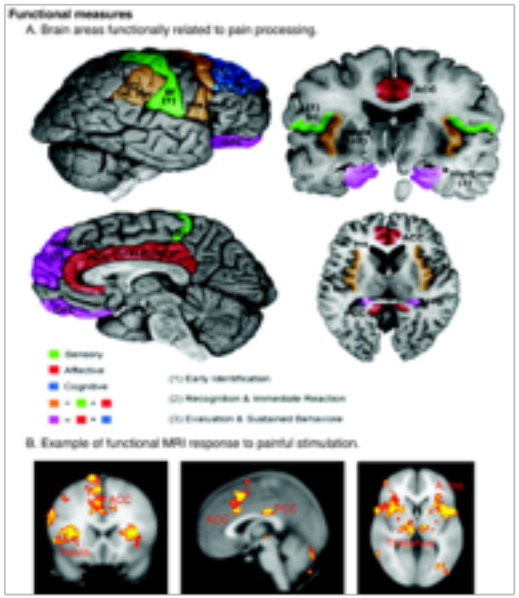
- Feinberg & Mallatt 2016: Fish brains have sufficient structure for exteroceptive/sensory consciousness and interoceptive consciousness
  - exteroceptive/sensory: laminar structure of piscine tectum (midbrain) sufficient for *X*-topic maps
    - but maybe not *necessary?* (cf. avian)
  - interoceptive/visceral: mesolimbic reward structures
    16/18 in bony fish vs. mammals
    - but (not) pain? — only reason they give: more A-δ than C

INTO THE NEUROMATRIX

A systems-level approach

cf. Andrew Barron: a connectomic view

dynamics matter



NONSPECIFICITY IN THE NEUROMATRIX

"Here, we will review the original concept of the "Neuromatrix" as it was initially proposed by Melzack and its subsequent transformation into a pain-specific matrix. Through a critical discussion of the evidence in favor and **against this concept of pain specificity**, we show that **the fraction of the neuronal activity measured** using currently available macroscopic functional neuroimaging techniques (e.g., EEG, MEG, fMRI, PET) in response to transient nociceptive stimulation is **likely to be largely unspecific for nociception**."

AN UNSATISFYING CONCLUSION

- Pain in non-mammals need not be a matter of having/lacking homologous structures to mammalian neocortex
- Alternative functional architectures could support dynamics of painful experience (birds, bees, etc.)
- Fishes are vastly underexplored: only a handful of the >30,000 species, and very few of the upper teleosts

Not enough is known to draw any firm conclusions (sorry!)

PAINFUL IN THE MIDDLE

Proponents
similar behavior
+ neurological
similarity
=> fish pain

Skeptics
anthropomorphized
behavior
+ neurological
*dis*similarity
=> no fish pain

Agnostics
whose behavior?
whose brain?
=> what experience?