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COGNITIVE

intelligence and cognitive skills

AIMS&OBJECTIVES

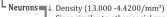
The aim was to envision how much dolphins do understand about themselves, others and their surroundings, as well as considering the suitability of the term "intelligence" as a describer for animal cognition.

The overall objective was to review and collect the strongest data on dolphin (bottlenose dolphin Tursiops truncatus; Montagu, 1821) behavior, cognition and neuroanatomy. Understanding of neuroanatomical underpinnings and assessing behavioral responses to cognitive tests, leads to a posterior discussion on the how unique/human-like is dolphin cognition.

BRAIN STRUCTURE & EQ

- Spherical; the telencephalic hemisphere is rotated rostral and ventralward. $\ensuremath{\mathsf{L}}$ Auditory field with $\ensuremath{\mathsf{hypertrophic}}$ auditory structures due to echolocation.
- LAdjacent to visual field = integration of acoustic and visual inputs. L Olfactory components are reduced.
- L Increased cerebral cortex + extremely folded neocortex.



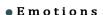


- Sizes similar to other social species ↑ Total nº in the neocortex (5.800x106)
 - ↑ Nº synapses similar to humans (0.87x10¹⁴ vs. 1.3x10¹⁴) ger and Oelschläger, 2002)
- Encephalization quotient (EQ): difference in mass of a brain (relative to body mass) to the expected value for its body mass (Jerison, 1985).



Social complexity hypothesis Evolution of echolocation Absence of pelvic girdle eutral drift





Dolphins, and many other animals, possess core emotions (e.g. fear, lust) because they are produced in ancient parts of the brain and are an evolutionary advantage. Anecdotic evidence states dolphins show empathy, a

complex emotion, that may rely on: └ genetic causes (social insects)

attribute feelings and beliefs to others).

>> It has not been further tested, but regardless, it is more parsimonious to state that dolphins rely on complex cognition for emphatic behavior production (De Waal, 2008).

Body-awareness •

Knowing that one has a body that is separate from other objects, by unconscious proprioception (body schema) + conscious perception (body image) (Gallaguer, 2009).

>> dolphins show conscious awareness of their body by recognizing and using body parts (including those they cannot see, i.e. melon) in novel situations.

> BODY PART (transfer test): objects + 9 body parts + 4 actions (Herman et al., 2001)

Agency and ownership •

Feeling that one controls one's actions (agency) and that one's body is undergoing an action (ownership; Gallagher, 2000).

dolphins show they can store and access mental representations of past events by constructing behaviors to be same / different from a previous one, by feeling agency and ownership of self and others.

Imitation and SELF-IMITATION (transfer tests):

repeat / don't repeat | create | repeat / any (Herman, 2011)

Self recognition •

Ability to identify oneself in a mirror and match one's own body plan with the reflection.

>> dolphins and other social species (chimps, elephants, birds) can recognize themselves in a mirror. MSR is an evolutionary **convergence**. May it be a step to self awareness consciousness / sense of self?

MIRROR SELF RECOGNITION Test (MSR):

"Δ" non olfactory mark on subject body

social behavior / explorative behavior (Reiss and Marino, 2001).

Symbol comprehension •

Understanding semantic and syntactic features of an artificial trained language. Symbols are arbitrary representations of abstract (e.g. less/fewer) or concrete (e.g. ball, speaker) concepts, bearing no resemblance with reality.

>> dolphins can form abstract - real linkages, understand properties of , classify concepts (semantics) and extract meaning from word order (syntax), by succeeding in novel sequences and extracting feasible subsets (repair) from anomalous strings or rejecting to perform, selectively. > rich mental representations useful for planning and problem solving...

MULTI-ITEM sequence (transfer tests); ANOMALOUS sequences (transfer test)

(object 1) + location + object 2 + action (location) + object 1 Θ + (location)+ object 2 + action × object 1: movable element × object 2: stationary element

Reject entire sequence - Repair anomalies (Herman et al., 1993)

Self and sociality •

Dolphins are cosmopolitan species with natal philopatry. Field studies in a dolphin community in Shark Bay Australia (Connor, 2007) show they live in complex social structures shaped by a $fission\mbox{-}fusion\mbox{-}pattern\mbox{,}$ where males, are related by $multi\mbox{-}level$ alliances that may last for minutes or years + Individuals create and possess unique vocalizations called "signature whistles" they use similar to human names.

>> dolphins evolved large brains for complex cognition to hold emerging sociality and having a unique whistle supports they have a sense of self and others.

DISCUSSION&TAKE-HOME MESSAGE

The study of dolphin cognition has some limitations:

- o Tursiops truncatus show species + few and repeated subjects
- o Associative learning ≠ true learning
- o Tests need to bear species ecological +evolutionary requirements
- o Human-like intelligence approach
- o Lack of evidence from other taxa and scientific consensus on a framework. Overall, our understanding on animals' minds is poor, they remain being a black

Dolphins are as skilled as other animals (rats, birds, octopuses, etc) in terms of consciousness, symbol use, imitation, social learnign, etc (Gregg, 2013). No evidence for human-like cognition in dolphins.

But, they possess a flexible mind to manipulate new information (Herman, 2010). Uniqueness relies on their combination of skills only comparable to primates and corvids, which shows they have behavioral plasticity in detriment of innate behaviors, and that alone is an evolutionary adaptation (Cantor and Whitehead, 2013).