

Behaviour, Ecology & Evolution
(of Fishes) Laboratory



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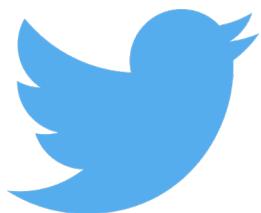
Social Learning in fishes

Prof. Culum Brown

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www.thefishlab.com

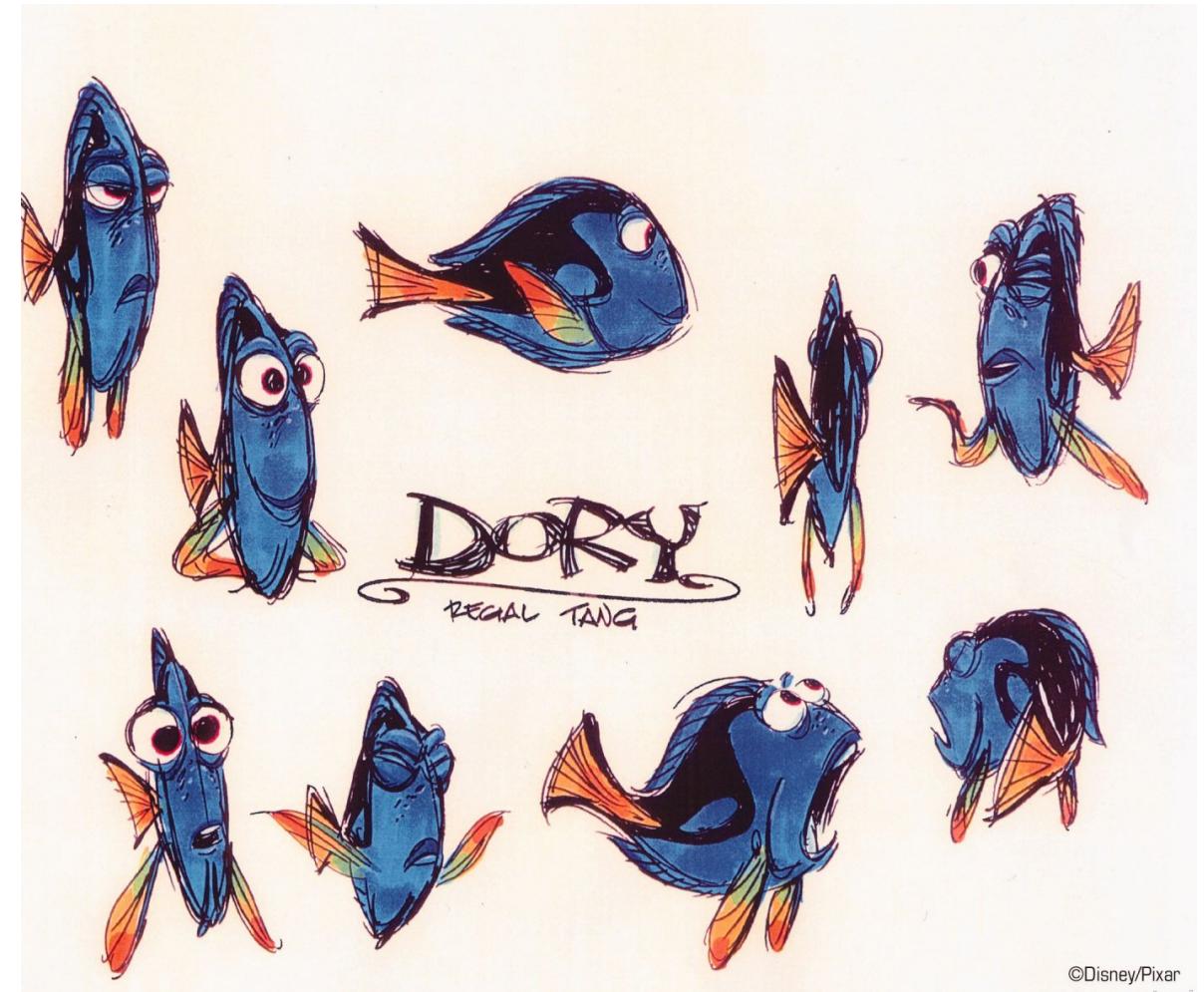
@CulumBrown
@FishLab_MQ



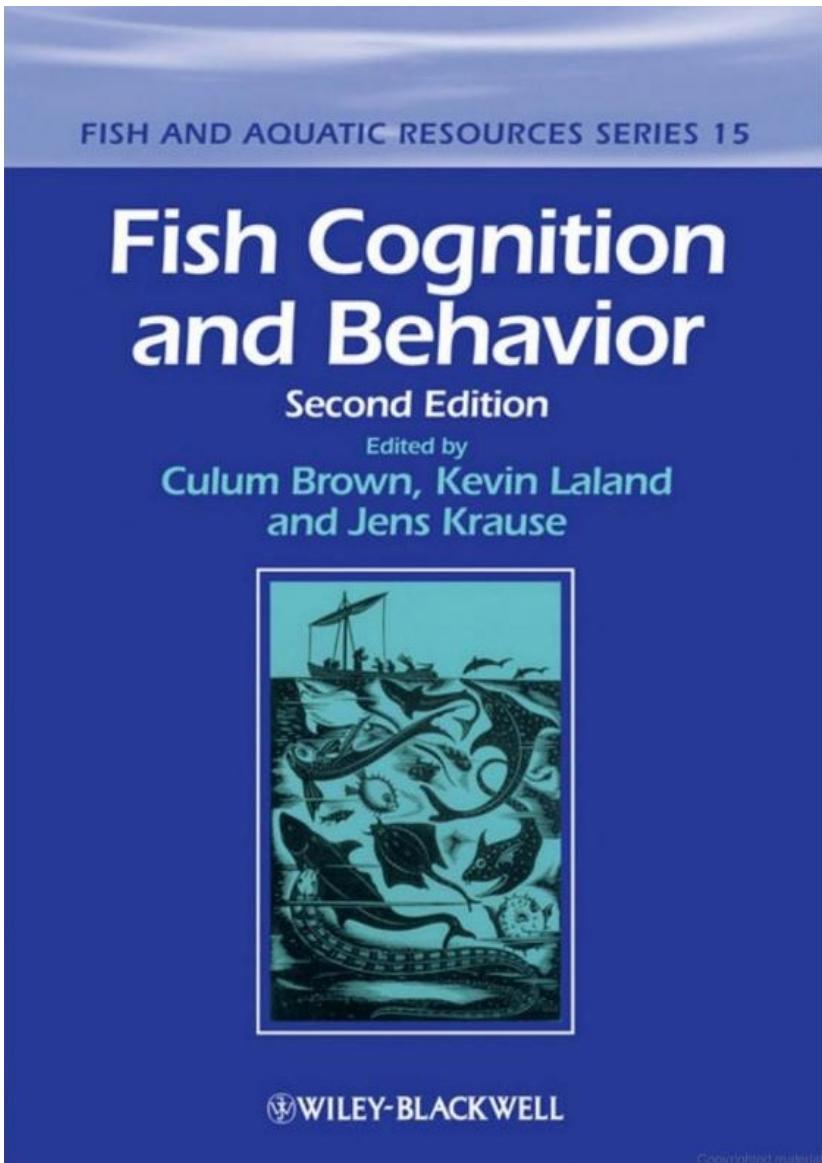
Cultural
Evolution
Society

Bad Press

Goldfish have a 3 second memory

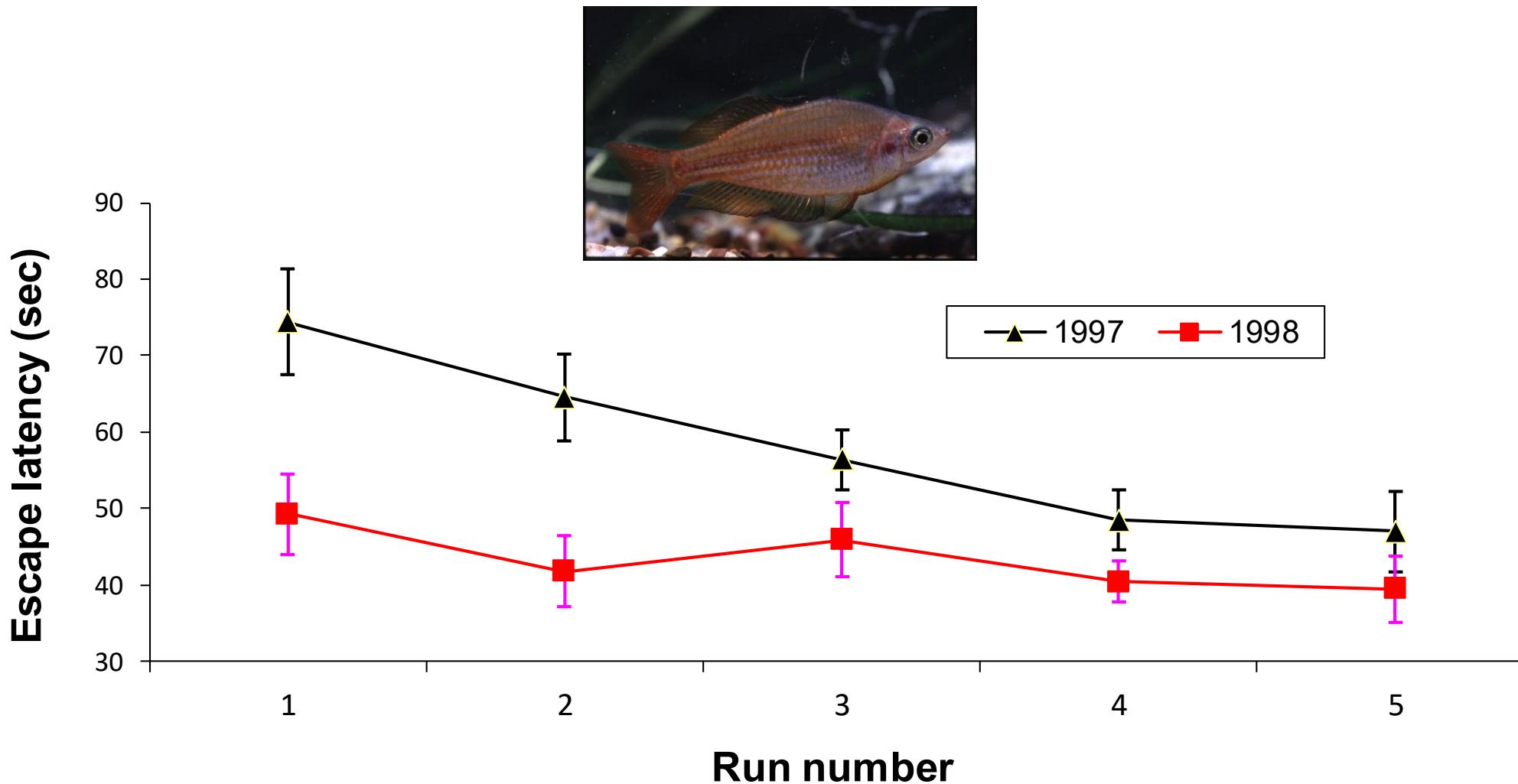


Fish are smart!



The image is a screenshot of a news article from the journal *nature*. The header features the word "nature" in a large serif font, followed by "International weekly journal of science" in a smaller sans-serif font. Below the header is a navigation bar with links to "Home", "News & Comment", "Research", "Careers & Jobs", "Current Issue", "Archive", "Audio & Video", and "For Au...". The main article title is "Animal behaviour: Inside the cunning, caring and greedy minds of fish", written by Alison Abbott on 26 May 2015. Below the title is a sub-headline: "By revealing that fish cooperate, cheat and punish, Redouan Bshary has challenged ideas about brain evolution." At the bottom of the article section, there are buttons for "PDF" and "Rights & Permissions". Below the article, there is a thumbnail image titled "Clever Fish - Cooperation on the reef" showing a fish swimming in the ocean.

Learning and memory



Social environment: Fish School

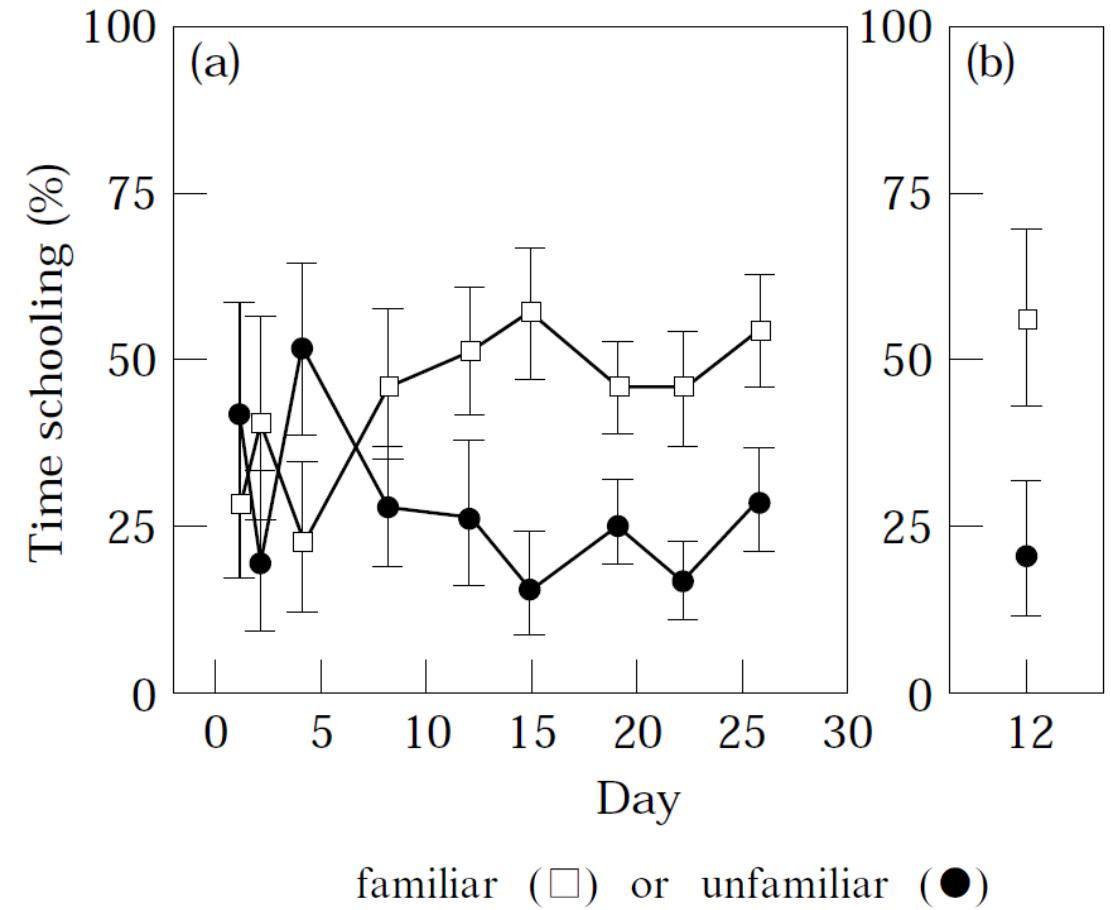


Living in complex social groups



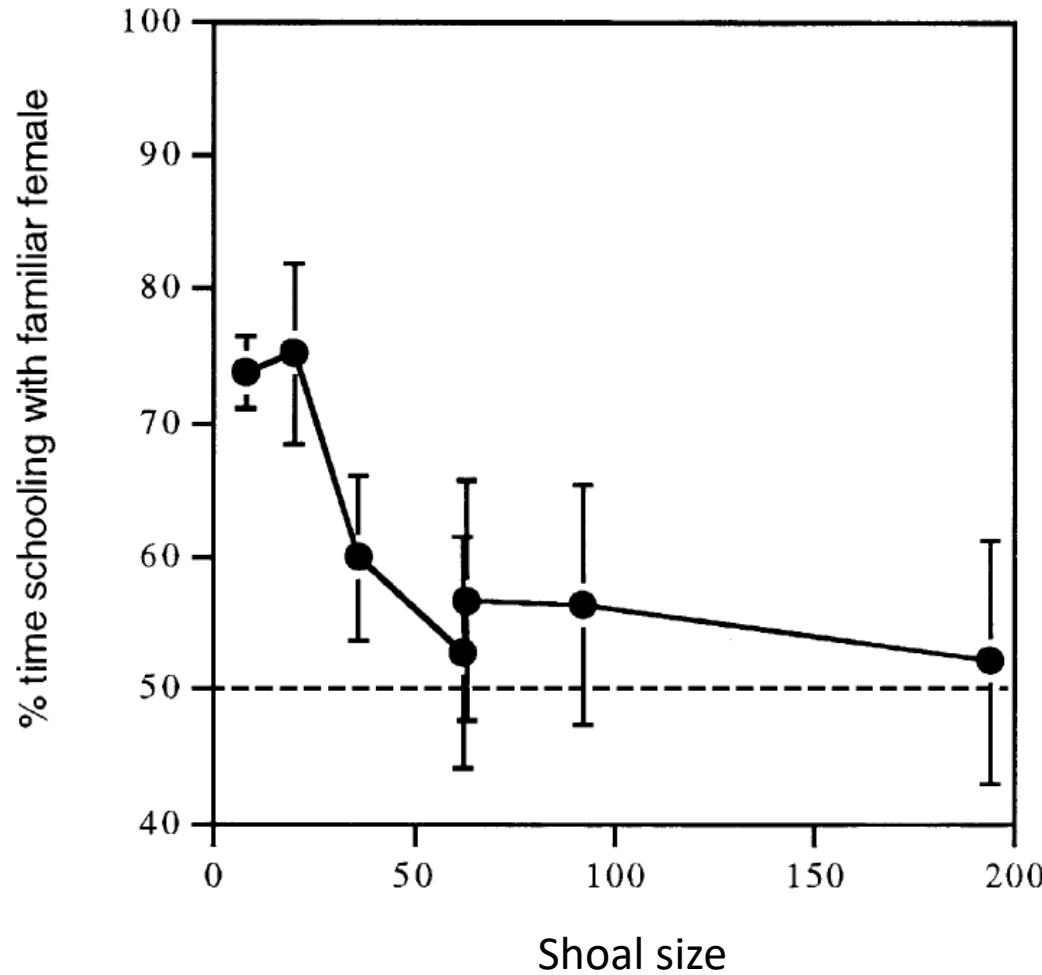
5 weeks

A. Bhat & A. Magurran 2006 J. Fish. Biol

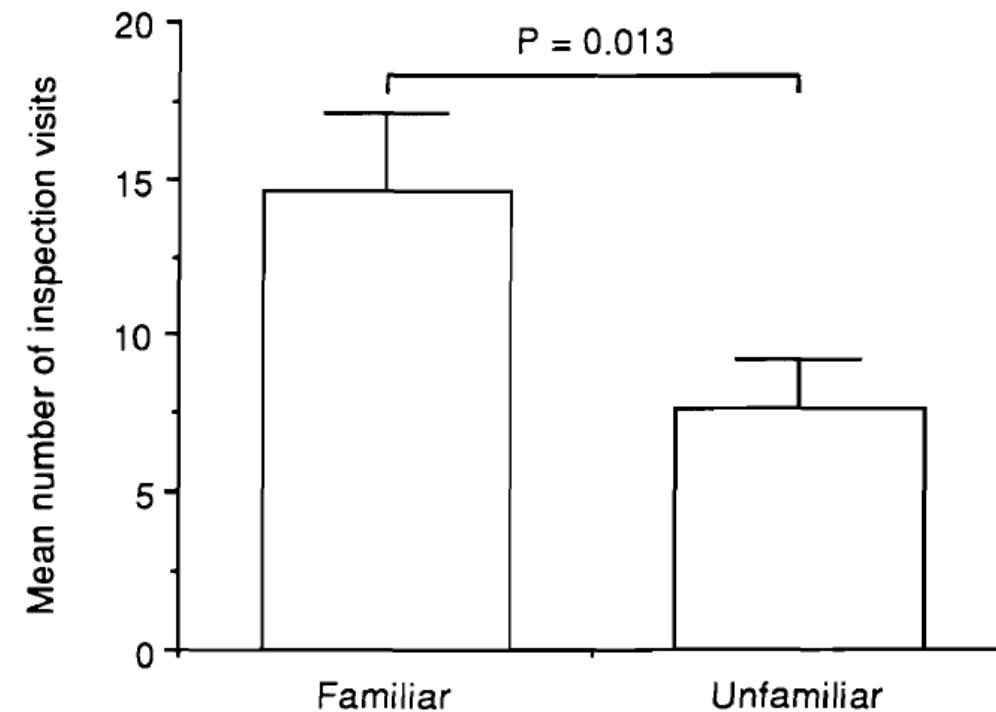
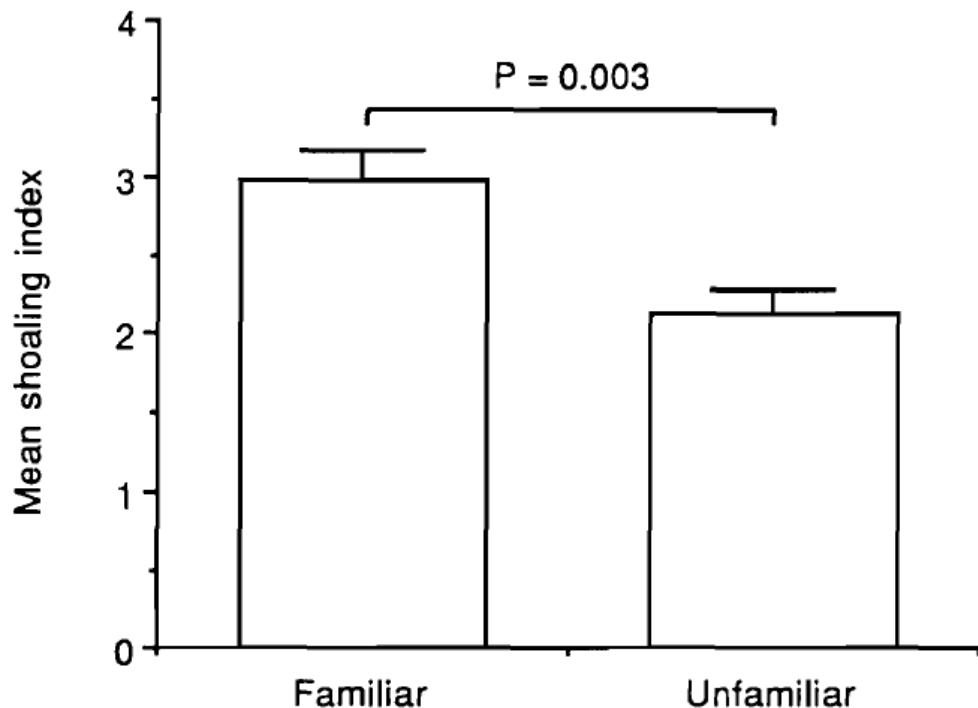


S. Griffiths & A. Magurran 1997 Anim. Behav.

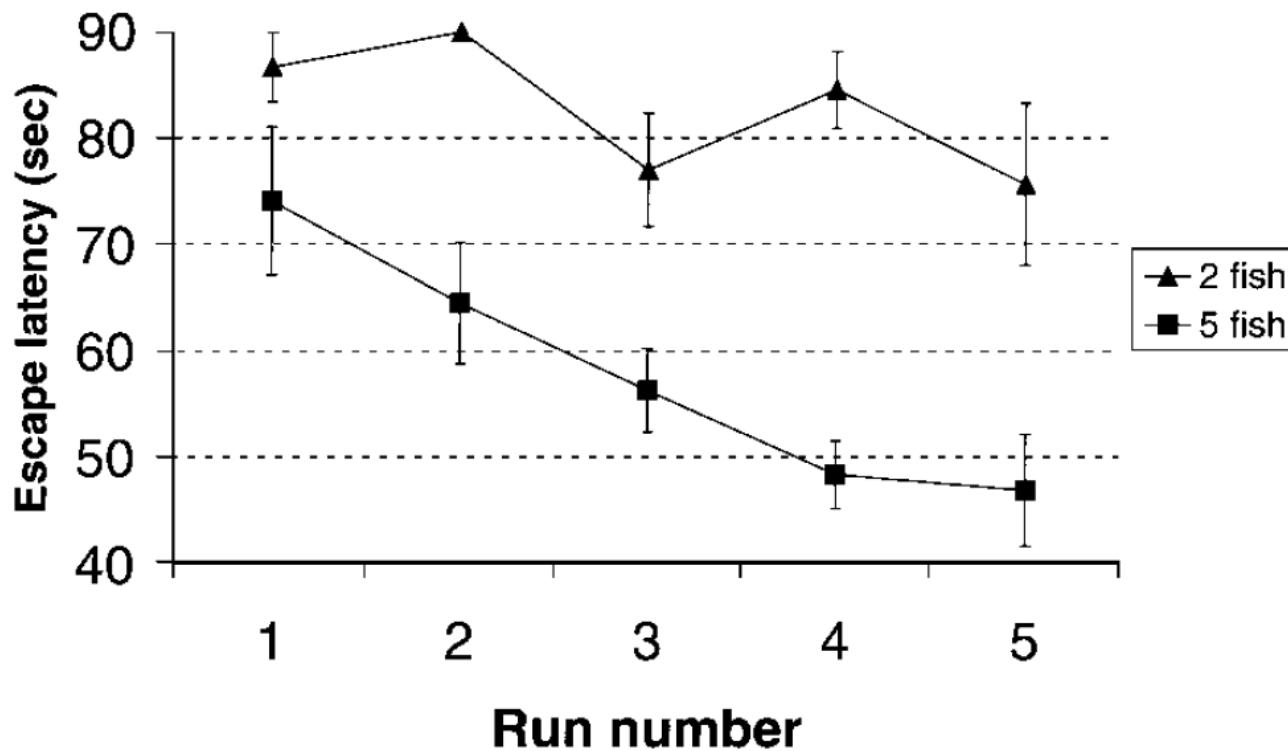
Group size matters



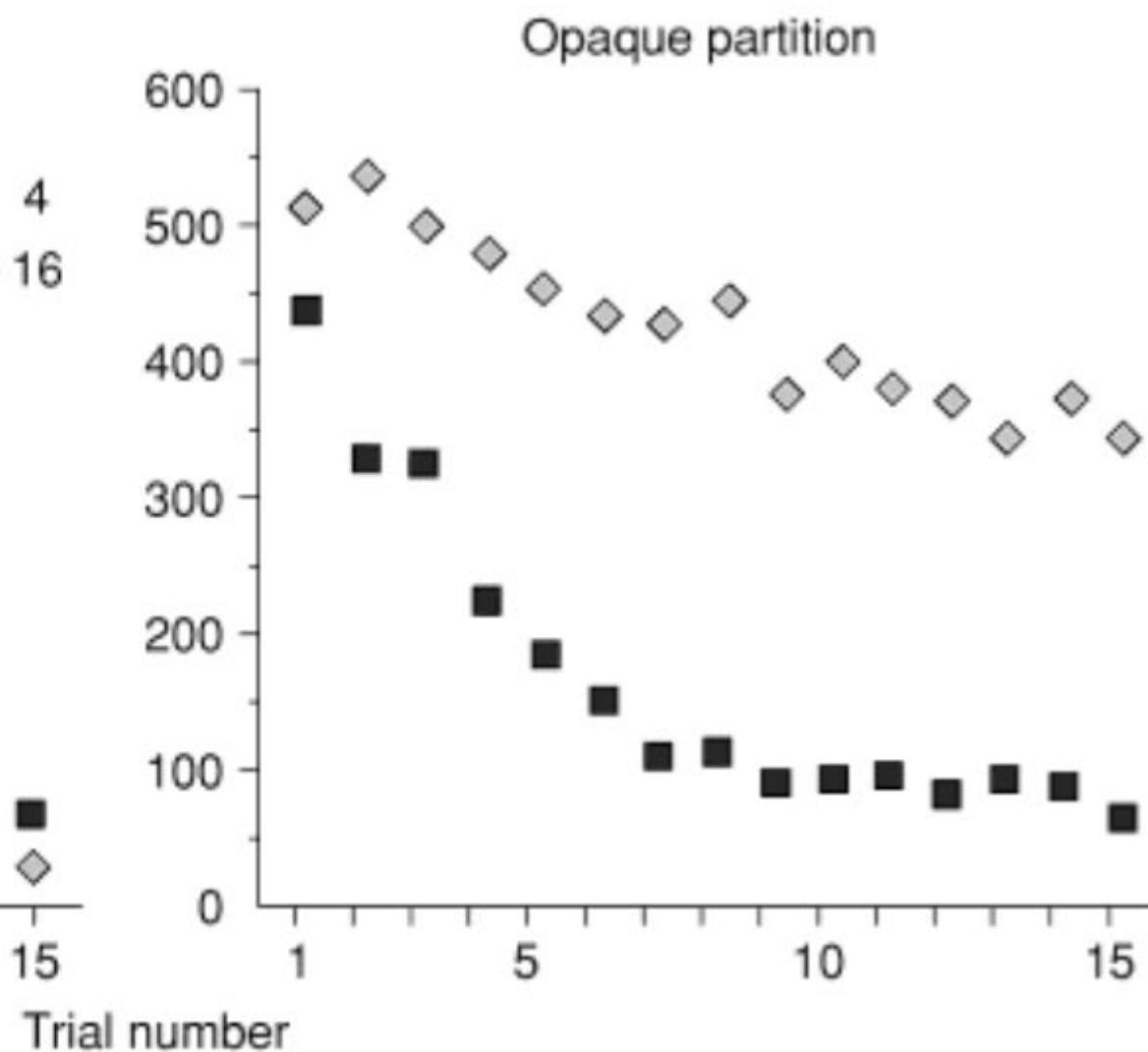
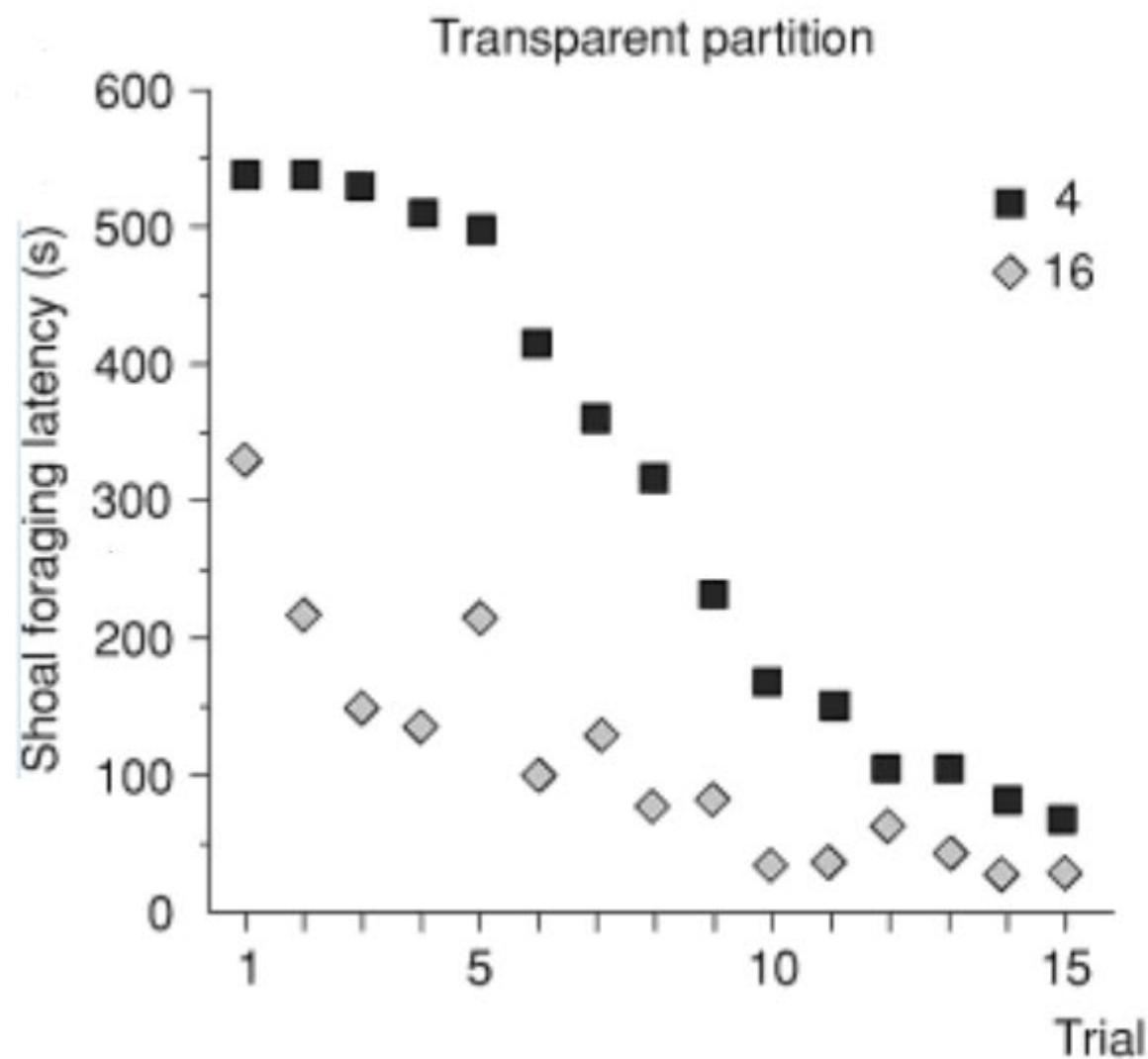
- Benefits of familiarity



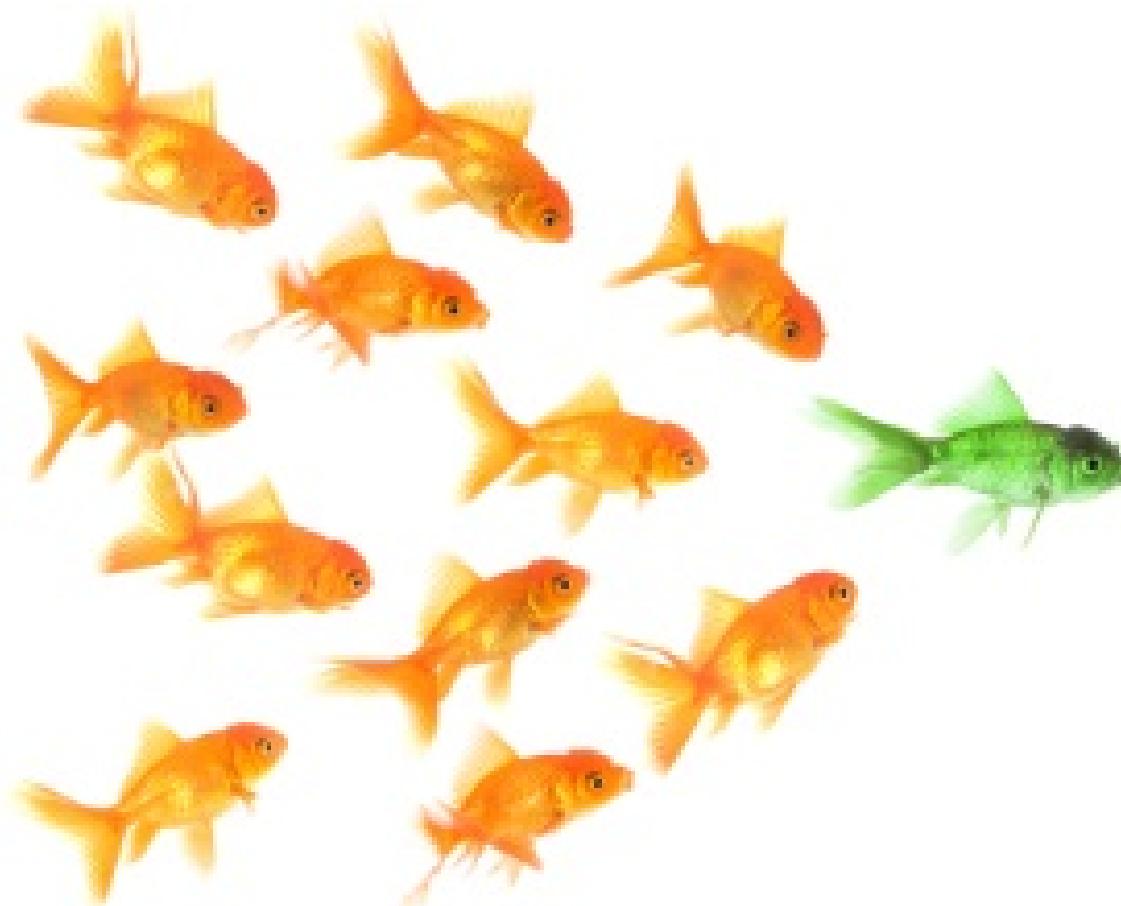
- Fish learn faster in larger groups



- Fish learn faster in larger groups... or not

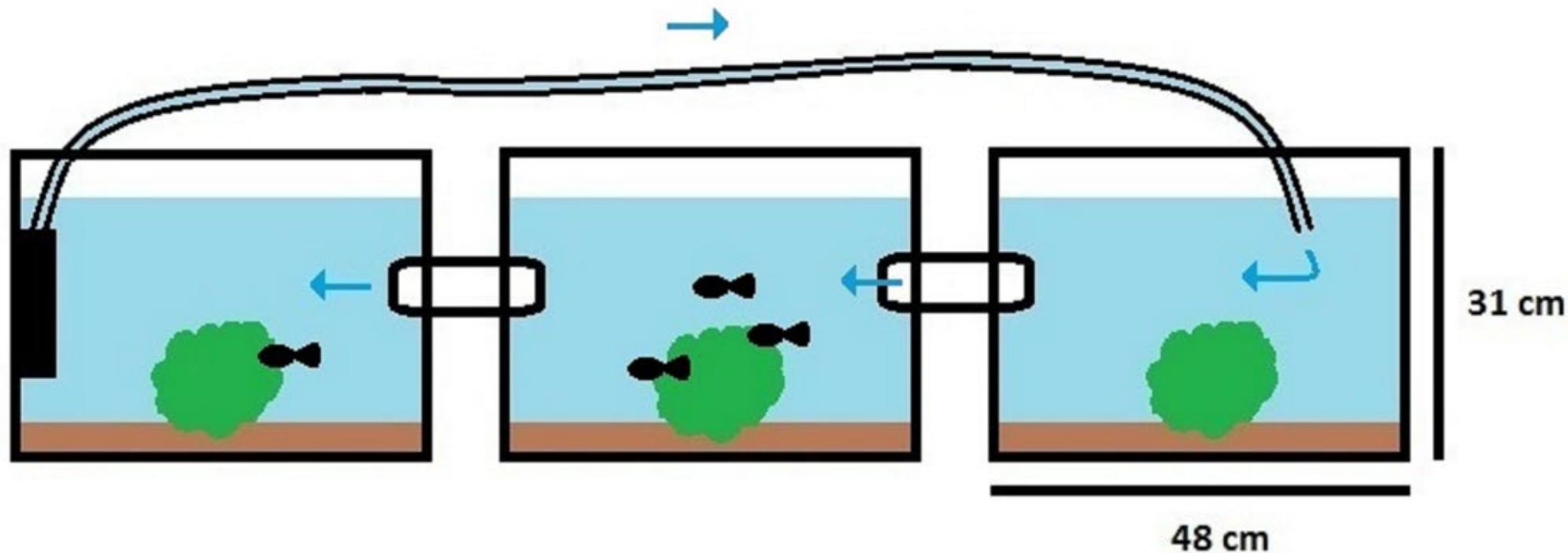


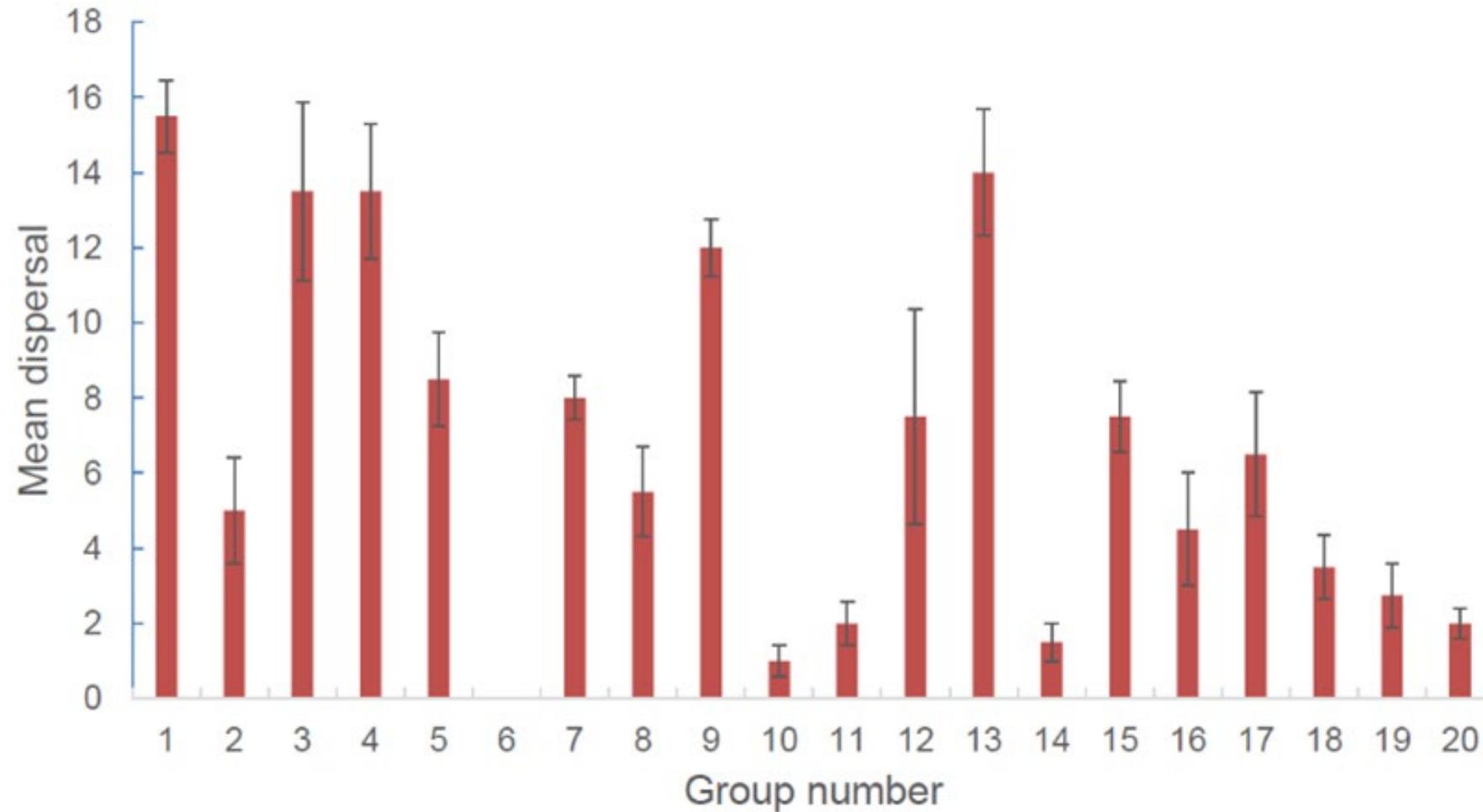
Leaders, followers and personality



- Boldness
- Sociality
- Activity

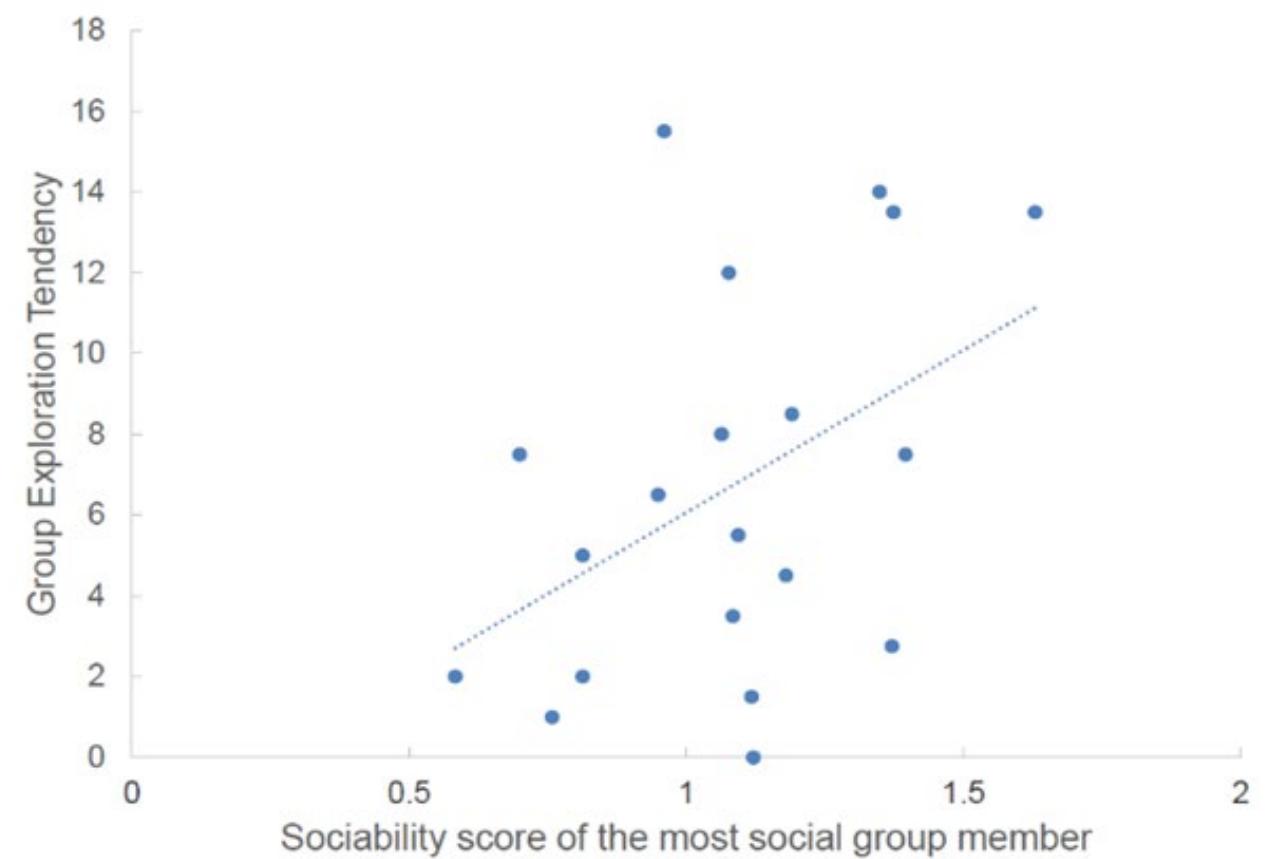
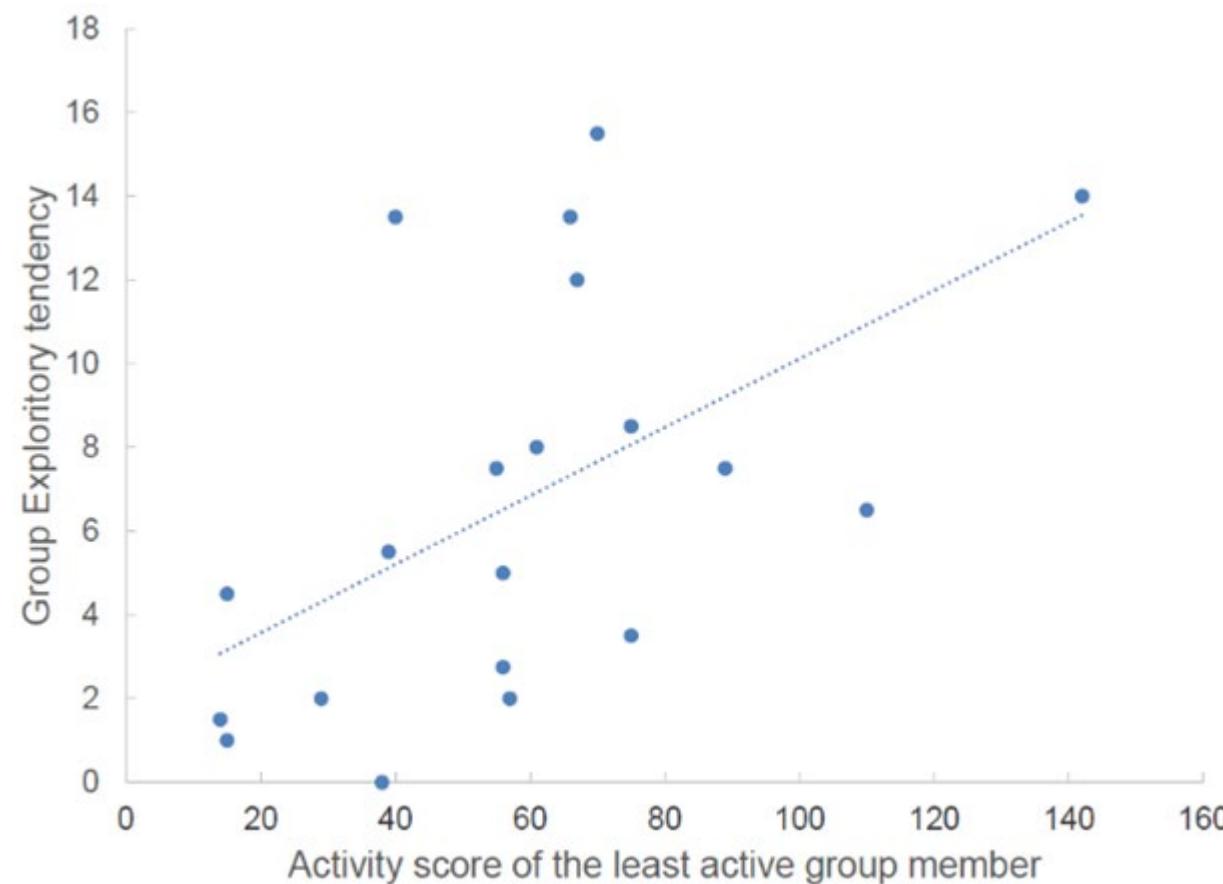
Dispersal



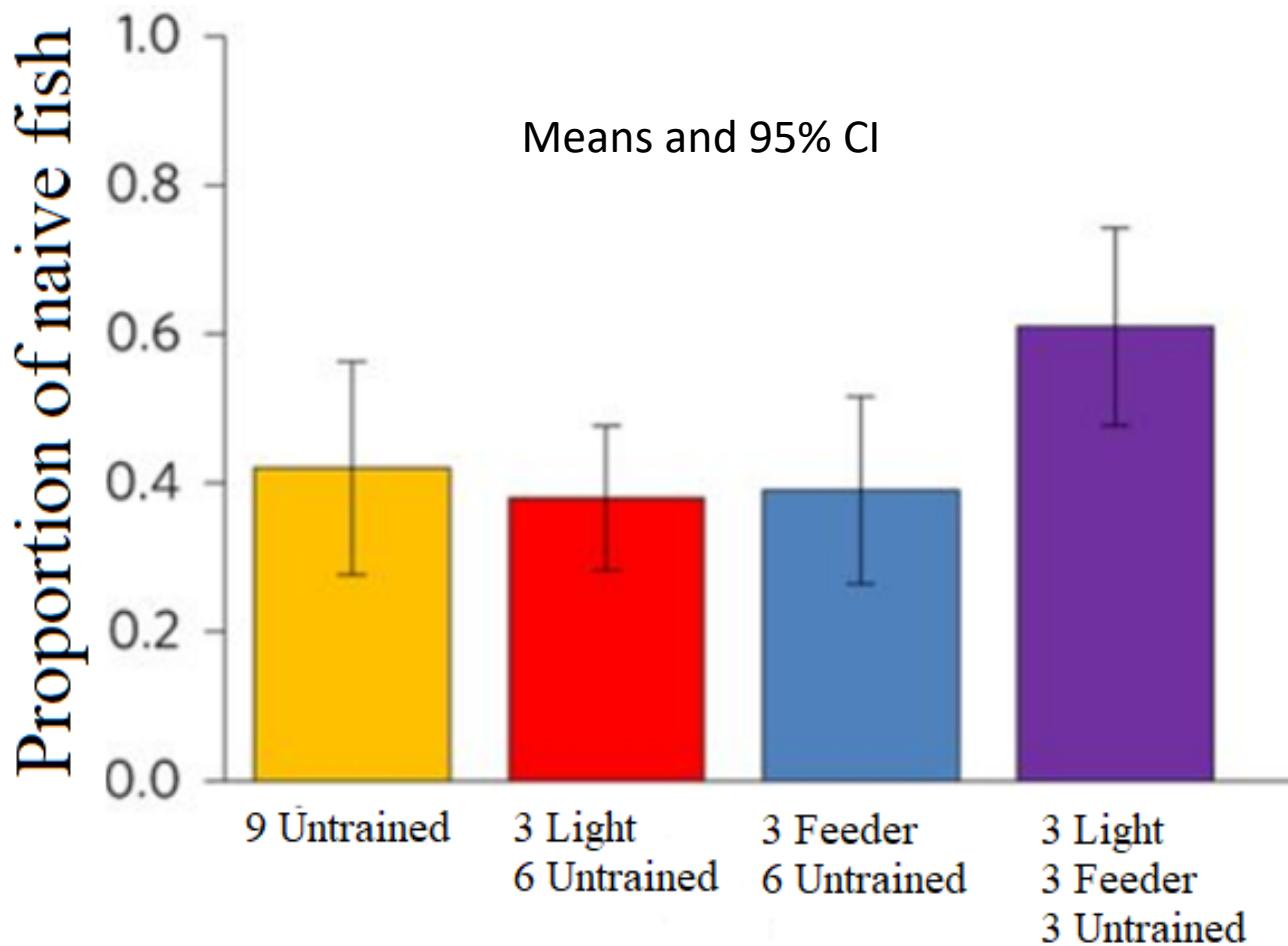


- Variation in group dispersal behaviour did not correlate with the groups' average personality score
- This is not about group conformity and consensus building

- Positive and negative social feedback defines group movement



Fish can pool their knowledge



Social learning



Predators

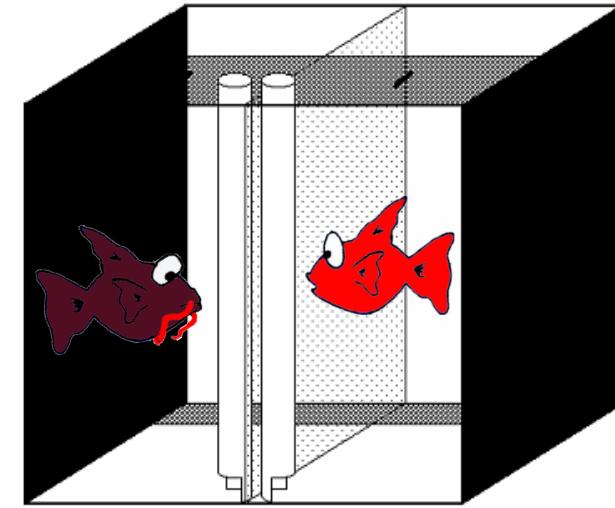
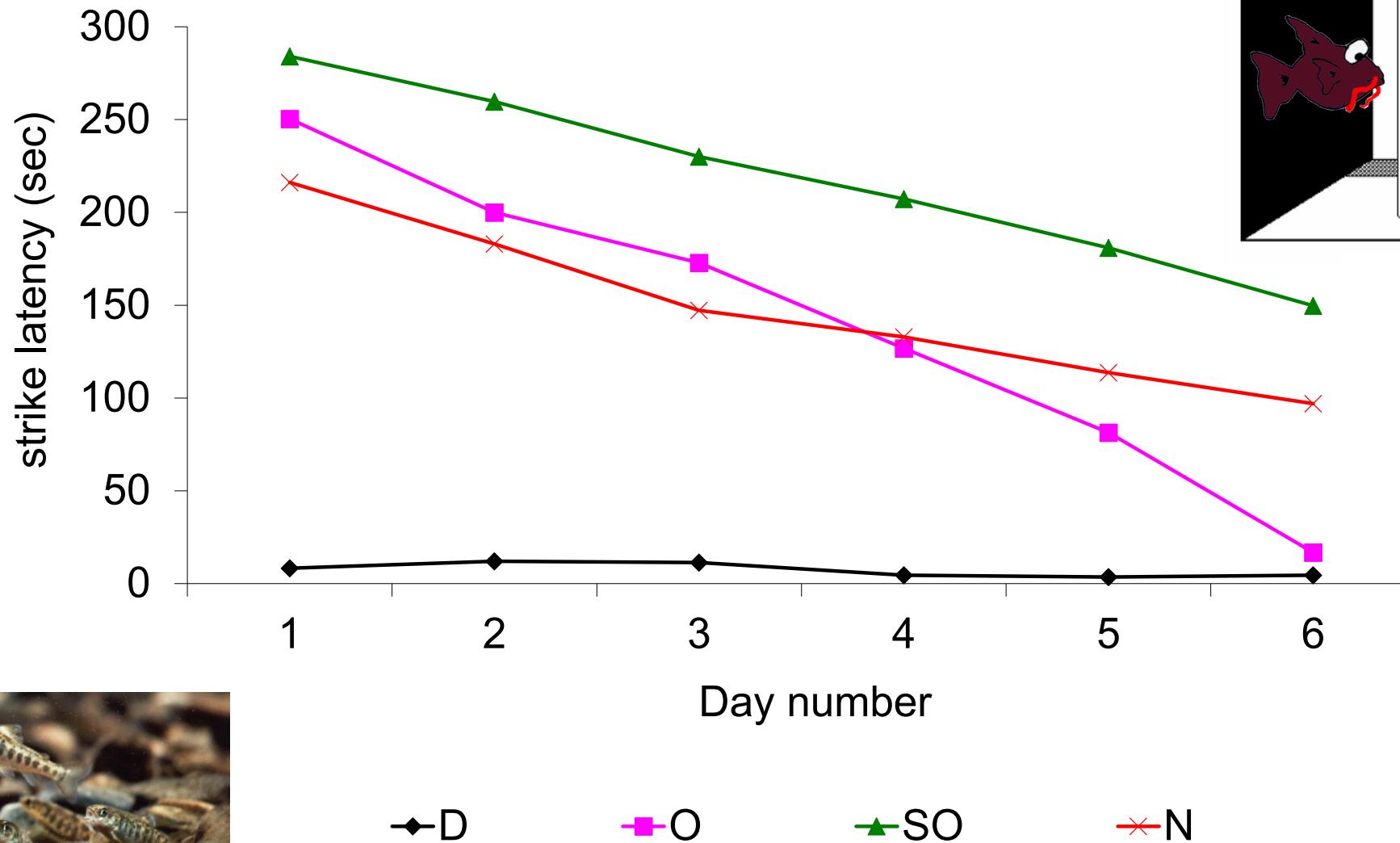


Mates

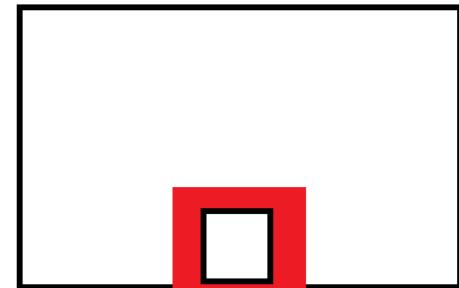
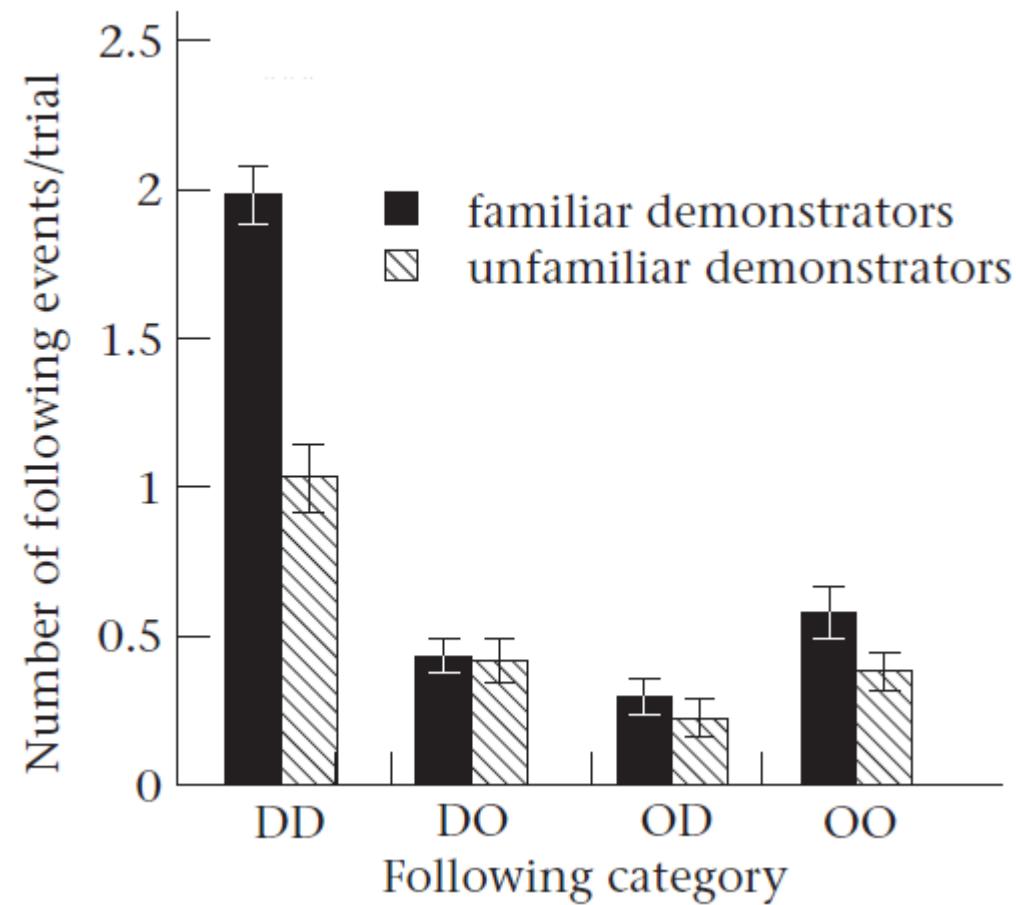
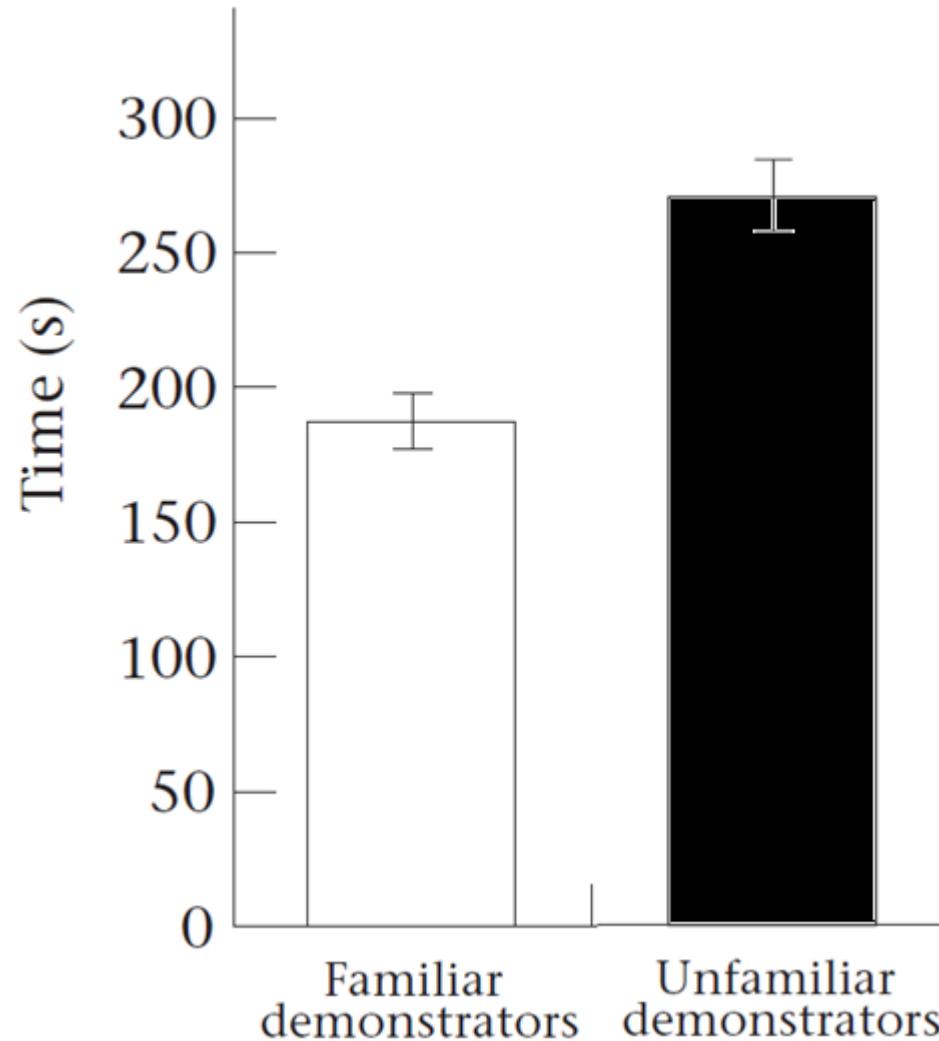


Prey

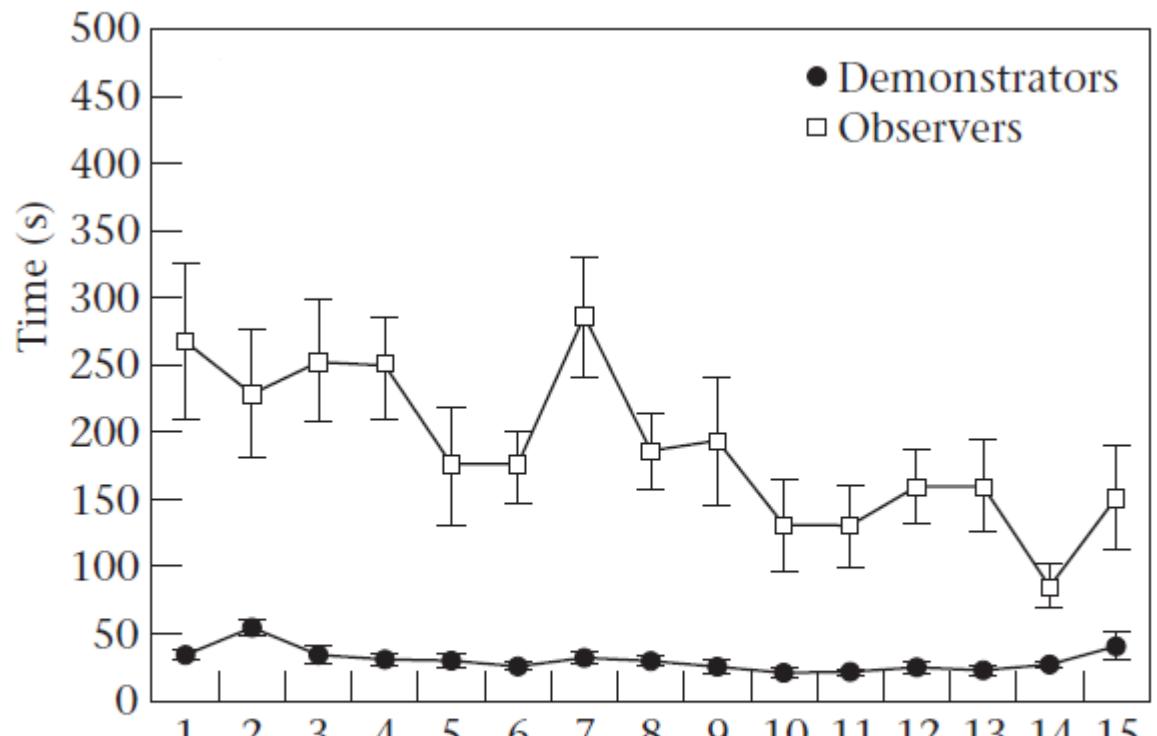
Social learning during foraging



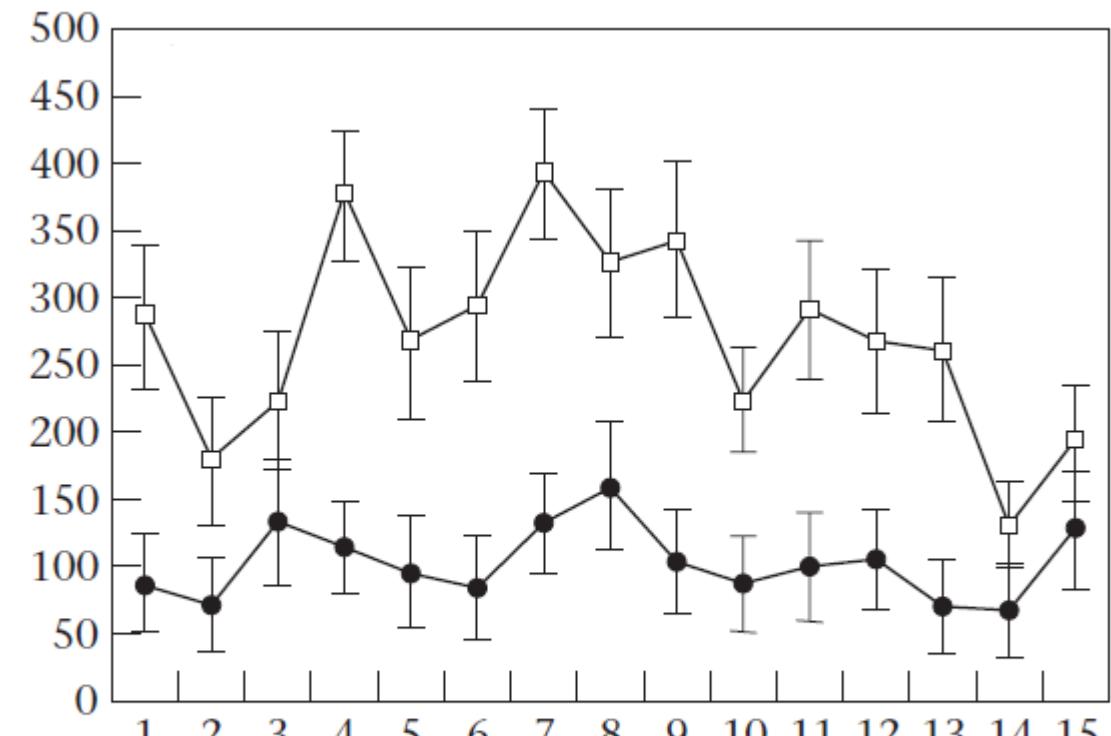
Social learning enhanced in familiar groups



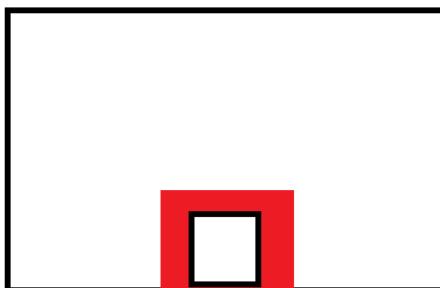
- Divided attention



Familiar



Unfamiliar

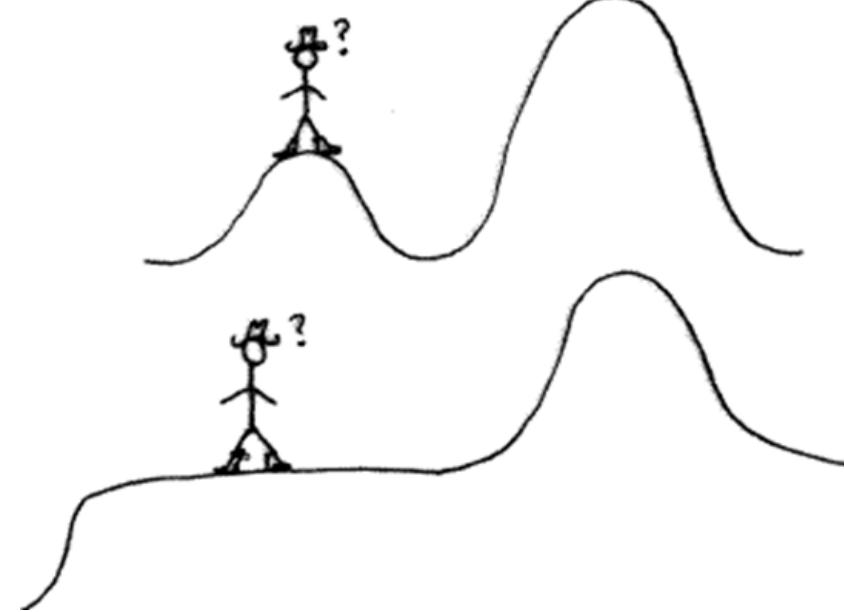
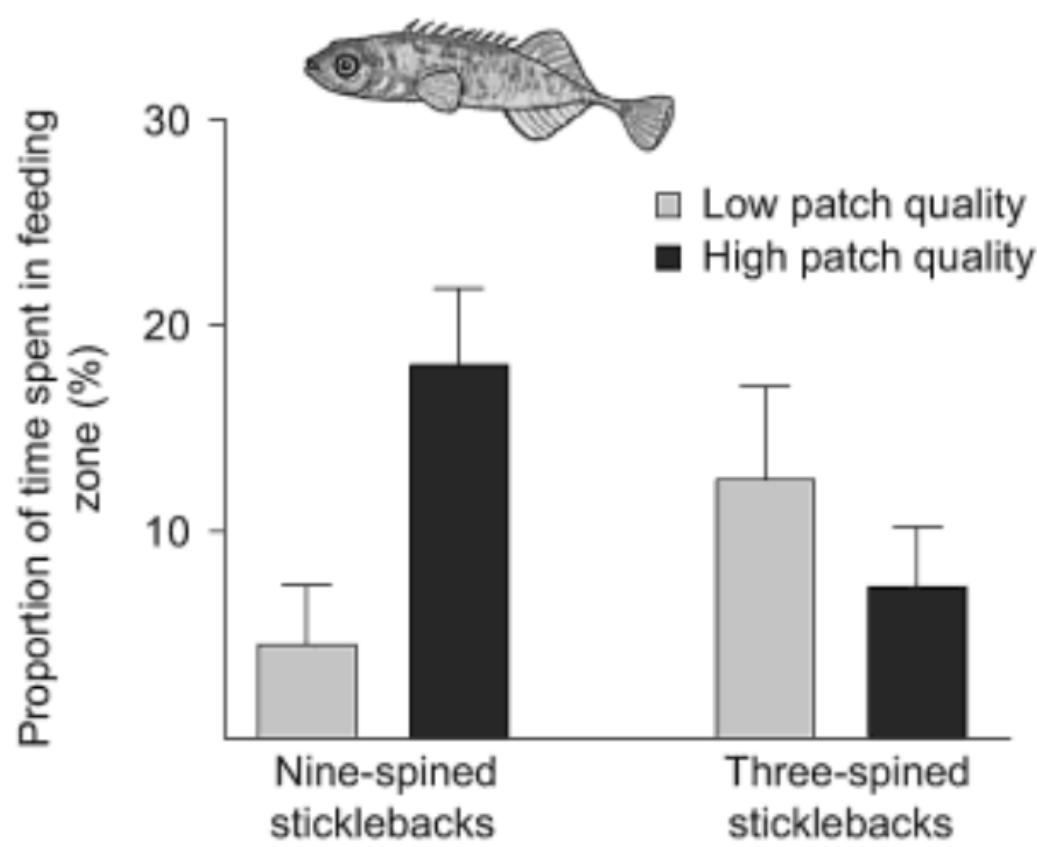


Who follows who?

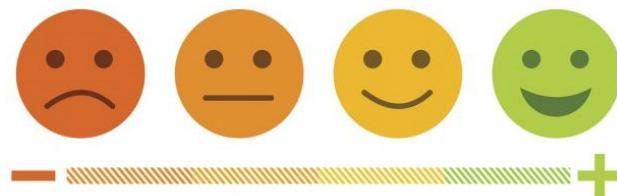
- Small fish follow other small fish
- Fish prefer to follow a large group than a small group
- Fish follow familiar rather than unfamiliar demonstrators
- Fish tend to follow demonstrators that have directed behaviour (high motivation)
- Poorly trained demonstrators are more effective than well trained demonstrators
- Males will follow females, but females wont follow males
- Personality partially defines each role (leader, follower, lager)

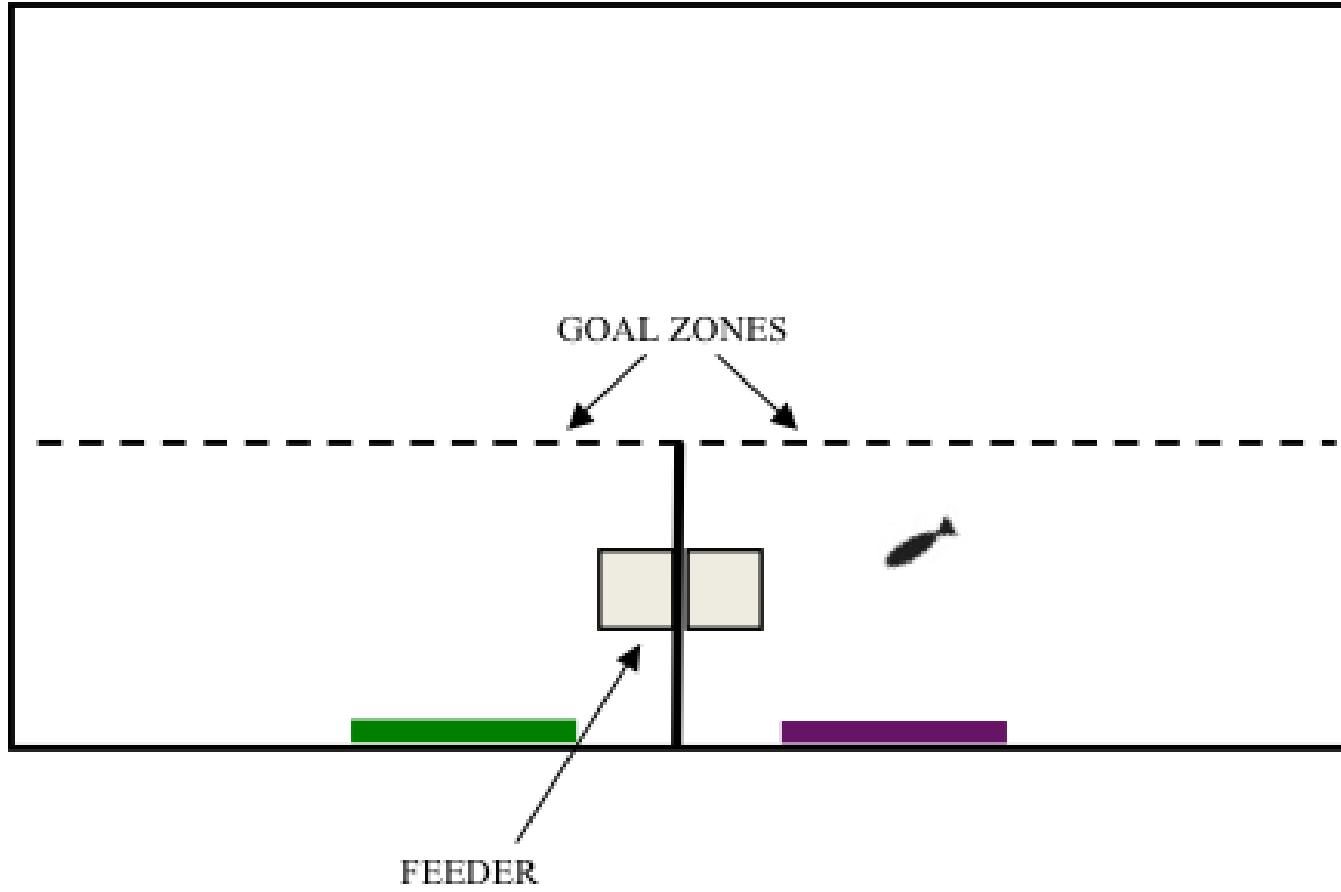


Public v private info



Personality affects trade-offs between private and social information





Personality test 1

Training (3x/d 15d)

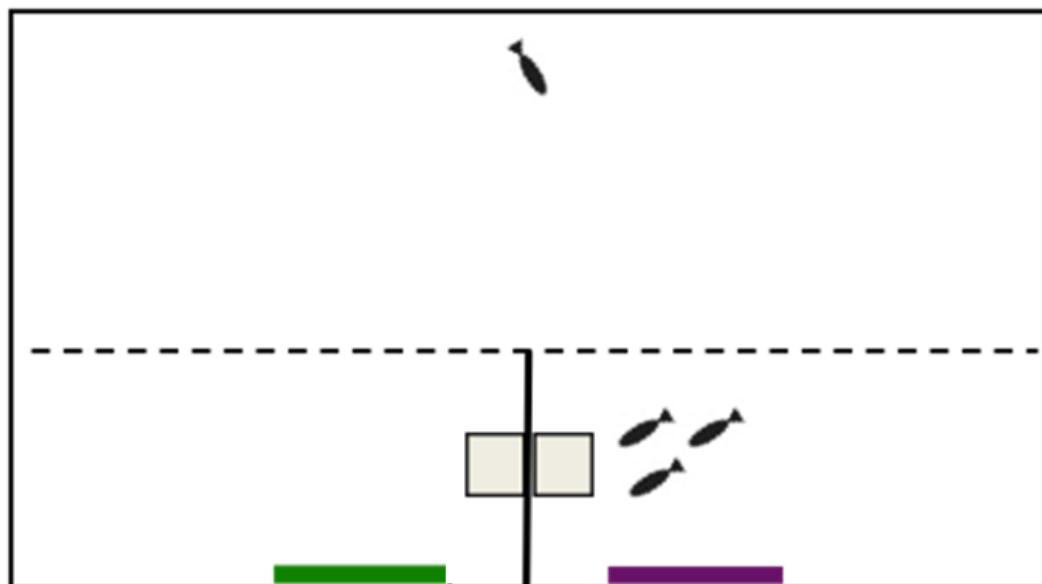
Preference test

Info use test

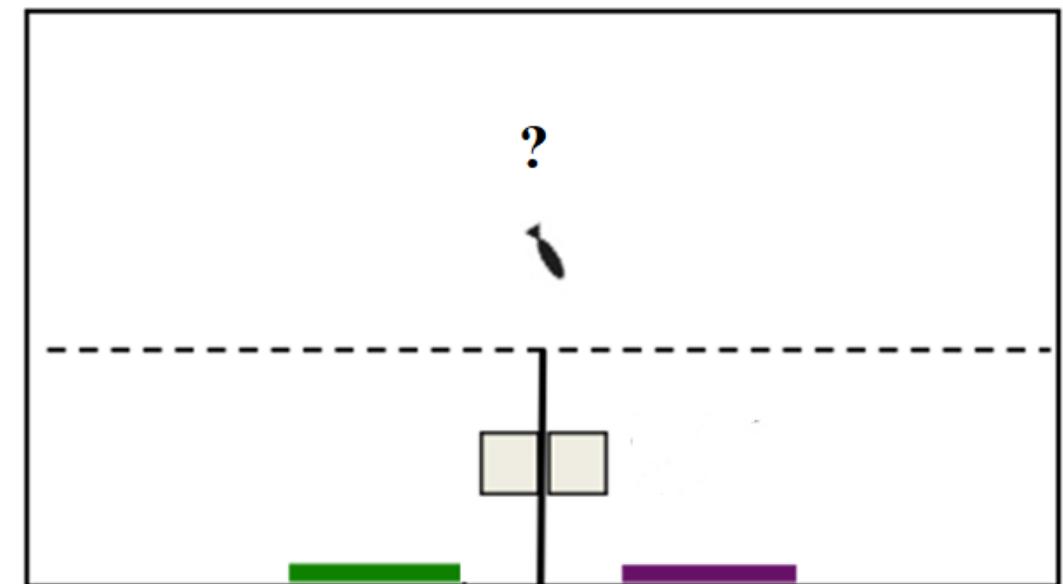
Personality test 2

Info use test

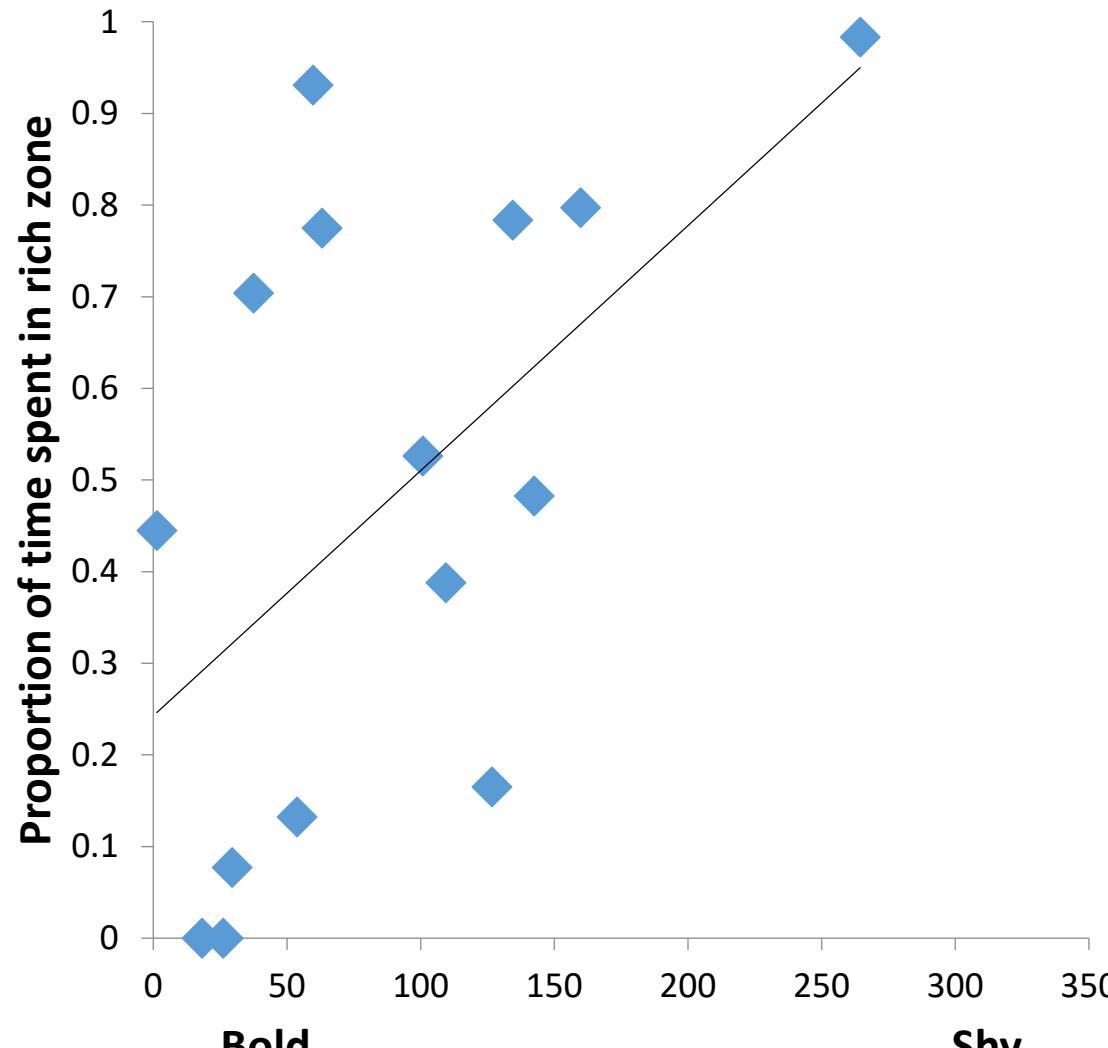
- Treatment 1) public and private info coincide
- Treatment 2) public and private info conflict
- Treatment 3) social stimulus control



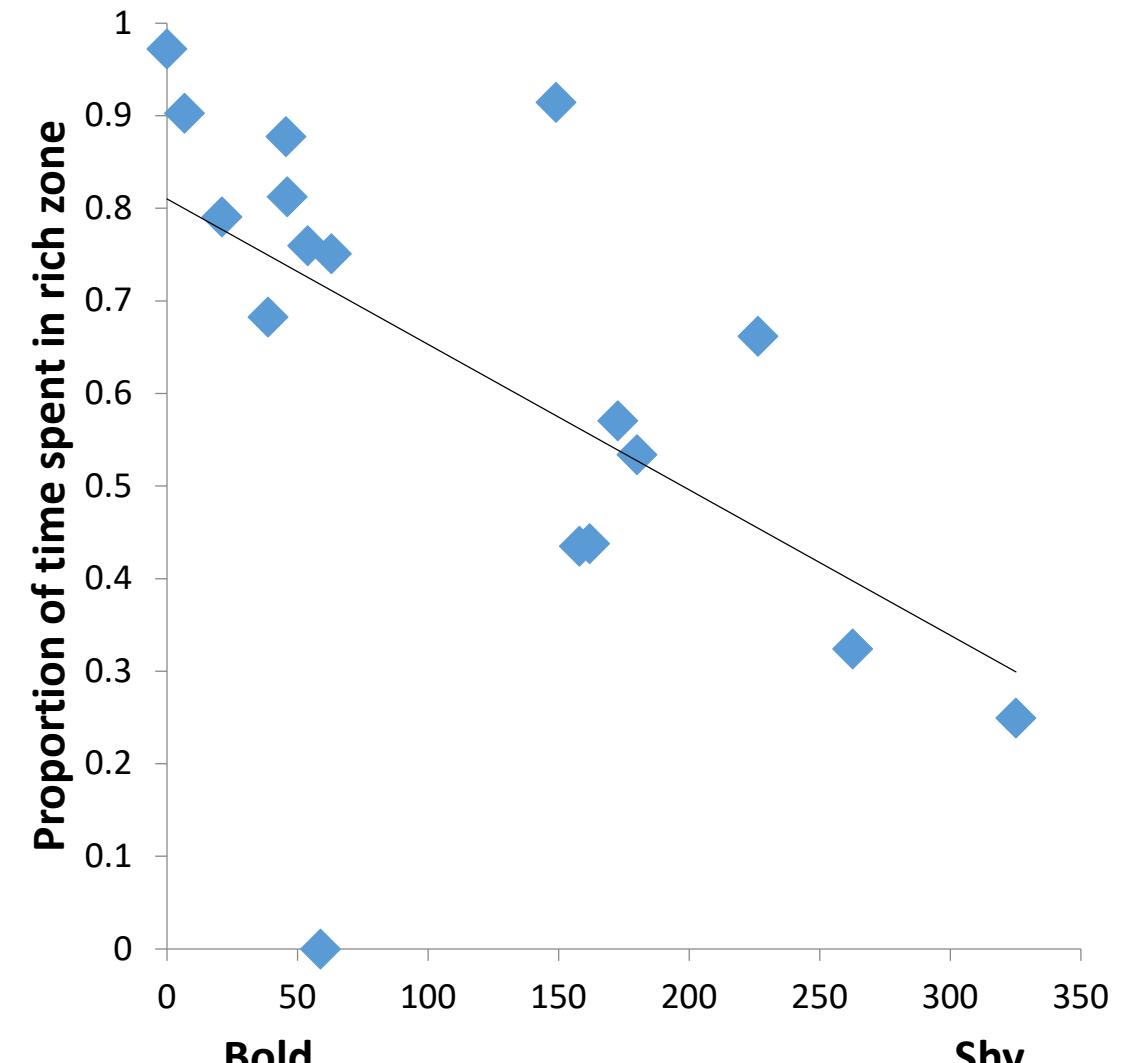
10 min demo



Choice test

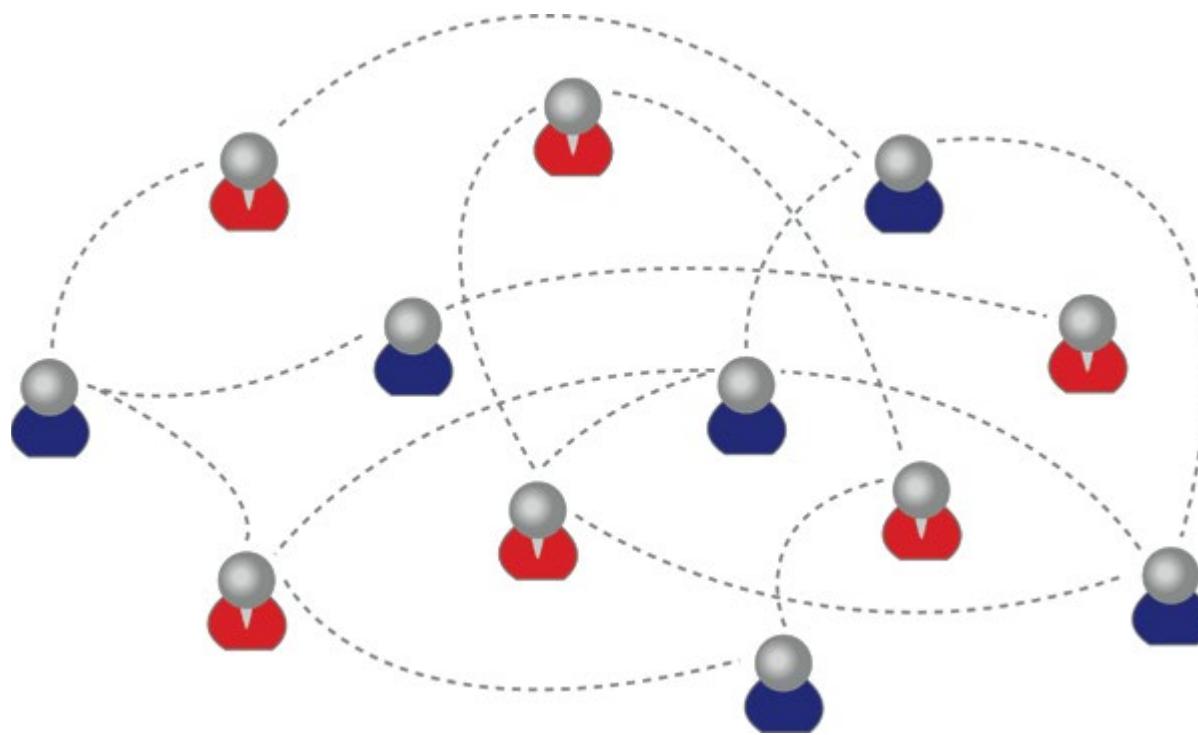


Private and public info coincide

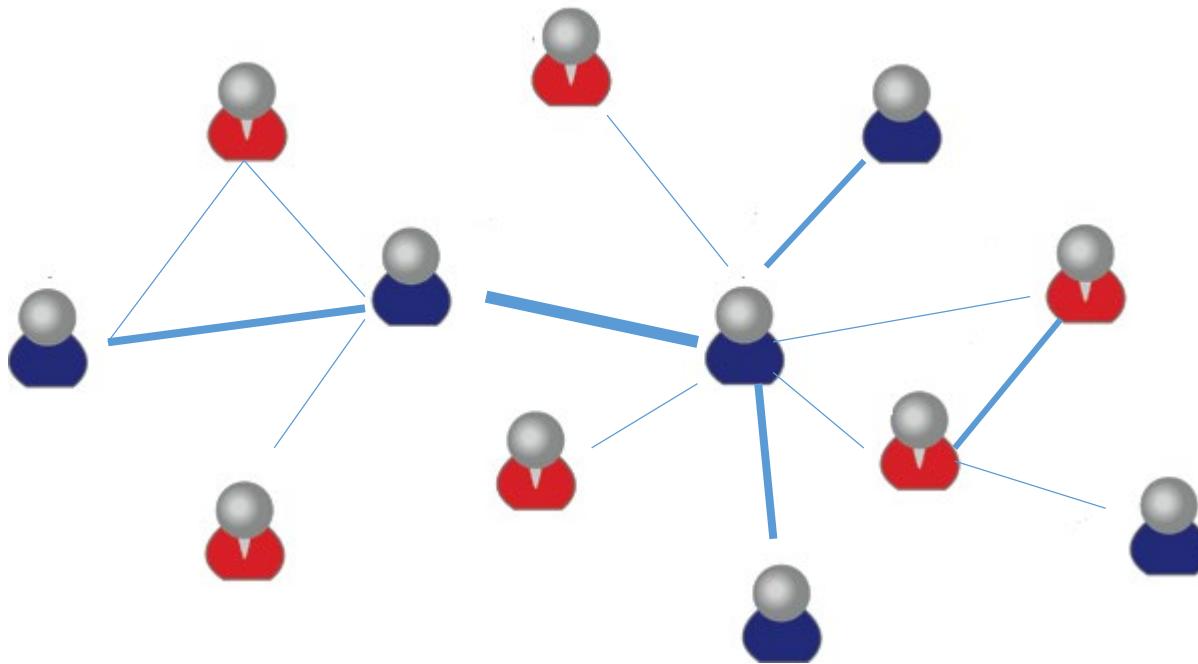


Private and public info conflict

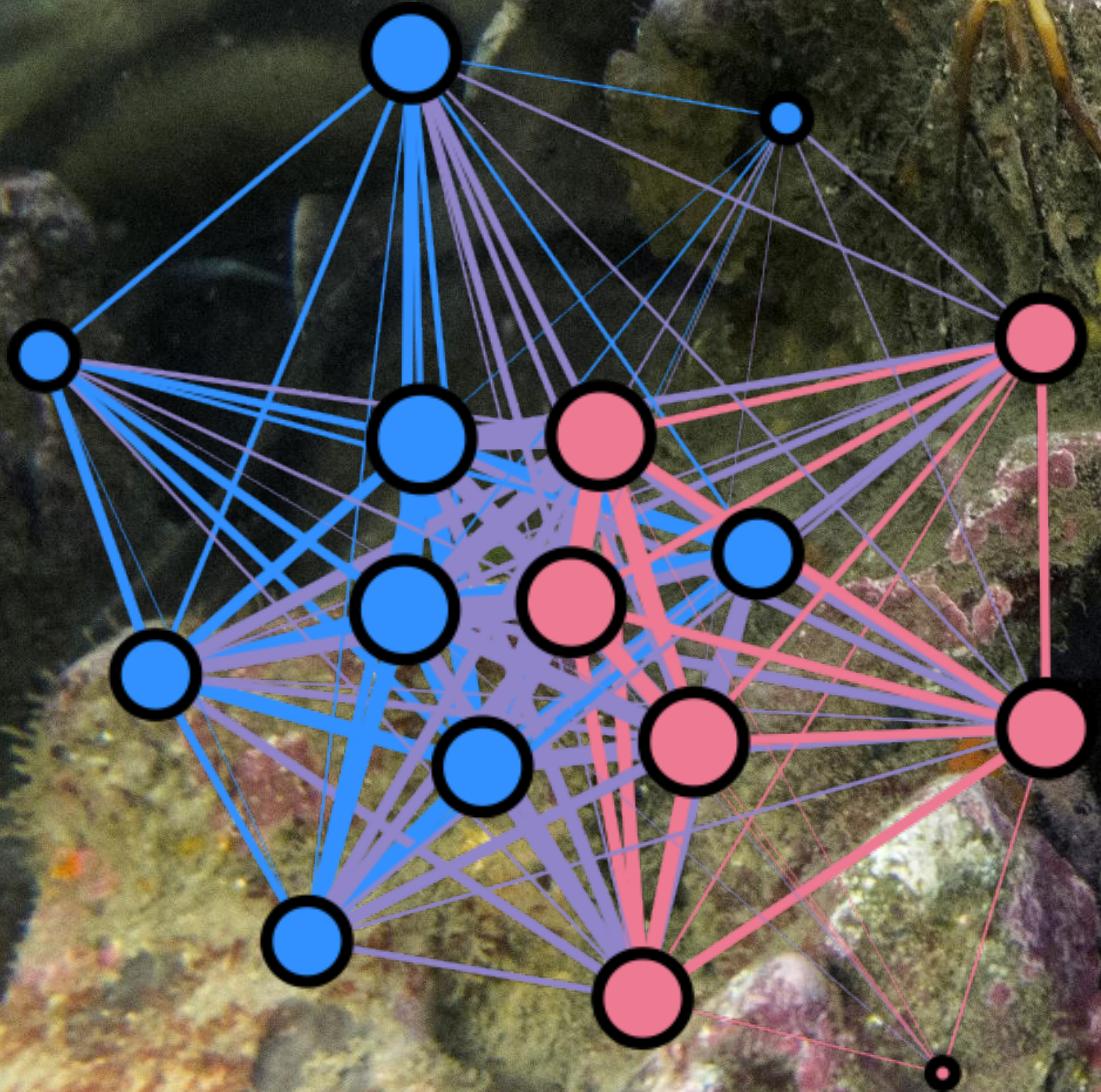
Social networks

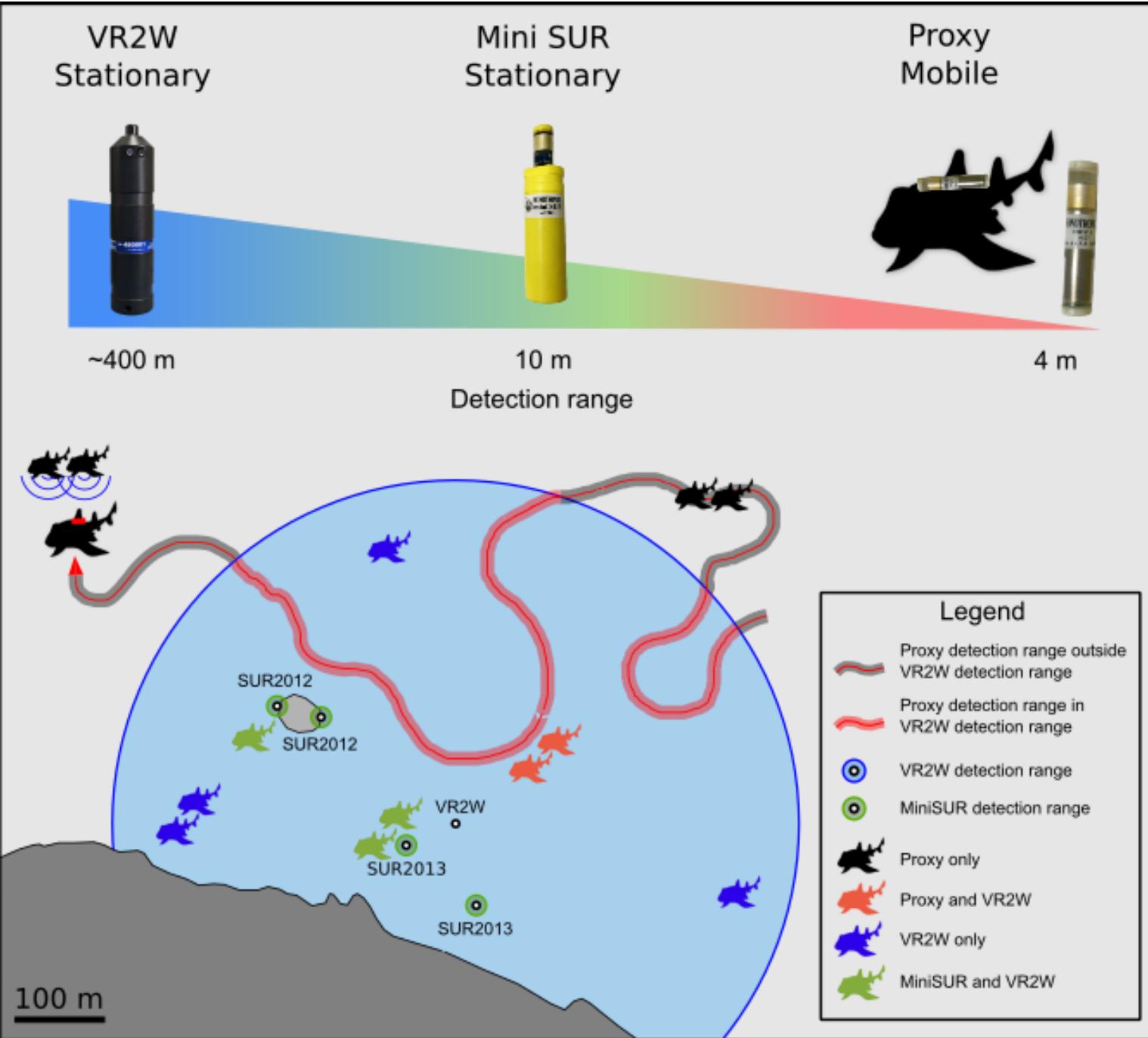


Social network analysis



Social networks in Port Jackson sharks



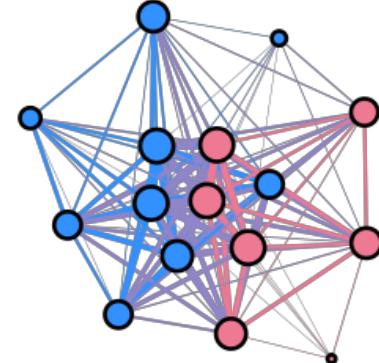


Collecting social contact data for social networks

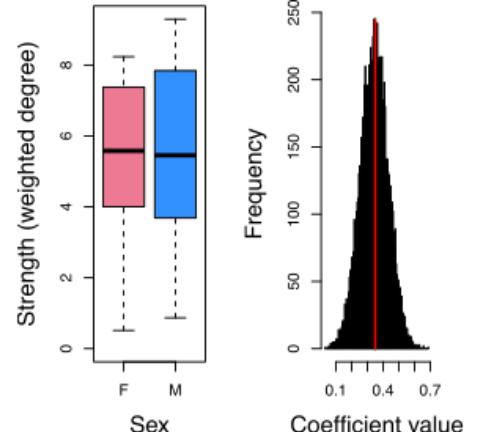
Social data must be collected at a small scale

Proximity receiver 2012

- No assortment by sex ($r=-0.02\pm0.08$)
- No assortment by size ($r=-0.01\pm0.06$)
- No assortment by genetic relatedness

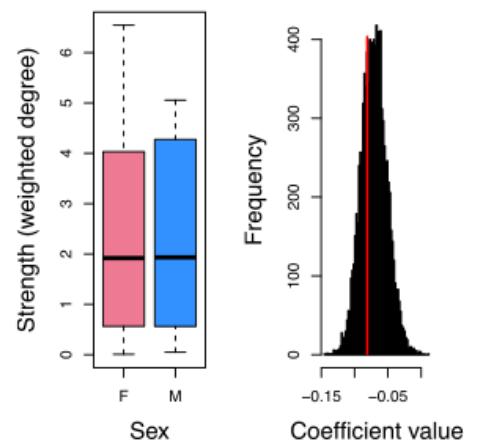
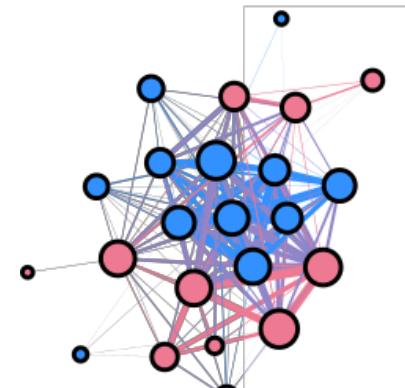


GLM: Degree ~ Sex



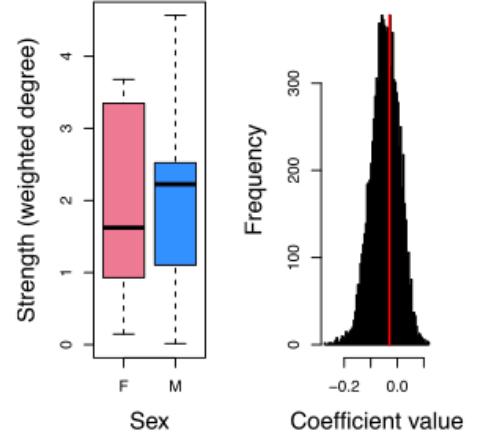
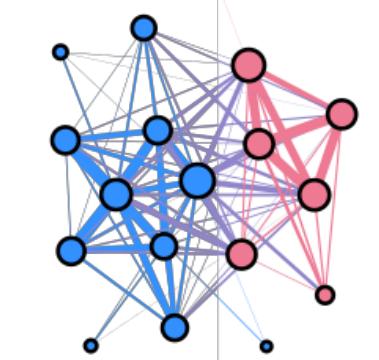
MiniSUR receivers 2012

- Assortment by sex ($r=0.13\pm0.07$)
- Assortment by size ($r=0.11\pm0.06$)
- No assortment by genetic relatedness



MiniSUR receivers 2013

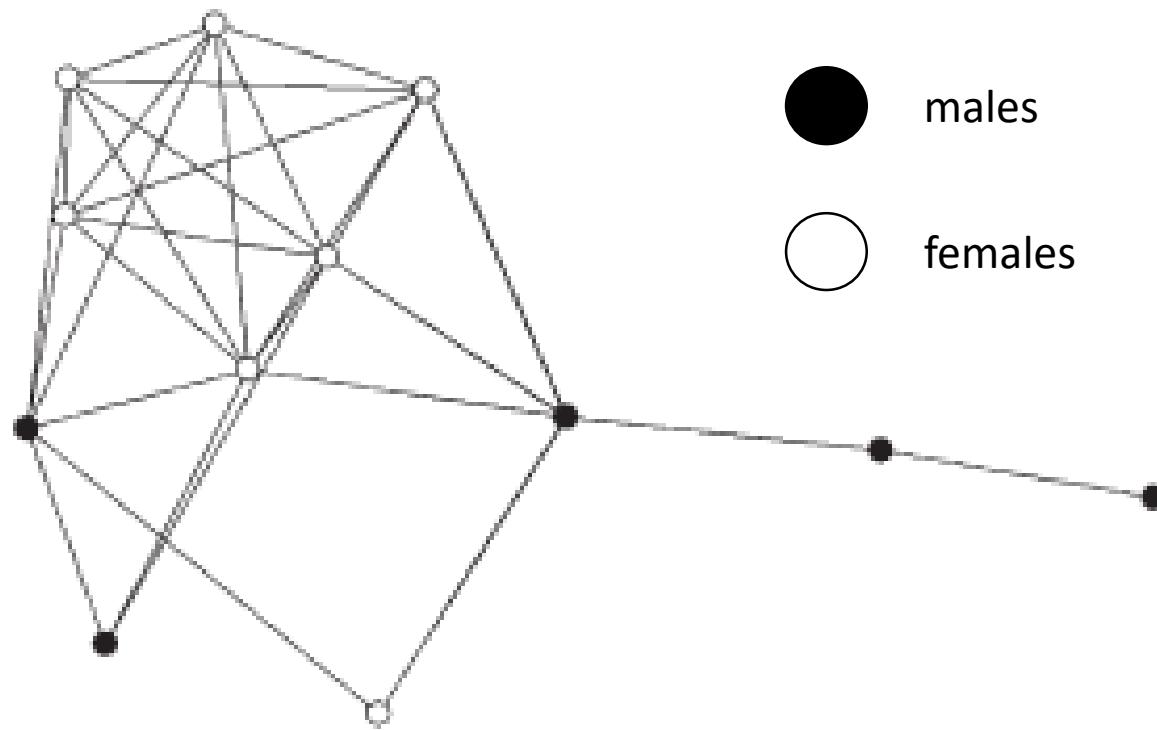
- **Similar associations to 2012**
- Assortment by sex ($r=0.35\pm0.08$)
- Assortment by size ($r=0.14\pm0.08$)
- No assortment by genetic relatedness



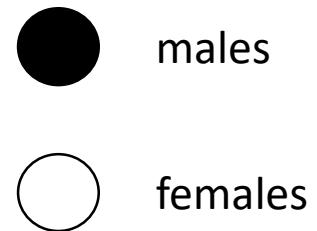
- Social aggregations act as information centres



Social networks and social learning

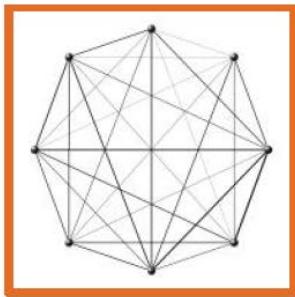
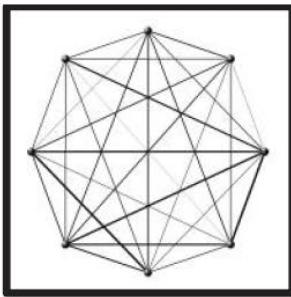
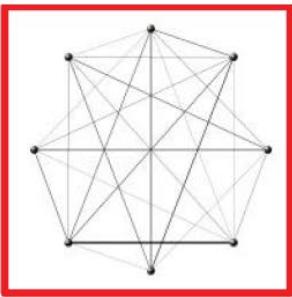
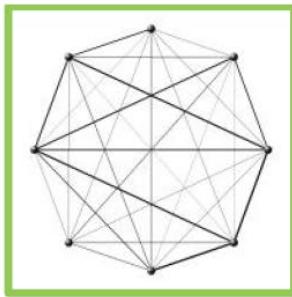
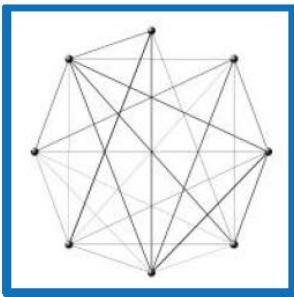


At least 3 interactions

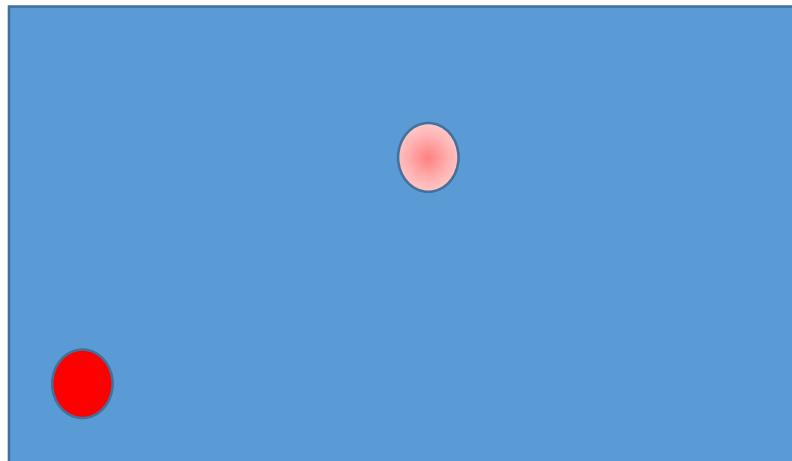


D. Croft et al 2006 Proc. Roy. Soc. B

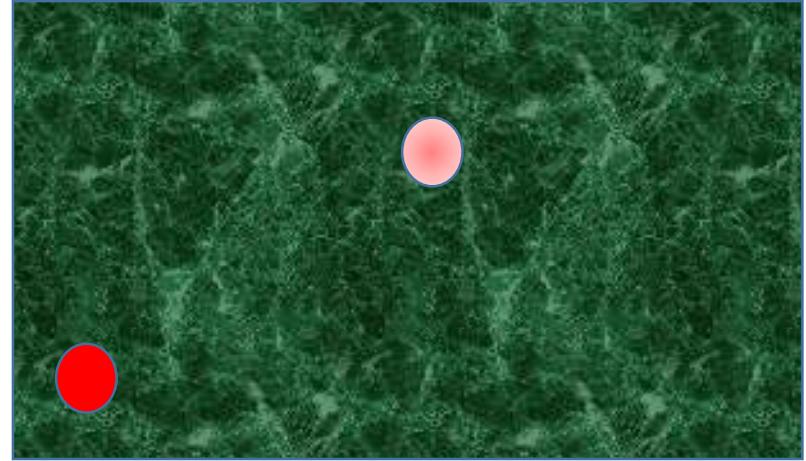
Social networks and information diffusion



Low complexity aquarium



Structurally complex aquarium



3-spined sticklebacks



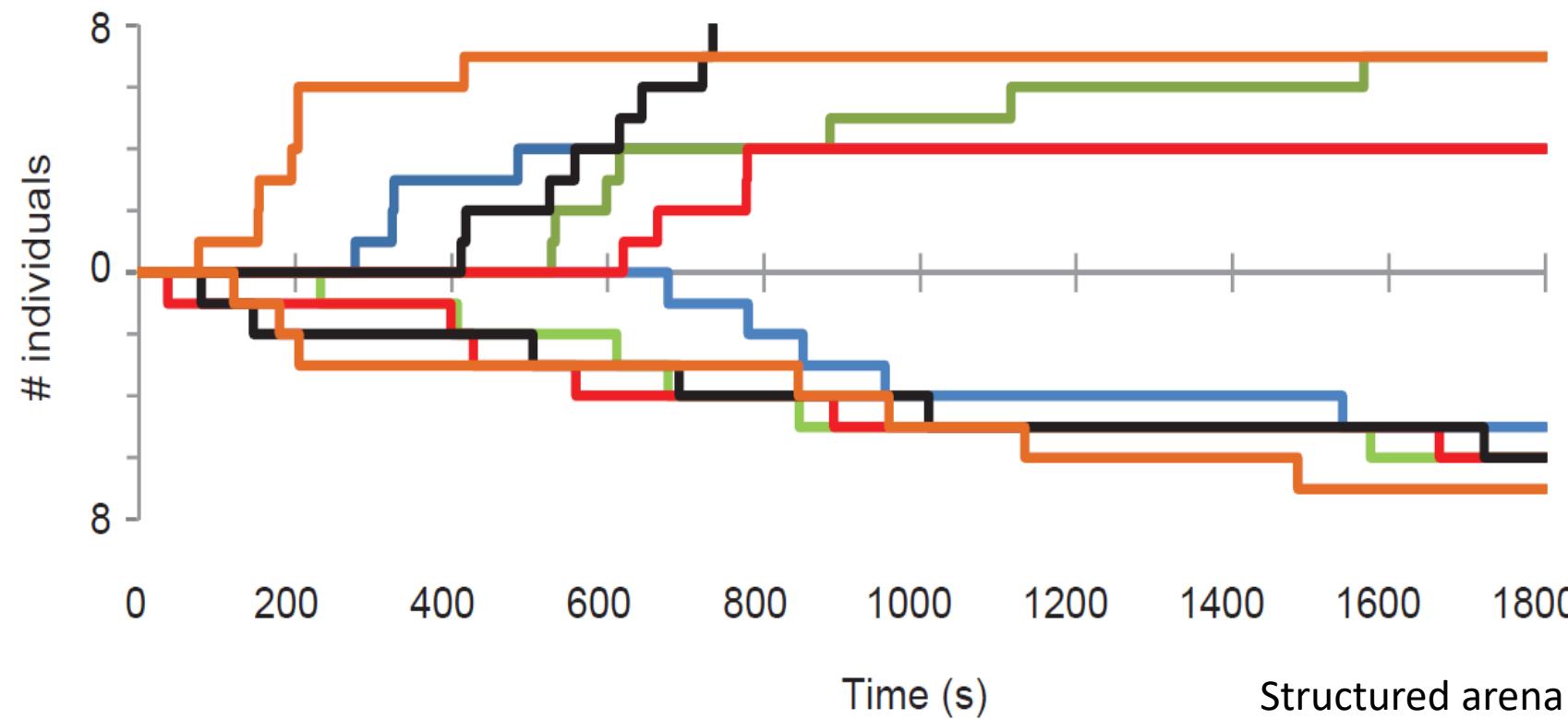
Rewarded foraging patch



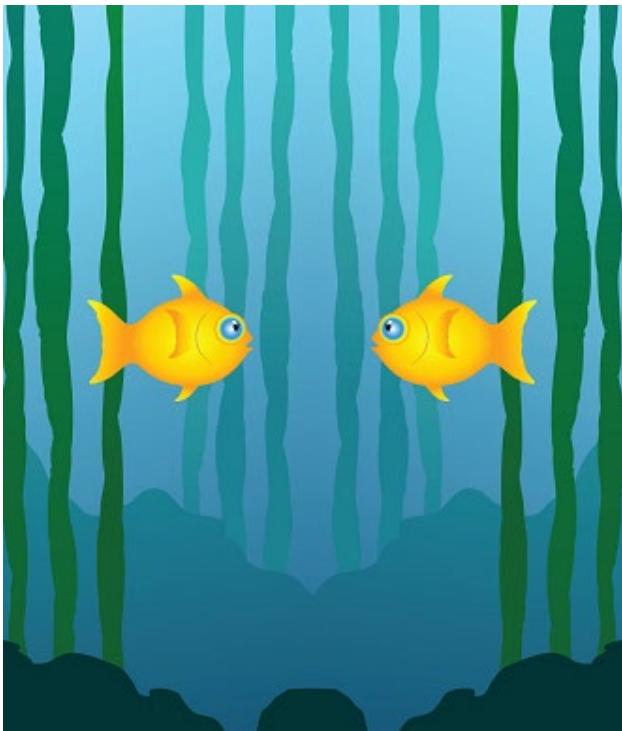
Control patch (no reward)

Social networks and information diffusion

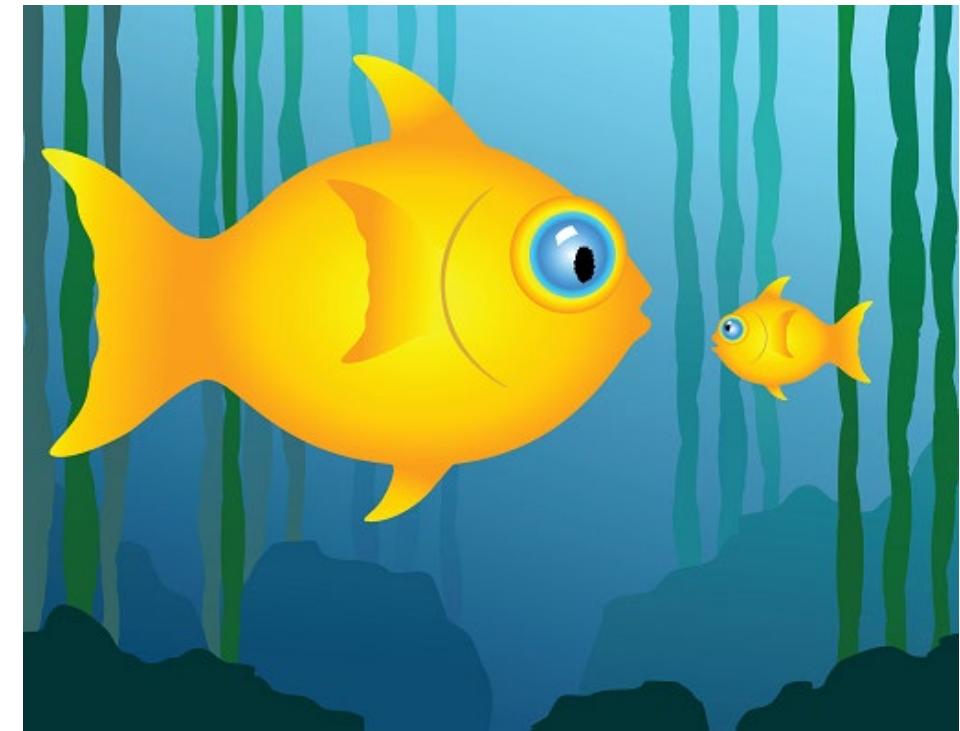
(ii) Latency to enter prey patch (upper) and control patch (lower)



Social learning and fishy culture

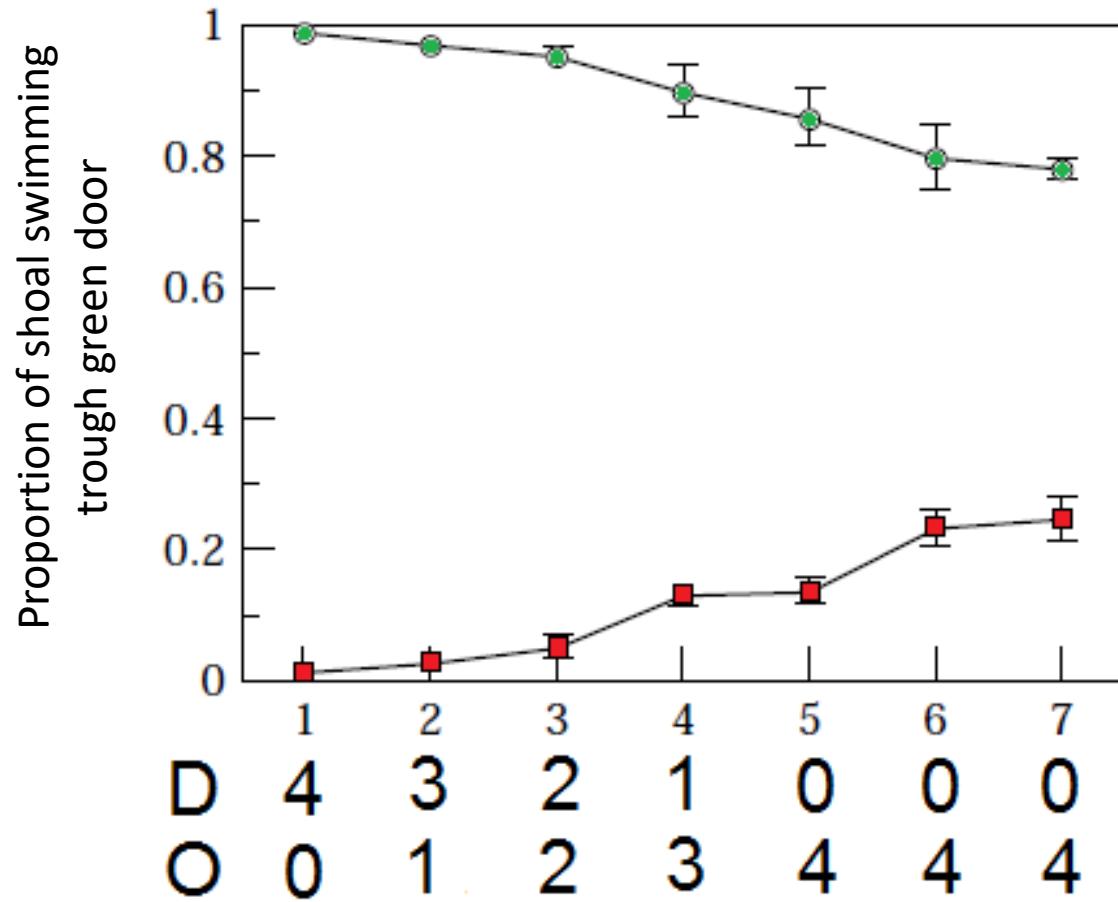


Within a generation



Between generations

Transmission chains



French grunt daily migrations

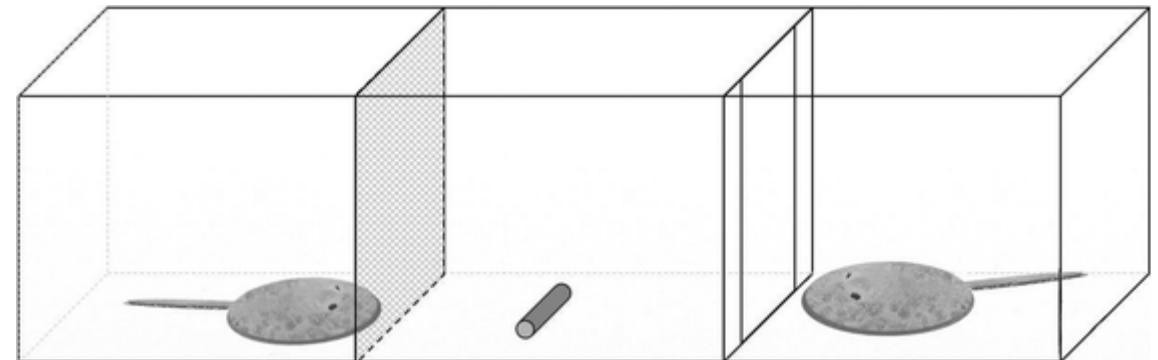


Imitation?

Learning to produce particular body movements through observation of others



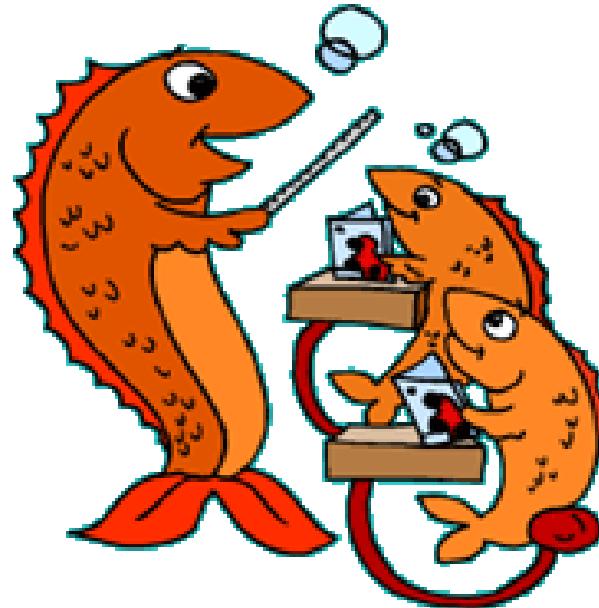
Brown Surgeonfish



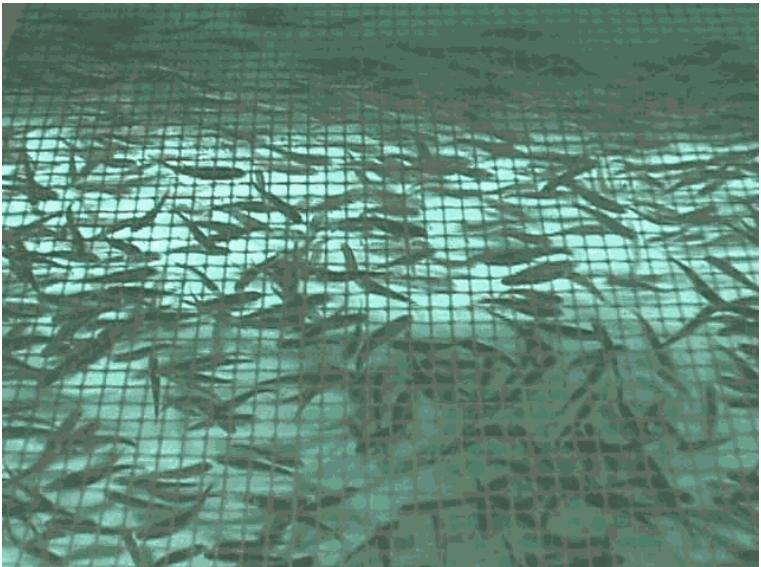
Freshwater stingray

Implications: social learning and culture

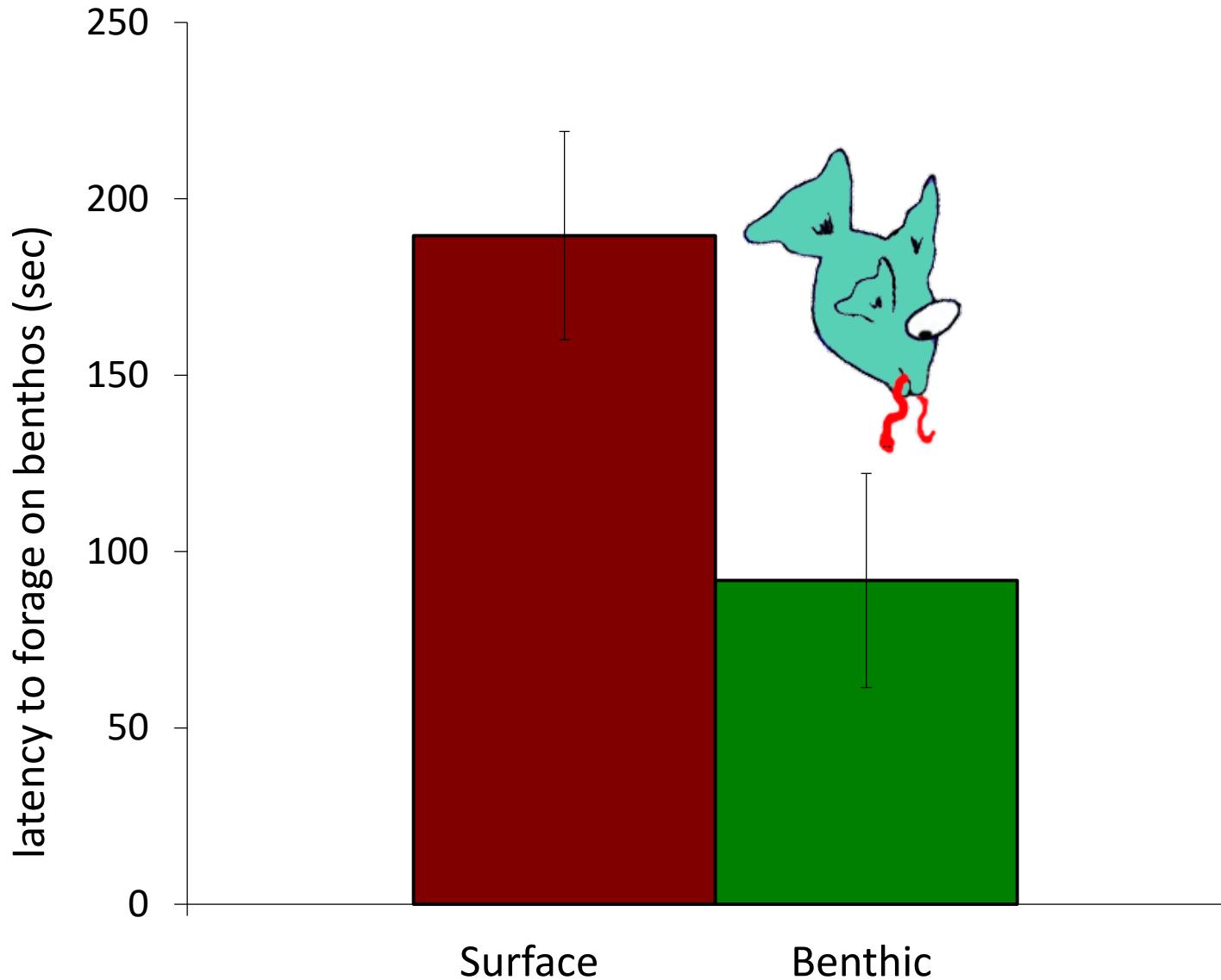
- Fisheries enhancements
- Fisheries conservation and management



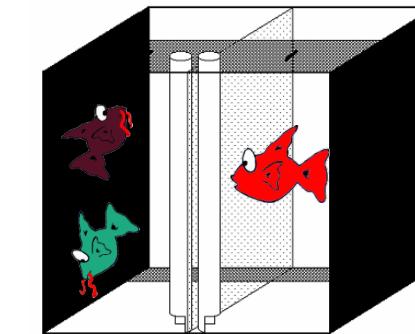
Hatchery production for restocking



Benthic Foraging



Demonstrator



Observer

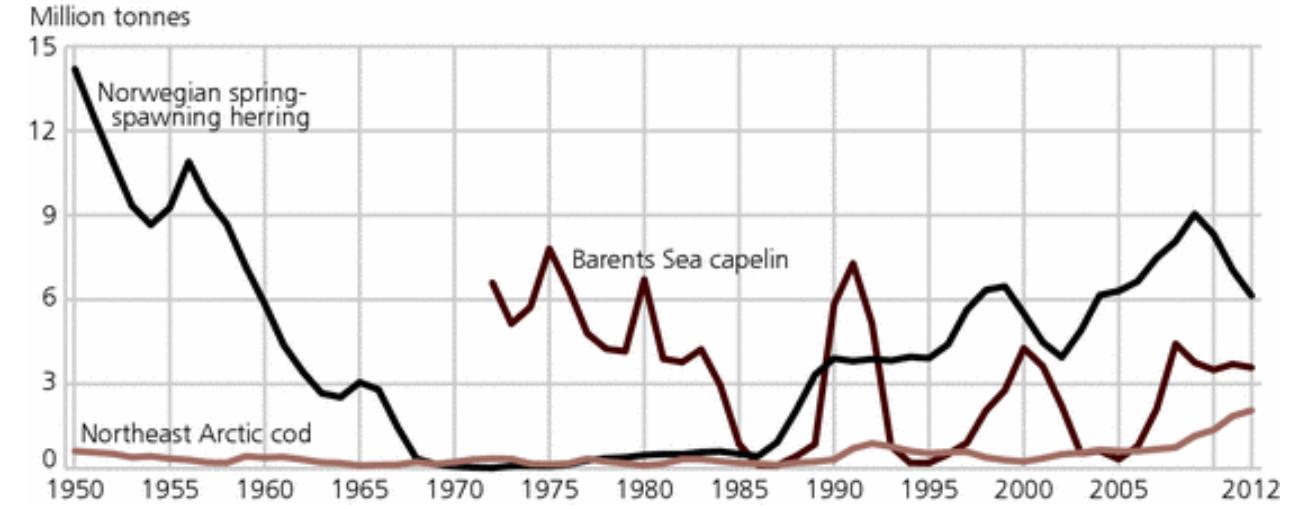


Fisheries management

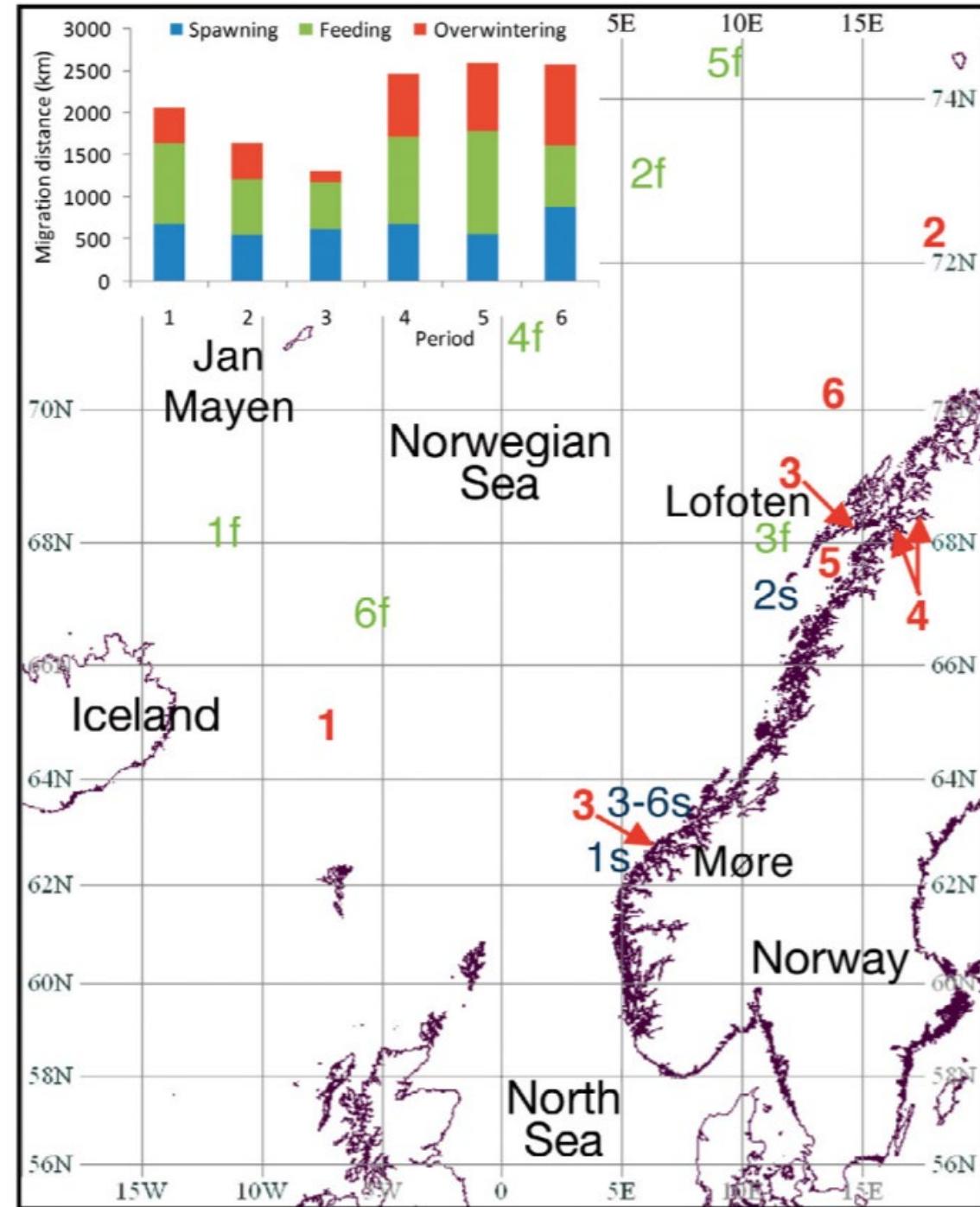


Herring movements in
the North Sea

- 1 = 1952-1956
- 2 = 1965
- 3 = 1973-1986
- 4 = 1988 -1994
- 5 = 1995-2001
- 6 = 2002 -2005



G. Huse et al 2010 Mar. Ecol. Prog. Ser.



Conclusions

- Fish are much smarter than most people think
- Fish rely on both social and private information
- Social learning causes information to rapidly spread through a group
- Social relationships predict how information disperses
- Vertical transmission of information can lead to stable culture
- Understanding social learning processes has practical applications in fisheries management

Suggested reading

- Brown C & Laland KN (2011) Social learning in fishes. In: Fish Cognition and Behavior 2nd Edition (Brown, C., Laland K. & Krause, J. eds). Blackwell Publishing, Cambridge, UK.
- Kendal RL, Boogert NJ, Rendell L, Laland KN, Webster M & Jones PL (2018) Social learning strategies: Bridge-building between fields. Trends in Cognitive Science 22, 651-655.