Specialization and selective social attention establishes the balance between individual and social learning

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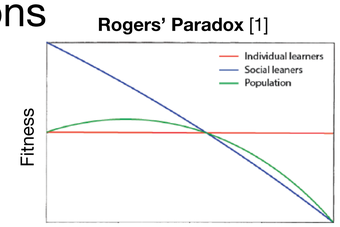
Introduction

Should you innovate alone or imitate other people? Learning from other people has *frequency-dependent fitness* [1], meaning the best strategy depends on what other people do.

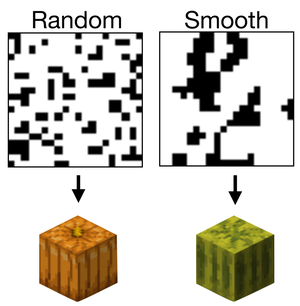
Using an immersive virtual foraging task (producer-scrounger game), we analyze foraging patterns, visual attention, and spatial trajectories to understand how groups collectively adapt to the fluctating demands of a social learning environment

Research Questions

1. How do groups collectively negotiate the balance between individual and social learning?



2. Can people adapt their reliance on social learning to different reward environments, where the predictability of rewards alter the relative advantage of individual vs. social learning?



Summary

Groups achieve a balance through **specialization** (as either source or target of social learning) and through **selectivity** of imitation (targeted towards individual learners).

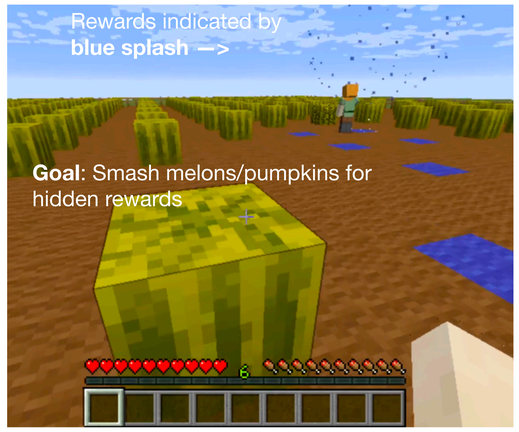
Asymmetry in the social learning structure may rescue the viability of social learning, preventing information cascades.

[1] Rogers, A. R. (1988). Does biology constrain culture? *American Anthropologist*, 90(*4*), 819–831

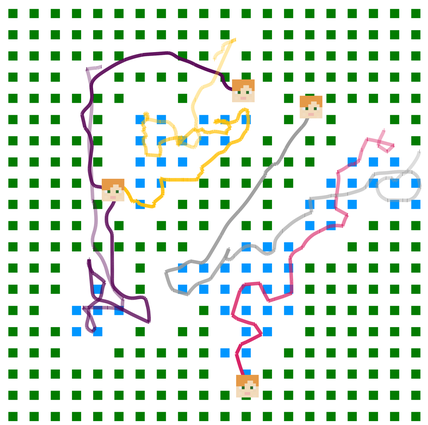
[2] Strandburg-Peshkin, A., Farine, D. R., Couzin, I. D., & Crofoot, M. C. (2015). Shared decision-making drives collective movement in wild baboons. *Science*, 348(*6241*), 1358–1361.

Collective foraging in a virtual environment

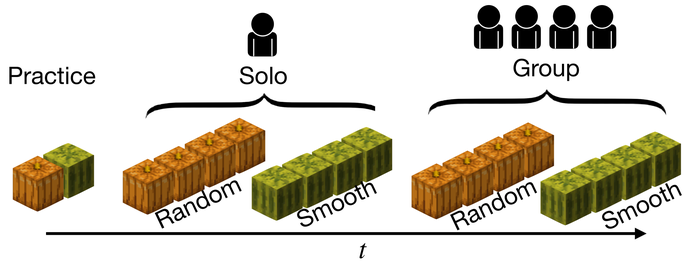
POV screenshot (click for video)



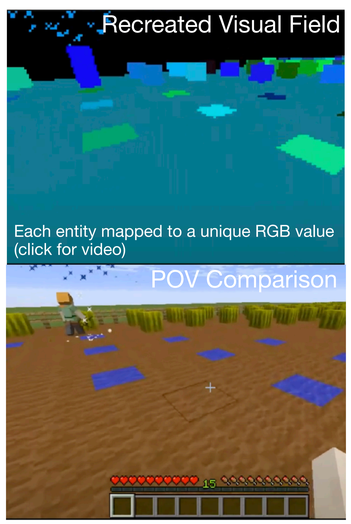
Bird's eye perspective



Task Design

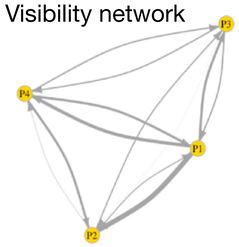


Visual field transcription

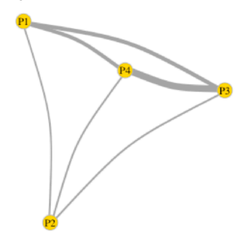


Network Analysis

Visibility network



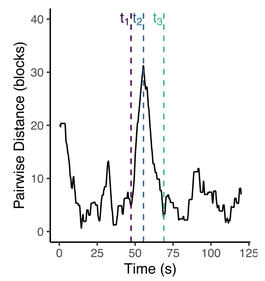
Spatial network



Social Influence Events

"Pull" events [2] extracted from min-max-min sequences in movement patterns and filtered by:

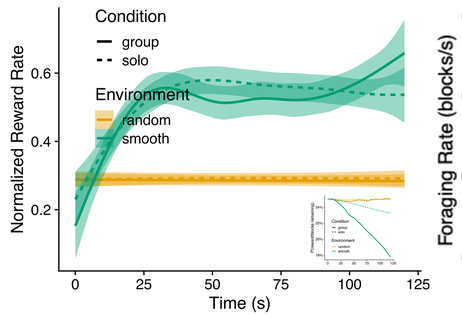
- Strength: large change in distance relative to absolute distance
- Disparity: one player moves more than the other
- Leadership: leader moved more in 1st segment and less in 2nd



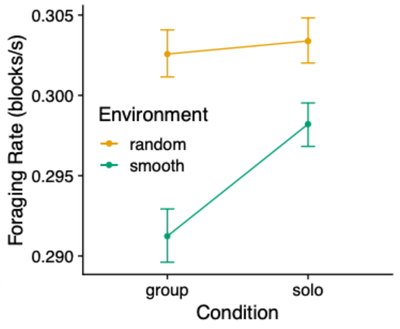
Results

Performance

When accounting for differences in reward depletion (inset), groups perform equivalently to individuals

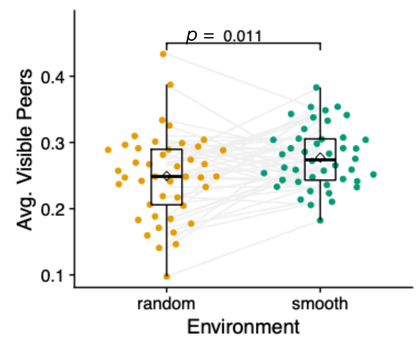


Smooth envs induced more selective foraging, with strong interaction of group:smooth

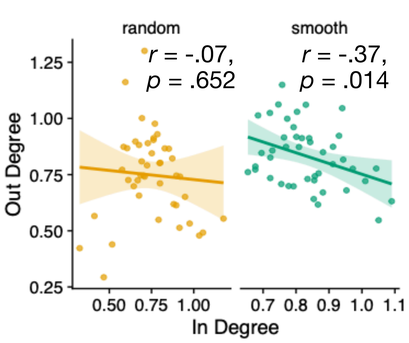


Social attention

More social attention (time looking at others) in smooth environments, where social information is predictive of rewards



Visibility network: inverse correlation of in- and out-degree in smooth envs (selectivity), but not in random envs



Social Influence

Left: Pull example. [t_1-t_2] **Follower** searches the SE corner, while **Leader** finds a new patch in the center. [t_2-t_3] **Follower** moves in to imitate.

Right. More pull events in smooth envs than random envs