Sharing is not erring: How environments can encourage pseudo-reciprocity in collective human search

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Abstract

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Information sharing in competitive environments may seem counterintuitive, yet is widely observed in both human and animal behavior. Scientists openly publish their research, often sharing free-to-access versions of their research, rather than only publishing into restricted access journals. Both large and small companies open source their technologies, rather than keeping them as trade secrets to gain advantages over competitors. What drives this behavior and in which environments is it advantageous for both the individual and group welfare?

Successfully navigating the exploration and exploitation dilemma in a collective search context depends on understanding the demands of the environment (Barkoczi, Analytis & Wu, 2016). The successfulness of a search strategy can be altered by changing one of many aspects of the task environment, such as the complexity of problem space (Mason & al., 2008), the connectivity of the communication network (Barkoczi & Galesic, 2016; Lazer & Friedman, 2007; Mason & al., 2008; Mason & Watts, 2012; Goldstone & al., 2013), the type of social information being communicated (Wisdom & Goldstone, 2013), and the learning strategies of each individual agent (Barkoczi & Galesic, 2016). However, in real world situations, the spread of information depends not only of these factors, but also on the explicit decision to either share or withhold information. We examine how different task environments influence human decision makers in how freely they share information, and how this relates to different demands from the exploration-exploitation trade-off.

In ecology, it has been observed that many species use mass recruitment systems when foraging for resources, whereby successful foragers send signals (e.g., sounds or pheromone trails) to help locate the resource. For example, the American Cliff Swallow has a unique call it uses when it finds food (Brown, Brown, & Shaffer, 1991). The call is a social signal to other Cliff Swallows, and does not only benefit con-specifics. Rather, the individual welfare of each

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Cliff Swallow is improved by the recruitment of peers towards the search effort, since the collective performs better at tracking prey than any alone individual. More generally, this behavior—common in different animal populations—is known as pseudo-reciprocity (Connor, 1986), and mainly depends on the distribution of resources in the environment (Brown, Brown, & Shaffer, 1991).

Pseudo-reciprocity differs from impure altruism (Andreoni, 1989), which is rather applied to models of giving such as public good games, but less so to competitive contexts. Moreover, impure altruism is defined in terms of an added social value (such as approbation) to the individuals utility, which is not the considered benefit in the context of collective search tasks. Pseudo-reciprocity results in tangible benefits for each individual.

In which environments will we find stable pseudo-reciprocity behavior in humans and when will we fail to find it? We present a collective search task over a two dimensional search space, where human participants are given a finite search horizon to search for rewards. At each point in time, players are able to select a patch and discover its value. The player is then given the possibility to either share her location with the other players, or withhold the information. If two players select the same patch at the same time, then they must share the rewards of the patch. We manipulate two main factors. First, we manipulate whether the environment has stationary rewards (e.g., normally distributed with a stable mean) or if rewards are dynamic over time (i.e., a restless bandit context). Second, we vary the sparsity of rewards. We hypothesize that stable pseudo-reciprocity will more likely be observed in dynamic and sparse reward environments, where the task of finding rewards is more difficult without cooperation. We believe that the difficulty and uncertainty of the task environment will drive players to share information, whereas easier task environments with stationary and saturated rewards will result in more competitive and less sharing behavior.

Keywords: Collective search, information sharing, pseudo-reciprocity

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