Mushrooms as 'food for thought': Cognitive science perspectives on fungi

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The predominance of English and English-speaking research over the topics and findings in cognitive science is increasingly recognized as adversely affecting the field (Blasi et al., 2022; Henrich et al., 2010). One of the blind spots owing to this bias is a sweeping disinterest in the fungi world: A simple search of keywords in APA PsycInfo (on Jan 24, 2023) combining *cognit** with each of the three major kingdoms of life returned the following number of hits: 44,257 for *animals*, 1,888 for *plants*, and 111 for *fungi*.

And yet, fungi are the reason why we are here today, why we thrive, and why some of us lose ourselves in a different world altogether comes fall. Fungi have been critical for life on earth, for cultural achievements from baking and brewing to antibiotics, and as a source of food throughout human history. At the same time, they pose unique challenges to key cognitive processes involved in categorization as when distinguishing highly similar and variable species, in predictive processing during foraging, in causal reasoning and risk appraisal for diagnosing whether a species is poisonous, or in the acquisition and storing of information by way of learning, memorization, and teaching (Kaaronen, 2019).

Still, we are short of answers to fundamental and ostensibly simple questions such as when and why our ancestors started to engage with the fungi world, whether and how their cognitive skills co-evolved with the challenges involved in foraging, which cognitive biases are at work when we reason about mushrooms, or—slightly more outside the box—what fungi can teach us about communication and cognition more generally (for indication of the latter, see Adamatzky, 2022; Segundo-Ortin & Calvo, 2022).

One reason for this ignorance is the deeply rooted mycophobia in the English-speaking world (Peintner et al., 2013; Wasson & Wasson, 1957), reflected in the scantness of anglophone scientists addressing such questions (Bender & Oterhals, subm.). It is thus no coincidence that participants in this symposium come from outside the anglophone world, and mostly from countries where people are more cognitively inclined to appreciate mushrooms and better prepared to perceive their relevance, such as Japan, Finland, or Italy.

In order to showcase why research on mushroom-related cognition and behavior is worthwhile—also, and particularly so, in cognitive science—this symposium straddles a wide range of perspectives, beginning with a talk by a leading expert on mycophagous primates (Sawada et al., 2014) on how our close relatives learn to distinguish edible from poisonous species. Bender and Oterhals (subm.) combine their expertise on cultural cognition and food science, respectively, to illustrate the factors that impact on whether a mushroom is considered edible. One of the few cognitive scientists pioneering the investigation of mushroom-related cognition (Kaaronen, 2020) then discusses the crucial role that heuristics play for risk-assessment and decision-making in mushroom foraging. Finally, a cognitive biologist at the forefront of his field urges us to abandon our anthropocentric stance and reconsider what (else) cognition can be (Parise et al., 2020).

Do monkeys avoid poisonous mushrooms? Japanese macaques living in Yakushima Island with high fungal diversity

Akiko Sawada

Although consumed by more than 60 primate species, mushrooms have received little attention as components in primate diets. Mushrooms are unique from other food items (e.g., fruits, seeds, leaves) due to difficulties in search, identification, and particularly the potential confusion with poisonous species. This presentation describes mushroom-eating behavior by wild Japanese macaques, highly social animals with complex diets, living in broadleaf-evergreen forests. Behavioral observation and molecular identification of mushrooms

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reveal that Yakushima macaques consume as many as 67 mushroom species throughout the year. Interestingly, they sometimes exhibit "examining behavior", such as sniffing and nibbling, while handling mushrooms. The highest rate of examination—and subsequent rejection—of *Amanita* (a genus including deadly poisonous species) indicates possible mushroom knowledge shared by macaques. In this talk, I will discuss a potential mechanism of how animals learn to distinguish edible mushrooms from poisonous ones.

What makes a mushroom poisonous? Cultural impacts on the evolution of knowledge

Andrea Bender & Åge Oterhals

Mushrooms have played an important role as a source of food for humans through history and around the globe. Since far from all species are edible, detailed expertise is required to avoid poisonous and even deadly species. This renders the accumulation and transmission of reliable knowledge on mushroom edibility and means for safe distinction a prime example of cultural evolution. Based on an overview of diverging cultural perspectives on mushrooms, we highlight some of the cognitive biases and mechanisms involved in cultural transmission that do shape folkmycological knowledge, illuminating how (and why) edibility appraisals for a range of mushrooms have been changing over time.

Mycological rationality: Heuristics and ecological rationality in mushroom foraging

Roope Kaaronen

Research on decision-making has for long established that humans tend to satisfice rather than optimize. This line of research has suggested that people often utilize cognitive "toolboxes" of heuristics to simplify problem-solving strategies. However, studies on heuristic problem-solving—"rules of thumb"—across human cultures have been scarce. This talk discusses the heuristics used by Finnish mushroom foragers. I describe how foragers utilize heuristics in the search and identification of mushrooms, with special focus on how simple precautionary rules of thumb are used to manage risks and uncertainties. This presentation also illustrates how (and why) heuristics are used in tandem with other, more complex, decision-making strategies. The study invites us to consider whether other human foraging cultures might use heuristics similarly, and how and why such traditions of heuristic "toolboxes" have evolved culturally; and it conjectures whether early hunter-gatherers might have used similar simple heuristics to deal with uncertainty in foraging tasks.

Extended plant cognition: When the cognition of plants and fungi meet

André Geremia Parise

Cognition has been increasingly recognized as a property of every living being, including plants and fungi. Research on plant cognition has demonstrated how proficient plants are in acquiring, processing, and using information to increase their survivability and reproductive success. The cognition of fungi is more neglected, but recent work suggests that they, too, make choices, communicate, and have memory. Now, what if the cognition of fungi and plants merge? For more than 400 million years, they have been collaborating in a symbiosis called mycorrhiza. Research elucidates how they exchange nutrients, carbon, water, etc. Their cognitive interactions, however, have never been explored: what happens when these cognitive systems intertwine so tightly? We raise the hypothesis that plants extend their cognition to mycorrhizal fungi, broadening the plants' sensorial and cognitive apparatus. This hypothesis—awaiting empirical corroboration—implies the fascinating possibility that organisms from different kingdoms can become a single cognitive entity.

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