From Fungi to Thought: Exploring Cognition in Mushroom Foraging

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Introduction

Tracing the evolutionary milestones of our species has been the focus of much exciting research. Yet, we are still unable to 'locate' the divergence point of our cognitive evolution, which has made us so unique in the animal kingdom (Tomasello & Rakoczy, 2003). We have identified a gap in our understanding, and that is the absence of a systematic exploration into the symbiotic relationship between *Homo sapiens* and fungi. This highly interdisciplinary symposium aims to address this oversight, emphasizing the important – yet underappreciated – role of fungi in cognitive contexts and challenge traditional views of cognition.

We argue that, to implement the prominent gene-culture co-evolutionary framework to solve the puzzle of our cognition, we need to consider the effects of fungi, as they have always been everywhere around us. Our prehistoric ancestors relied on them for sustenance (Martínez-Ibarra et al., 2019), medicine (Molitoris, 1994), and tinder material (Berihuete-Azorín et al., 2018). The persistence of fungi in our daily lives and the evolution of information relating to them illuminate the necessity to account for their effects as a great environmental influence (Kaaronen et al., 2023).

Our symposium also emphasizes that the accumulation and transmission of reliable knowledge regarding mushroom edibility, a phenomenon encapsulated by cognitive means for adaptive identification (Abel, 2023), serves as a key example of cumulative cultural evolution. So, to understand the cognitive co-evolution of our species with fungi-related cultural practices and information, we discuss the potential mechanisms underlying the capacity of humans and other primates to (i) discriminate between edible, inedible, and poisonous mushrooms and, possibly, (ii) learn this information from others and (iii) transmit it onward. This can unravel the processes that bring about adaptive decision-making while foraging and improve our understanding of ecological cognition.

Our symposium, then, begins with a talk resembling a meta-discussion about cognition itself, that will challenge conventional thinking. Matteo Colombo, an accomplished philosopher (Colombo & Knauff, 2020), will present three views on fungal cognition, prompting a reevaluation of the interdisciplinary scope of cognitive science. Following this, Akiko Sawada and Aliki Papa, experts in mycophagous primates (Sawada et al., 2014) and cultural transmission biases (Papa et al., 2021), respectively, discuss primate cognition, drawing parallels between humans and primates in distinguishing edible from poisonous mushrooms. Roman Abel, an expert in learning strategies (Abel, 2023), sheds light on learners' awareness of the educational importance of distinguishing confusable categories, providing insights into the evolutionary impact of mushroom behaviors. Lastly, Roope Kaaronen, a notably multi-disciplinary scientist (Kaaronen, 2020), explores mushroom-related cognition through a comprehensive ethno-mycological study, emphasizing the need for expanded research to enrich our understanding of human-fungi relations.

Together, these talks form a comprehensive exploration of the multifaceted interactions between humans and fungi, encouraging forward-thinking and visionary discussions among participants.

Fungal Cognition, or What's the Scope of Cognitive Science?

Matteo Colombo

Systems without a brain are sometimes said to perform cognitive tasks. Fungi, for example, have recently been said to perform tasks like learning, remembering, decision-making, and even conscious perception. Here, I distinguish three views about fungal cognition. The first view is that it is literally true that fungi perform cognitive tasks, because being alive essentially involves having a mind. The second view is that it is only a productive metaphor to assume that

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fungi perform cognitive tasks, because the same theoretical approaches can fruitfully be applied to study and understand organisms with and without a brain. The third view is that it is non-sensical and unproductive to say that fungi perform cognitive tasks, as approaches from biochemistry and physics suffice to fully explain fungi's behaviour. After unpacking these three views, I work out some of their consequences for how we should understand the scope of cognitive science.

From Monkeys to Humans: The Evolution of Cognitive Mechanisms to Deal with Mushrooms

Aliki Papa & Akiko Sawada

When learning about mushrooms, humans display cognitive biases that can prove very adaptive, such as a copy-the-mushroom-expert bias or follow-the-guidebook bias. Yet, our ancestors, unlike us, had to learn individually through painful – at times even deadly – processes of trial-and-error to achieve sustenance. We propose that such processes closely resemble those exhibited by the Japanese macaques; a primate, who finds sustenance in more than 60 mushroom species and displays a spectrum of examining behaviors when faced with mushroom edibility dilemmas. We explore the idea that cognitive biases operating during the transmission of knowledge about mushroom edibility among modern humans is a result of the cumulative co-evolution with the knowledge itself. Studying macaques allows us to glimpse the primitive form of this knowledge, while lab experiments with modern humans illuminate its evolutionary 'journey' and impact on primate cognition. This talk emphasizes the effects of interactions with fungi across species and cultures on cognitive evolution.

Avoid confusion! Learning Strategies for Distinguishing Edible and Poisonous Mushroom Twins

Roman Abel

Learners generally lack the awareness of educational importance of distinguishing easily confusable categories. Accordingly, learners refrain from spontaneous use of alternating sequences, in which confusable categories are juxtaposed (i.e., *interleaving* – ABABABAB), but prefer learning without alternation (AAAABBBB). Hunter-gatherers were faced with the survival threat of confusing edible mushrooms with their poisonous doubles, imposing selection pressure on those who failed to detect subtle differences by contrasting them (i.e., interleaving) and probably leaving imprints on spontaneous learning behaviour of succeeding generations. We manipulated the labels of two mushroom types between subjects, poisonous & edible (survival threat) vs. growing on acid & alkaline to neutral soil (control). Under the survival threat, learners interleaved to a higher extent and distinguished the mushroom doubles more reliably. Our research results are consistent with the "ancestral priorities" view, suggesting that learners spontaneously make adaptive study sequence choices when it is important to avoid confusion.

A Global Ethnographic Review of Human–Mushroom Relations

Roope Kaaronen

While mushrooms are integral to various human subsistence and cultural practices, the study of human–mushroom relations across cultures is still in its infancy. Ethnomycology, compared to ethnobotany, receives limited attention, potentially influenced by Western ethnographic biases. This manuscript offers a comprehensive ethnomycological analysis of the entire eHRAF World Cultures ethnographic archive. Focusing on texts detailing human–mushroom interactions, the thematic analysis provides a global, cross-cultural review of mushroom use. The discussion reveals diverse cultural mushroom-related practices, emphasizing the significance of mushrooms beyond culinary value to include ceremonial, medicinal, economic, and other domains. Special attention is given to exploring how mushrooms and foraging shape and challenge human cognition. However, the review also exposes a lack of detail in descriptions of human–mushroom relations, even for cultural keystone species. This underscores the need for expanded ethnomycological research to enrich our understanding of human–fungi relations.

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