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DIALOGUE

ITERATIVE ALTERNATIVE EVALUATION WITHIN HUMAN–ARTIFICIAL INTELLIGENCE PROBLEM-SOLVING: AN EXTENSION TO RAISCH AND FOMINA'S "COMBINING HUMAN AND ARTIFICIAL INTELLIGENCE"

In their recent article "Combining Human and Artificial Intelligence: Hybrid Problem-Solving in Organizations," Raisch and Fomina (2024) revitalize research on problem-solving—that is, problem definition and solution search—in the age of artificial intelligence (AI). Based on the assumption that predictive and generative AI form more comprehensive *representations* of the search space than humans, they theorize that three types of AI usage—namely, *autonomous*, *sequential*, and *interactive search*—shift humans' limits on problem-solving. This affects search scope as the deviation from existing knowledge and search depth as the reuse of existing knowledge.

A core assumption of the article is that humans accept AI agents' propositions for problem definitions or solutions simply relying on AI's *anticipatory quantification* of fit. While this may come true, research suggests that humans are first skeptical about AI propositions (e.g., Jussupow, Benbasat & Heinzl, 2024). Hence, it is behaviorally more plausible that humans will question AI's propositions and ask the agent to dive deeper (e.g., Bouschery, Blazevic & Piller, 2023). Acknowledging that such a dynamic inquiry is vital to cover the stage of alternative evaluation (Knudsen & Levinthal, 2007), we add iterative evaluation in multiple interactions to Raisch and Fomina's (2024) three types of hybrid problem-solving to unveil the mechanisms of joint search.

In general, evaluating alternatives redirects their subsequent regeneration (Billinger, Srikanth, Stieglitz & Schumacher, 2021). As humans fine-tune prompts to better understand the outputs from AI (Dell'Acqua et al., 2023), they alter the AI agent's representation by imposing parts of their cognitive representation. This iterative process of alternative evaluation is vital, as it directly affects the adjustment mechanisms in representations and, thus, search behavior. If human and AI agents interact repeatedly, a human is not only exposed to more complex, static representations but it also influences them dynamically, ultimately affecting search scope and depth.

In "autonomous search," Raisch and Fomina (2024) theorize that predictive and generative AI's complex representations broaden the search, with humans selecting from alternatives using AI's quantified evaluation of the solution fit. Yet, from a behaviorally plausible perspective, humans prompt the AI to elaborate on its outcomes and validate them before selecting a solution (Dell'Acqua et al., 2023). Thereby, they adjust AI's representation toward some focus areas, as spotting successful solutions narrows the search (Billinger, Stieglitz & Schumacher, 2014). While the complex algorithmic representation will still generate highly novel alternatives, the search scope will increase at a decreasing rate with each interaction. As for search depth, we suggest that human interference compels AI to search more deeply. As humans adjust AI's representation only before selection, search depth rises most strongly in the first interaction, with multiple interferences from humans increasing search depth at a decreasing rate. Importantly, humans adjust the representation of AI, but not vice versa, as human and AI agents do not search collaboratively.

In "sequential search," a predictive, explainable AI defines the problem, allowing a human to refine their representation of the search space and engage in a better-informed and deeper, but less broad, solution search (Raisch & Fomina, 2024). Facing such an opportunity to refine their representation, humans likely strive for even more accurate cognitive representations (Puranam & Swamy, 2016). Thus, they engage in multiple interactions with AI, prompting it to provide them with a more accurate problem definition. Unlike in autonomous search, multiple interactions at the stage of problem definition result in mutual adaptations of human and algorithmic representation toward more focused areas with increasing depth. Accordingly, AI iteratively refines humans' representation; humans selectively integrate such knowledge, refine their representation, and prompt the AI to provide more detail on the problem. Thus, the mechanisms of selective knowledge integration and representation refinement (Raisch & Fomina, 2024: 12) iterate. In this context, humans' first interference significantly reduces the search scope and iteratively narrows it,

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although less intensively, over multiple interactions, leading to a convex relationship. Given the increasing convergence of both agents' representations over time, search depth rises exponentially.

"Interactive search" refers to humans searching with predictive and generative AI agents for problem definition and solutions, with "each interaction cycle enabl[ing] new variance and learning" (Raisch & Fomina, 2024: 13). While humans adjust their representation to include more distant, AI-proposed alternatives, the constant broadening of both representations that Raisch and Fomina (2024) propose is likely to decrease in intensity over multiple interactions. Decisive for such decreasing marginal increase is the complex and dynamic representational interplay between human and AI agents. Humans modify their representation in response to AI's output, leading to refined subsequent prompts that guide the algorithmic representation toward deeper search, while generative AI still offers novelty within this deeper search. As humans iteratively integrate this knowledge, their updated cognitive perspective results in refined prompts, leading to broader and deeper search at a decreasing rate. Such frequent adjustments toward broad and deep search likely cause cognitive overload in boundedly rational humans (Resch & Kock, 2021). This compels them to cease adjusting their representation, resulting in a plateau in search scope and depth.

Broadening the mechanism of representational adjustments to multiple interactions amplifies the contribution of Raisch and Fomina (2024). Including dynamics in hybrid problem-solving enhances the theory's behavioral plausibility, brings it closer to traditional Carnegie School literature (e.g., Knudsen & Levinthal, 2007), and strengthens the contribution to unveil search mechanisms. In particular, accounting for multiple interactions reveals that the degree of change in search scope and search depth depends on *when* humans finally select a solution.

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