Beyond Reciprocity: Psychological Needs as a Foundation for Human-AI Cooperation

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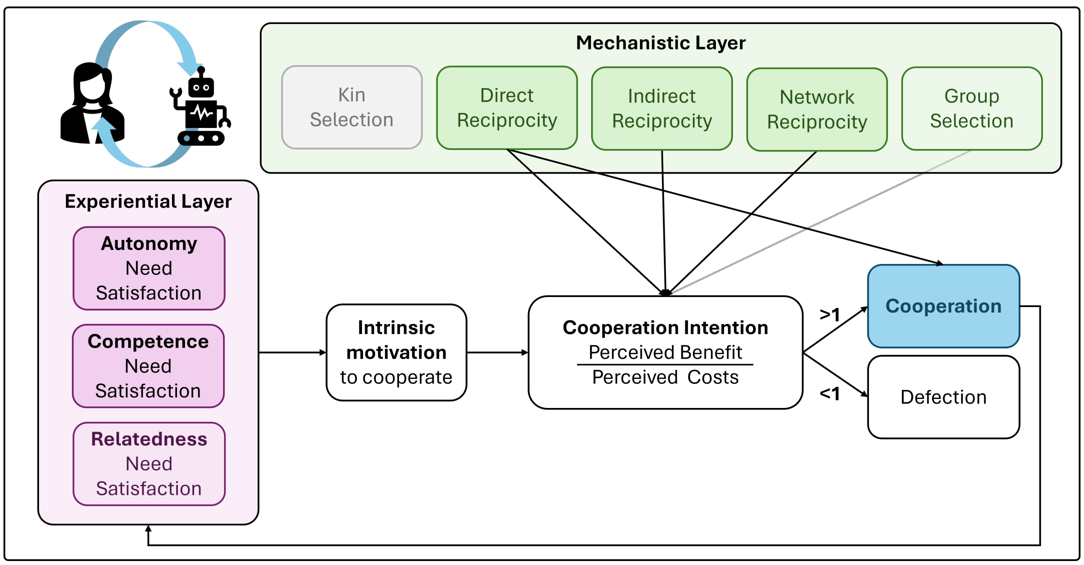

Figure 1: Integrated Framework of Emerging Human-AI Cooperation from a Human-Centered Perspective.

Abstract

In the coming years, human-AI cooperation will become an even more central part of many people's private and work lives, supporting and shaping cognitive processes, while also influencing social dynamics. To understand the conditions under which humans choose to cooperate with AI, researchers have widely utilized evolutionary theories and game-theoretic approaches. However, these frameworks primarily emphasize utility maximization and strategic behavior, overlooking the subjective, experiential dimension of cooperation. To overcome this limitation, we here propose an integrated framework for the emergence of human-AI cooperation, which combines a mechanistic layer drawn from evolutionary theories of cooperation with an experiential layer provided by self-determination theory. We further propose to operationalize the human cooperation intent as the *perceived* balance between benefits and costs of cooperating, which is moderated by the extent to which psychological needs are satisfied through the cooperation. Our framework offers a novel approach for experimentally testing the formation a human-AI cooperation intent, highlighting not only when and why cooperation may occur, but also how it can be designed to be intrinsically motivating and meaningful for users.

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CCS Concepts

• **Human-centered computing → Collaborative interaction**; **HCI theory, concepts and models**; **Interaction design theory, concepts and paradigms**; **Collaborative and social computing theory, concepts and paradigms**; • **Computing methodologies → Philosophical/theoretical foundations of artificial intelligence**.

Keywords

human-AI cooperation, human-AI teaming, game theory, basic psychological needs, self-determination theory

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1 Evolving Dynamics of Human-AI Cooperation

Artificial intelligence (AI) systems are increasingly present in work and private life, expanding the scope and variety of human-AI interactions [2, 4, 7]. In many of these interactions, dynamics of human-AI interaction are shifting toward more socially rich encounters: social dynamics gain prominence [13, 24, 25, 30], and AI roles diversify [19, 23, 26, 28, 42, 46]. Depending on context, AI may be perceived as a technical tool [23, 36], a cooperative teammate [43, 49, 54], or even a relationship partner or friend [6, 35, 45]. This spectrum of perceived social roles shapes user expectations and interaction patterns [14, 15]. For instance, perceiving a decision-support system as a rigid, rule-based tool may lead to undertrust [10]. Such misconceptions can be particularly detrimental when AI systems are expected to contribute to shared goals in interdependent settings, where success depends on coordinated input from both human and artificial agents [38, 40, 53].

Thus, a foundational requirement for effective AI integration is that people willingly engage in cooperation with AI systems [20, 51]. This raises a key question: Under what conditions are individuals intrinsically motivated to cooperate with AI? To address this, we draw on theoretical frameworks with a long-standing tradition in explaining sustainable cooperation among humans (evolutionary cooperation theory) and in accounting for human psychological need satisfaction and well-being (self-determination theory).

Traditionally, evolutionary cooperation theory [34, 44] has focused on strategic mechanisms that explain how cooperative behavior emerged and stabilized over time, with game theory providing a formal framework to test such dynamics. While this perspective has been extended to human-AI interaction [32, 33, 39], it remains limited in scope as it primarily addresses *whether* cooperation can emerge and be sustained, but offers little insight into the subjective conditions under which humans choose to engage with AI. Yet, designing successful human-AI cooperation requires an understanding of *how* people experience the cooperative process itself, as subjective perceptions critically shape both engagement and outcomes [1, 8, 22, 29, 41].

To address this experiential dimension, self-determination theory (SDT; [37]) offers a candidate framework for understanding how AI interaction design can foster human flourishing by supporting the needs for autonomy, competence, and relatedness [5, 21]. For instance, when perceived as a subordinate tool, an AI system can support human autonomy and competence by remaining controllable and responsive to human input [16, 50]. As a more autonomous teammate, it may better satisfy relatedness needs but challenge human autonomy [47]. These effects highlight the need to consider both task effectiveness and psychological need fulfillment in design of cooperative intelligence, which remains a key challenge for AI development [9].

2 Integrated Framework of Emerging Human-AI Cooperation

We propose an integrative framework combining structural insights from evolutionary cooperation theory (e.g., [34]) with motivational principles from SDT [37] to tackle the question which factors may explain the conditions under which humans enter into a stable cooperation with an AI. It addresses both the strategic factors that can initiate cooperation and the experiential dimensions that are expected to shape it (see Figure 1). Central to the framework is the assumption that basic psychological need satisfaction is not only an outcome but also a key driver for initiating and maintaining cooperative behavior.

The *Mechanistic Layer* represents the five basic evolutionary cooperation strategies [34] and their relevance to human-AI interaction. Kin selection (relying on genetic relatedness) is not applicable in this context; therefore shown in gray. Direct reciprocity, which can function without higher-level cognitive processing [31], is linked directly to cooperative behavior, but can also serve as a basis for forming a cooperation intention. Indirect and network reciprocity rely on reputations that are cognitively represented [31], therefore they may contribute to the formation of a cooperation intention as well. Group selection is included as a potential future mechanism; while it may not yet motivate cooperation in current human-AI teams, it could become relevant in more advanced, socially integrated hybrid societies.

The *Experiential Layer* reflects the three basic psychological needs identified in SDT (autonomy, competence, relatedness). We suggest that in first encounters with AI systems, expectations regarding need satisfaction through the interaction moderate the formation of a cooperation intent. If these needs are then satisfied through the cooperation (see feedback loop), they can recursively enhance intrinsic motivation and stabilize cooperation. While the importance of autonomy and competence is well-supported in the context of human-AI interaction in general [3, 11, 12, 16, 17, 48], the role of relatedness remains less conclusive [6, 18, 27, 52]. Thus, this component is shown transparently, requiring further research.

The integration of evolutionary and SDT perspectives is captured in the concept of *Cooperation Intention*, determined by the perceived balance of cooperation benefits and costs. When (expected) benefits outweigh (expected) costs, cooperation is initiated. Psychological need satisfaction moderates this balance: Need fulfillment that is aligned with user expectations may make costs (e.g., cognitive effort, time, or information sharing) feel more meaningful and goal-aligned, while frustrated needs may make them feel imposed or inefficient, reducing the willingness to cooperate.

To move from theory to practice, the assumptions require systematic empirical testing. Our integrated framework provides a foundation for formulating hypotheses and examining how experiential factors (expected or actual psychological need fulfillment) and mechanistic factors (evolutionary principles such as reciprocity or reputation, which unfold differently in one-shot interactions versus long-term human-AI cooperation) jointly shape the emergence of users' cooperation intentions. Changes in the willingness to accept certain costs (e.g., waiting time) may serve as a direct operationalization of shifts in individuals' intrinsically motivated intention to cooperate with AI.

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