Opening Psychosocial Discussions on Multi-Human-Robot Work Teams

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Abstract

Which teams are most likely to welcome a collaborative robot? Intuitively, cohesive teams should integrate cobots more readily. Our initial findings suggest otherwise. This exploratory study examines how individual dispositions (cooperativeness, competitiveness, attitudes toward robots) and perceived team climate influence anticipatory perceptions of cobot integration. Triads of participants (N=18) completed simulated assembly tasks before evaluating a hypothetical scenario where a cobot joins their team. We assessed discomfort with human–robot teamwork and perceived role changes (threat vs. enhancement). Counterintuitively, participants experiencing stronger collaborative climates reported heightened resistance. We interpret this as team protectiveness: the better the collaboration, the more there is to lose from structural disruption. Additionally, negative robot attitudes emerged as stronger barriers than positive attitudes as facilitators—an asymmetry critical for intervention design. We discuss a psychosocial research agenda for understanding when cooperative teams welcome versus resist robotic teammates.

CCS Concepts

- **Human computer interaction (HCI)**;

Keywords

Team dynamics, Robot task allocation, Cooperative attitudes, Attitudes toward robots

ACM Reference Format:
Federica Nenna, Margherita Nannetti, and Luciano Gamberini. 2026. Opening Psychosocial Discussions on Multi-Human-Robot Work Teams. In *Extended Abstracts of the 2026 CHI Conference on Human Factors in Computing Systems (CHI EA '26), April 13–17, 2026, Barcelona, Spain.* ACM, New York, NY, USA, 5 pages. https://doi.org/10.1145/3772363.3798968

1 Introduction

As robots increasingly enter our world, research has focused primarily on dyadic Human-Robot Interactions (HRIs) [1, 12, 13]. However, everyday contexts, such as workplaces [4], are inherently social. In these settings, collaborative robots (cobots) must integrate into teams, not just interact with individuals. Understanding how teams anticipate a cobot's arrival is thus crucial: what determines whether it will be accepted as a teammate and how will members envision their changing roles?

Multiple factors likely shape robot integration in work teams. Individual attitudes toward robots are known to influence acceptance in both dyadic [12] and multi-human-robot scenarios [8, 19, 24]. Additionally, when robots enter group contexts, socially-oriented dispositions (e.g., cooperativeness, competitiveness) become equally critical. These dimensions shape group work quality and newcomer acceptance, whether the newcomer is human [2, 5] or robotic [6, 23]. However, existing research presents contradictory patterns. In leisure contexts, Fraune et al. [7] found cohesive groups more open to robot approach, though these findings may not generalize to workplaces. Conversely, human team research shows that cooperative or competitive groups often resist newcomers [5, 11, 17], raising the question: how do these dynamics play out when the newcomer is a cobot?

Another key factor is task assignment: research shows that task allocation preferences reveal the depth of trust and collaboration people envision [25], with workers showing greater acceptance when robots handle simpler, well-defined tasks alongside humans rather than replacing them [20, 25].

While task allocation has gained research traction, particularly in human-robot dyads, the psychosocial fabric of multi-human-robot work teams remains a nascent research area. Psychosocial dynamics operate on two levels: as individual tendencies (e.g., dispositional cooperativeness or competitiveness), and as contextual experiences (perceived team climate during collaboration). Yet studies addressing how these multi-level dynamics shape workplace robot integration remain scarce.

This paper contributes an exploratory probe into multi-human-robot team dynamics, surfacing counterintuitive patterns—most notably, that stronger collaborative climates associate with greater anticipated resistance to cobots. Rather than offering definitive answers, we aim to provoke conversation and outline research directions on an understudied question: what psychosocial dynamics determine whether a cobot becomes a teammate or an intruder?

2 Related Work

Cooperation, Competition, and Newcomer Acceptance in Human Teams. In group dynamics, cooperativeness and competitiveness shape not only work quality but also responses to structural changes like newcomer integration. Cooperation refers to accepting short-term costs to generate mutual or collective benefits [16], with cooperativeness capturing the dispositional tendency to engage in such behavior, though its expression is shaped by contextual factors such as perceived similarity and prevailing social norms [15]. From

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CHI EA '26, Barcelona, Spain

ACM ISBN 979-8-4007-2281-3/2026/04
https://doi.org/10.1145/3772363.3798968

an evolutionary perspective, mechanisms such as reciprocity and reputation-building explain why cooperative groups consistently achieve higher collective performance [16]. Similarly, competitiveness manifests as a trait (enjoyment of competition), attitude (belief in its value), or behavior (actions to outperform others) [26]. Social Identity Theory [22] suggests individuals become more competitive once identifying with a group, underscoring the importance of considering both individual dispositions and group-level contexts.

Interestingly, being cooperative or competitive does not guarantee openness to newcomers. Cooperation often operates parochially—directed inward toward in-group members [5]. Once individuals identify with a group, they become less inclined to support outsiders, viewing newcomers as potential "free riders" [5]. Baier and Struwe [2] demonstrated this: participants in highly cooperative groups were more cautious about admitting unqualified members. Competitiveness also complicates integration. While developmental competition can strengthen team empowerment, hypercompetition undermines it [17]. When newcomers join, they introduce social uncertainty; in highly competitive contexts, this erodes trust and hinders collaboration [11].

Robot Integration in Teams: Contrasting Patterns. While human team psychology provides interpretive frameworks, evidence on robot integration presents mixed patterns. Although no studies directly examine cooperativeness in HRI work teams, agreeableness (i.e., encompassing cooperative and friendly tendencies) positively correlates with robot acceptance, and more agreeable participants demonstrate greater comfort with social robots [6, 9, 23].

Team-level dynamics reveal similar complexity. Robot acceptance depends on fit with existing structures: roles, relationships, and group entitativity [14]. In leisure contexts, Fraune et al. [7] found that groups with higher entitativity were more welcoming to robot participation, allowing closer approach distances. However, findings from leisure settings may not transfer to workplace contexts. This contrasts with human newcomer research, where cohesive groups show greater exclusion [2, 5].

Interaction context further shapes robot perception. In cooperative settings, robots are judged as more independent and intentional, with the strongest effects in cooperative-competitive scenarios (teaming with robot against another human-robot team), while pure competition positions robots as opponents rather than teammates [18].

Taken together, prior work suggests that robot acceptance in teams may depend on both individual social dispositions and context-dependent team dynamics, and that interaction framings (cooperation vs. competition) can shift how robots are interpreted as teammates or opponents [18]. However, direct evidence on how dispositional cooperativeness/competitiveness and experienced team climate jointly shape anticipatory cobot acceptance in work-relevant settings remains scarce.

3 Methods

Participants. We recruited 18 young adults (9 women, M_{age} = 24, SD_{age} = 2.09) working in triads (six groups). Participants were classified as robot-naive based on self-reported robotics competence and familiarity: ~80% scored neutral or below on robotics

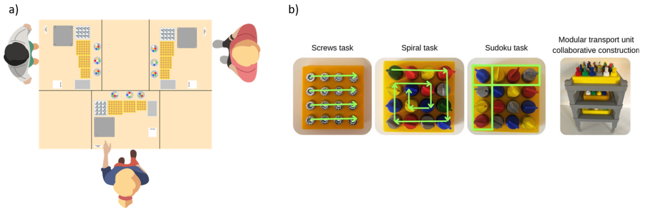

Figure 1: a) Experimental set-up; b) Individual tasks (Screws, Spiral, Sudoku) and collaborative assembly tower

competence (1–5 scale), and ~70% reported no prior robot interaction. All provided informed consent; the protocol was approved by the local ethics committee.

Procedure and Measures. Before the experiment, participants completed questionnaires assessing demographics, cooperation-competition tendencies (Cooperative and Competitive Personality Scale [10]), and attitudes toward robots (positive/negative dimensions of General Attitudes Toward Robots Scale [3]).

They then engaged in a simulated manufacturing workcell where triads assembled modular units (Figure 1a). Each turn comprised: (1) an individual phase where participants simultaneously completed distinct but interrelated tasks (screw tightening, spiral assembly, or sudoku assembly), followed by (2) a collaborative phase integrating components into a shared tower-shaped transport unit (Figure 1b).

The tasks, selected via pilot study with seven HCI experts, were designed to reflect common manufacturing operations [21]. *Screw tightening* was repetitive and fully structured, *Spiral assembly* used semi-structured logic with color constraints, and *Sudoku assembly* used structured logic with row/column constraints. Descriptive task experience ratings are reported in Appendix A (Figure 3).

Across nine turns, each participant experienced all three tasks at least once, rotating roles to ensure varied exposure. After each turn, participants rated momentary perceptions of team climate using two 7-point Likert items: *"During teamwork, I felt a collaborative climate"* and *"During teamwork, I felt a competitive climate"*. For analysis, we focused on perceived collaborative climate as a state-like contextual experience (distinct from dispositional cooperativeness), computed by aggregating turn-level ratings to obtain one score per participant. Competitive climate served as a methodological control to verify the activity did not inadvertently foster competitive dynamics.

After the full activity (~1.2 hours), we introduced a hypothetical scenario. The activity was designed to let triads develop an interaction history and shared climate under task interdependence. Participants were then told a cobot would join their team, described as *"a collaborative robot designed to work alongside the three human team members, sharing the workspace safely and capable of performing any of the three assembly tasks (screw tightening, spiral assembly, or sudoku assembly) as assigned by the team"*.

Participants were explicitly instructed to anchor their responses to their just-completed collaboration as the reference team context. Critically, no physical robot was presented. This robot-agnostic approach was deliberate: by avoiding specific robot forms or capabilities, we isolated psychosocial dynamics from morphology-driven reactions, enabling examination of how team experiences—rather than robot characteristics—shape anticipatory acceptance. While this limits ecological validity (participants could not visualize a concrete robot), it strengthens internal validity for our theoretical question: do team dynamics predict resistance before any robot-specific information is available?

Participants then reported three anticipatory perceptions on 7-point Likert items: (1) *Discomfort*: *"I would feel uncomfortable working in a team that includes a robot"*; (2) *Role threat*: *"Robot integration could reduce my role value"*; (3) *Role enhancement*: *"Robot integration could increase my role value"*.

Data Analysis. We fitted exploratory linear mixed-effects models (RStudio) with fixed effects for individual dispositions (robot attitudes, cooperative/competitive tendencies) and perceived collaborative climate, plus random intercepts for Group to account for nested data structure. We report marginal R^2 (variance explained by fixed effects) and conditional R^2 (full model including random effects).

4 Results

Descriptive ratings confirmed the activity was perceived as collaborative (M = 4.92, SD = 1.24) rather than competitive (M = 2.41, SD = 0.78), validating our cooperative task design. Prior to modeling, we verified adequate data quality: no multicollinearity (all Spearman |r| < .50), score distributions covering most of the 1–7 Likert range for all measures (avoiding floor/ceiling effects), and appropriate outcome distributions confirmed via visual inspection and fit indices. We present findings as exploratory associations that reveals patterns worth investigating, rather than confirmatory evidence. Given the small sample (N=18; six triads), all effects should be interpreted as preliminary signals motivating future research directions.

For **discomfort with human-robot teams**, negative attitudes toward robots, $\chi^2(1) = 5.76$, $p = .016$, and lower perceptions of collaborative climate, $\chi^2(1) = 4.22$, $p = .040$, were significant predictors, while positive attitudes were marginally associated, $\chi^2(1) = 4.07$, $p = .044$. The model explained substantial within-sample variance (marginal $R^2 = .35$, conditional $R^2 = .84$).

Anticipations of **perceived role threat** following robot arrival were higher among participants with stronger competitive tendencies, $\chi^2(1) = 8.33$, $p = .004$, and weaker cooperative tendencies, $\chi^2(1) = 4.72$, $p = .030$. Negative attitudes toward robots, $\chi^2(1) = 4.71$, $p = .030$, and lower perceptions of collaborative climate, $\chi^2(1) = 6.40$, $p = .011$, also predicted stronger perceived role threat (marginal $R^2 = .40$, conditional $R^2 = .77$). Notably, dispositional cooperativeness and perceived collaborative climate showed opposite associations with role threat despite being uncorrelated (Spearman r < .50): cooperative individuals anticipated less threat, while those perceiving stronger team collaboration anticipated more. This divergence, unpacked in the Discussion, suggests trait-level openness and state-level team experiences may operate through distinct mechanisms.

Finally, greater cooperative attitudes, $\chi^2(1) = 10.92$, $p < .001$, and stronger competitive attitudes, $\chi^2(1) = 7.39$, $p = .007$, were both associated with higher **perceived role enhancement**. Conversely, negative attitudes toward robots strongly reduced perceived role enhancement, $\chi^2(1) = 19.17$, $p < .001$ (marginal $R^2 = .74$, conditional $R^2 = .75$).

Figure 2a visualizes fixed-effect estimates, showing direction and magnitude of predictors' influence. Figure 2b displays marginal R^2 for each predictor, highlighting relative contributions to explained variance.

5 Discussion

Our exploratory study reveals three preliminary patterns that highlight open questions and methodological gaps in how HRI research approaches team dynamics. Rather than treating these as conclusive findings, we leverage them to articulate a research agenda addressing when, how, and for whom psychosocial dynamics become barriers or facilitators to cobot integration.

Pattern 1: The Collaborative Climate Paradox. Participants reporting stronger collaborative climate during teamwork anticipated greater discomfort and role threat when imagining a cobot joining. This contrasts with Fraune et al.'s [7] findings that cohesive groups in leisure contexts welcomed robot approach—though as those authors noted, such patterns may not generalize to workplace settings. Our pattern instead aligns with human team research showing cooperative dynamics often operate parochially— directed inward, resistant to outsiders [2, 5]. One plausible mechanism is that teams who perceive great cooperation may become more protective of what makes their coordination work. In this sense, a cobot does not enter as a neutral tool, but as a structural change: a new teammate that may reshape routines, roles, and informal norms. Anticipatory resistance may therefore reflect less generalized fear of robotics and more concern about preserving a valued team balance-the better the collaboration, the more there is to lose.

This pattern generates a critical question: does collaborative climate cause resistance, or does it merely correlate with unmeasured variables (e.g., stronger role identification, higher performance standards)? Future research should test whether the association holds when controlling for team identification and performance expectations, and whether resistance persists after actual cobot interaction or reflects anticipatory bias that dissolves through experience.

Pattern 2: Social Activation Over Directionality. Both cooperative and competitive dispositions associated with higher perceived role enhancement. What matters may be less the direction of social orientation than its intensity: socially activated individuals—whether inclined to collaborate or compete—may possess stronger frameworks for construing role value under structural change. This finding exposes a methodological gap: our individual-level analysis cannot determine whether the effect reflects personal dispositions or emergent team-level composition. Do teams with mixed cooperative-competitive profiles show different dynamics than homogeneous teams? Answering this requires designs with sufficient team-level sample sizes to model cross-level interactions—a methodological priority our initial study was not powered to address.

Pattern 3: The Negativity Asymmetry. Negative robot attitudes showed stronger and more consistent associations across all outcomes than positive attitudes. This asymmetry emerged even

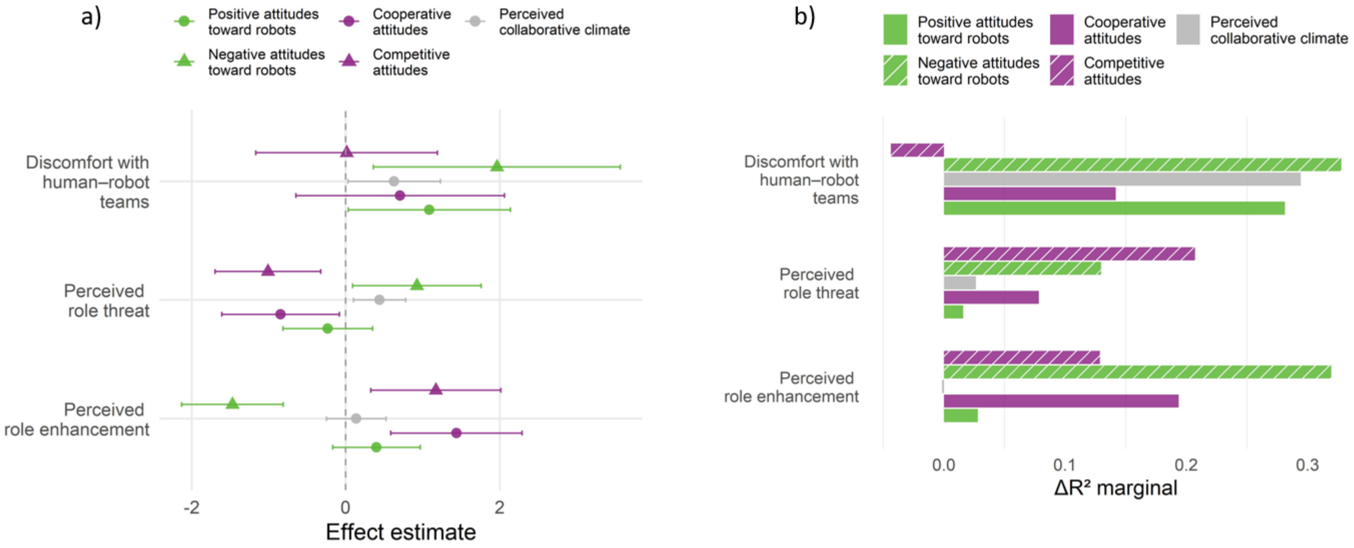

Figure 2: a) Fixed-effect estimates with 95% confidence intervals for the three outcome variables (discomfort with human–robot teams, perceived role threat, and perceived role enhancement). Shapes and colors distinguish between predictors; b) Change in marginal R^2 associated with each predictor, indicating its relative contribution to variance explained in the models of discomfort with human–robot teams, perceived role threat, and perceived role enhancement.

in young digital natives—a population expected to show high acceptance. If negativity bias persists in this favorable demographic, barriers may be substantially more pronounced in the broader workforce. For practitioners, this asymmetry suggests a strategic reframe: rather than "selling" cobot capabilities, integration efforts may benefit from prioritizing anxiety reduction—emphasizing transparency, predictability, and preserved human control. This implication, while requiring experimental validation, offers actionable guidance grounded in the observed pattern.

Limitations and Conclusions. This study has clear constraints: small sample (N=18), young robot-naive participants, and scenario-based robot introduction limit generalizability. All effects are indeed exploratory associations requiring replication with diverse populations and physical robots. Additionally, our scenario presented robot introduction as non-negotiable; anticipatory resistance may differ when teams perceive agency over whether and how a robot joins.

Within these constraints, we contribute a focused psychosocial exploratory study revealing preliminary associations between team dynamics and anticipatory perceptions of cobot integration. Within these constraints, we contribute a focused psychosocial exploratory study that surfaces preliminary links between team dynamics and anticipatory perceptions of cobot integration. Our key takeaway is a potentially consequential tension: teams that experience highly collaborative coordination may also anticipate greater disruption when imagining a robotic teammate. If replicated, this pattern suggests that readiness for hybrid teamwork cannot be inferred from individual attitudes alone, and motivates HRI research and design approaches that explicitly account for the stability and value of existing human team practices. Ultimately, advancing cobot integration in the workplace requires treating robot introduction as a socio-technical change, and understanding not only how humans interact with robots, but how teams adapt, negotiate, and preserve meaning when collaboration becomes hybrid.

Acknowledgments

This study was carried out within the PNRR research activities of the consortium iNEST (Interconnected North-Est Innovation Ecosystem) funded by the European Union Next-GenerationEU (Piano Nazionale di Ripresa e Resilienza (PNRR) – Missione 4 Componente 2, Investimento 1.5 – D.D. 1058 23/06/2022, ECS_00000043). This manuscript reflects only the authors' views and opinions; neither the European Union nor the European Commission can be considered responsible for them. We thank Maria Filippi and Giovanni Monteleone for their support in the data collection.

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A Task Experience Ratings

Participants rated their experience with each task on 7-point semantic differential scales assessing demand and engagement (Figure 3). *Screw tightening* was consistently rated as more banal, boring, easy, flat, and monotonous, whereas *Spiral* and *Sudoku assemblies* were evaluated as more engaging, stimulating, and dynamic, with Sudoku standing out as most difficult yet challenging.

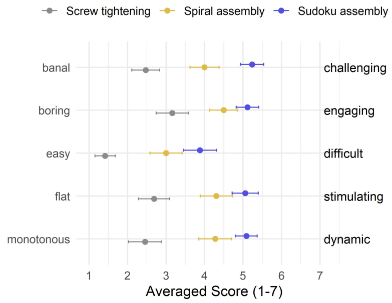

Figure 3: Task experience ratings. Points show mean scores; error bars indicate SE.

B Task Delegation Patterns

Table 1 reports means and standard deviations of individual attitudes and perceived team climate across delegation groups.

Table 1: Psychological profiles by task delegation preference (M, SD); att. = attitudes; Perc = Perceived; collab. = collaborative

	No pref. (13.4%)	Screws (52.1%)	Spiral (13.4%)	Sudoku (21.0%)
Positive att. (robots)	5.16 (0.51)	5.06 (0.84)	4.72 (0.75)	4.30 (0.68)
Negative att. (robots)	2.08 (0.49)	2.67 (0.87)	3.10 (0.76)	2.57 (0.72)
Cooperative att.	5.57 (0.45)	5.55 (0.50)	5.80 (0.71)	5.84 (0.58)
Competitive att.	3.31 (0.67)	4.11 (0.48)	4.15 (0.43)	3.56 (0.71)
Perc. collab. climate	4.25 (1.53)	4.92 (1.15)	5.14 (0.96)	5.24 (0.85)