

Synthetic Authority: Speculating the Future of Leadership in the Age of Human-Autonomy Teams

Subhasree Sengupta, Nathan J. McNeese

School of Computing, Clemson University, 100 McAdams Hall, Clemson, S.C. 29634

Abstract

The dawn of automation, often termed the fourth industrial revolution, is ushering several new waves of societal change. As existing scholarship demonstrates, considerations of human-autonomy teams across varied contexts are becoming crucial and vital. A critical arena of investigation that is currently understudied is the development of leadership in human-autonomy teams and the associated factors that impact emergent leadership patterns. While existing scholarship points to key leadership traits on the human side that will be needed to manage human-autonomy teams, further research is needed to fully visualize the effect of different leadership paradigms on the collaborative spirit of human-autonomy teams. Motivated by conceptual precursors, this position paper proposes a speculative design-based investigation aimed at understanding the expectations and perceptions around leadership in the context of human-autonomy teams. The goal of this investigation is to gain insights into the adaptations in workflows, enhancements needed in competencies for both human and non-human actors, novel task management and delegation routines, and contextual considerations that characterize the way in which leadership patterns can be conceptualized for human-autonomy teams. Further, through a critical turn, investigating the ethical and larger societal ramifications of such models is also another essential goal this proposed work aims to achieve. The ultimate aim of this work is to pave the way toward design recommendations and policy considerations associated with envisioning the construct of leadership in the human-autonomy assemblage.

Keywords

Leadership, Human-Autonomy Teams, Workflows, Speculative Design

1. Introduction

The rising ubiquity of Artificial Intelligence (AI) is causing widespread change and reorganization of existing social practices and norms [1]. Such changes are implicitly and explicitly reshaping day-to-day social functions and lived experiences of people across many different contexts [2]. Autonomy can be found in varied scales and scopes, ranging from being a mere tool that in the form of chatbots can aid information and knowledge discovery on websites, to being a more sentient teammate that can act, reason, and collaborate nearly at par with humans [3, 4]. Particularly, by envisioning AI as a teammate, it becomes important to understand the impact of such collaborative endeavors on the level of cohesion, coordination, and overall effectiveness of such teams [5]. Several studies have indicated different antecedents of trust and reliance on autonomous entities that can play a pivotal role in sustaining human-autonomy teams [6]. Thus, leadership and management of such teams have thus become vital considerations [7].

The question of leadership is particularly essential in order to understand the manifestation and concentration

of power and authority in human-autonomy teams [8]. Further, it can impact the practices and management of such teams, delineate the norms of exchange and reciprocity crafted, and shape the type of roles and responsibilities established and maintained [9]. The concept of leadership is not just about *who the leader is or should be*, but also calls for a deeper understanding of the structure and group processes that are the key markers of how leadership is enacted and embraced [10]. Thus, the style of leadership can impact the nature of workflows, coordination, and cooperative outcomes human-autonomy teams scaffold. With the growing impetus of the need to understand ethical visions associated with human-autonomy teams, the question of leadership and its impact on the collaborative dynamics established accrues further significance. In addition, as existing literature surmises, with the growing influx of autonomous agents, it becomes critical to investigate the nature of agency and autonomy humans retain and delegate to their autonomous counterparts [11, 12]. Yet, as leadership in the human-human context has posited, the nature and style of leadership may be contingent upon contextual parameters, thus the way in which context shapes leadership attributes is also an arena that warrants further investigation. It is essential to also unpack all these motivating factors that call for a more nuanced investigation into various facets associated with leadership and the impact that leadership has on team outcomes.

While leadership in the human-human context has seen widespread exploration [13], it remains to be under-

AutomationXP23: Intervening, Teaming, Delegating - Creating Engaging Automation Experiences, April 23rd, Hamburg, Germany

✉ subhass@clemson.edu (S. Sengupta); mcneese@clemson.edu (N. J. McNeese)

🆔 0000-0001-5055-3859 (S. Sengupta); 0000-0002-9143-2460 (N. J. McNeese)

© 2023 Copyright for this paper by its authors. Use permitted under Creative Commons Attribution 4.0 International (CC BY 4.0)



CEUR Workshop Proceedings (CEUR-WS.org)

stood how concepts from human-human teaming evolve with the infusion of autonomous agents in the teaming dynamic [14]. While some conceptual and empirical investigations have been proposed and conducted, these remain limited in their conceptual and contextual scope and relevance [15, 16]. The key gaps that exist revolve around the following. (1) A deeper understanding of how the notion of leadership (particularly from a structural perspective) may evolve to encompass the impact and influence of autonomous entities on teaming dynamics (2) perceptions and expectations around autonomous leaders (3) the impact of emergent leadership models on teaming outcomes, particularly trust. To address some of these crucial gaps, a speculative design initiative is proposed to explore thoughts and rationales to capture critical nuances associated with the construct of leadership. The motive of using a speculative design approach is driven by prior research that highlights the power of this methodological paradigm to capture desires, beliefs, and values in a futuristic context, thereby inspiring perspectives and guidelines that can impact the conceptualization of future technical artifacts [17]. The contextual stage for this study shall encompass several domains, as the goal will be to understand the phenomenon of leadership and its impact on Human-autonomy teams, instead of binding it to a specific contextual premise. The aim of conducting this exploration is to provide insights into the way in which leadership models particularly in the human-autonomy teaming frontier can be more rigorously conceptualized and the inferences, associations unpacked can further inform the way in which autonomous agents factor into the teaming dynamic. The expected outcomes include a deeper understanding of how the inclusion of autonomy in the teaming dynamic calls for the need to adapt leadership and management routines and the way in which such adaptations are perceived to impact the competencies needed to sustain such teams.

2. Related Work

2.1. Leadership in Organizational Studies

Leadership is an essential facet of any group-linked endeavor [10]. Leadership is critical for the success, survival, and sustenance of any team-driven activity [18]. Leadership is primarily crucial from the point of view of establishing structure with entails creating routines and processes needed to manage and maintain order in a group. From the point of organizational studies, leadership has been investigated through various theoretical perspectives to better situate the demands and needs associated with the leadership function [19]. Especially in this regard, different models of leadership (transactional, transformational, autocratic, democratic, charismatic)

are named as the most widely studied and employed models [20]. Leadership as these models theorize, has been investigated in terms of behavioral attributes that can be critical in encouraging growth and enrichment of the overall organizational climate [21]. Empirical investigations that build upon the findings of these models have indicated how leadership attributes can impact leader-follower relations, collective and individual morals, team and individual performance and essentially demonstrate the essence of leadership as the binding thread that defines and holds a team together [22, 23].

2.2. Leadership and Technology

Leadership is a highly fluid and dynamic notion, with a variety of factors impacting such fluctuations [7]. Further, in this regard, with the advent and prolific adoption of Information and communication technology (ICTs), the notion of leadership needs to change to accommodate the presence and influence of non-human actors. A seminal synthesis of scholarly visions in this regard was provided by Larson and DeChurch (2020) [14]. This endeavor posited four key models highlighting various ways in which technology can mediate and impact leadership. The key takeaway from this exploration is that the dynamic between technology and leadership entails where and how the technology is positioned, and how it mediates and impacts the team dynamic through various affective and cognitive states (such as trust, cohesion, and shared mental models) which ultimately impact the way in which leadership is practiced. Building on adaptive structuration theory, a novel theoretical proposition postulated the interplay between leadership and ICTs, mutually shaping one another, that states while technical mediums impact the way in which leadership is structured, the style of leadership also, in turn, impacts the nature of appropriation of such channels that mediate and impact group processes [24].

In this regard, a major line of inquiry has primarily focused on the way in which the emergence of virtual communication formats (such as email and groupware systems) impacts leadership processes and the adaptations that are needed to acclimatize with the change in modality [25, 26]. Competencies in the form of motivational traits, behavioral characteristics, and empathetic stances that are needed to succeed in such leadership roles have also been explored [27]. Contextual mediation and the impact of factors such as the effect of the COVID-19 pandemic on workplace regimes and the influence of situational needs on leadership styles are also critical lines of scholarship that have been investigated in this context [28, 29]. While this line of scholarship continues to grow in momentum, another key arena wherein leadership and technology intertwine is the frontier of human-autonomy teams.

2.3. The Rise of Human-Autonomy Teaming

Before detailing the emergent stream of work associated with leadership in human-autonomy teams, a brief overview of the scholarship in the human-autonomy teaming arena is warranted to set the stage for this proposed study. Expanding the notion of human-human teams, human-autonomy teams are defined as interdependent entities, collectively engaged in a shared vision, purpose, and goal [5]. Pertinent in such discussions is the consideration of expectations and characteristics that would be desired in autonomous teammates [30]. Essential in such cases are the considerations of shared mental models that develop and are critical for such teams to operate and thrive [31]. Agent characteristics and role in the team dynamic can be crucial factors mediating the way in which such teaming endeavors are sustained [32]. Studies have shown how perceptions of AI teammates can impact the overall task effectiveness and interdependence between teammates [33]. In aggregate, all these investigations highlight key strands of scholarship that demonstrate the growing need to further develop this domain of investigation. Adding to this eclectic collage of ideas and concepts, considerations around leadership can be essential to gain a deeper sense of the way in which team management, orchestration, and distribution of tasks across human and non-human actors can add another layer of conceptual nuance that presently is under-explored.

3. Research Framing: Leadership and Human-Autonomy Teams

Leadership in the context of human-autonomy settings involves several conceptual considerations. Several questions surrounding the impact and intertwining effect of autonomy also become critical [34]. A key line of inquiry in this regard has explored how extant literature in human-robot collaboration, positions robots with respect to human actors when elaborating on collaboration, taking a more network view on leadership to understand the embeddedness of autonomous agents [35]. Further, [15] posited how leadership can be envisioned in relation to resource sharing and management, drawing on literature from leadership investigations under the umbrella of organizational studies. This article while visionary does not capture the relational dynamics between human and non-human actors, as it takes an information exchange perspective to leadership. This paper calls for a deeper need for empirical investigations, which motivates the research plan proposed in this narrative.

Related explorations have considered human-autonomy teaming in contextual settings, investigating

the impact and needed skill adaptation at the human level in order to incorporate, manage and negotiate the effects, and implications of artificial intelligence usage while also balancing team effectiveness and performance [16]. In this study, which is most closely linked with this proposed endeavor, the goal has been to highlight the skills and required characteristics needed by human leaders within the military context to lead human-autonomy teams. While the insights are critical, it does not fully capture the way in which leadership models impact team dynamics. It does not elucidate on structural perceptions of leadership, capturing the way in which workflows, roles, and task management will undergo potential changes. It does not factor in the perceptions of the impact of leadership on team dynamics and it does not capture nuances about perceptions around the viability of envisioning autonomous leaders. Further, it is limited in context since it only focuses on the case of military leadership. All these aforementioned limitations are the gaps the proposed investigation envisions to fulfill. Below, we present a set of wide-ranging research questions that are meant to provide the foundations for future research and also aim to elicit further conversations around leadership and human-autonomy teams.

3.1. Research Questions

1. How will different leadership styles impact team dynamics in human-autonomy teams?
 - a) How might they impact workflows?
 - b) How might they impact human autonomy and agency?
 - c) How might they be characterized by contextual attributes?
2. What autonomous agent characteristics might impact and be needed to sustain leadership in human-autonomy teams?
 - a) What characteristics may be expected and desired for an autonomous leader?
3. What critical considerations and concerns may arise when construing leadership for human-agent teams?
 - a) How might it influence ethical visions?

4. Proposed Methodological Approach – Speculative Design

Although human-autonomy teams are likely going to find widespread use in the future [16], it is still a nascent field today, thus the goal of the motivating research questions stated above is to tap into the way people envision future use cases around leadership in human-autonomy

teams. This is similar in motive to speculative design-based approaches, which have found frequent use to conceptualize everyday use and appropriation of automated artifacts such as robots [17]. However, such approaches are yet to be applied in the context of human-autonomy teams. Given that such techniques provide an effective approach to elicit considerations to ideate and deliberate regarding a futuristic context, it serves as an efficient methodological tool to be employed for achieving the goals associated with this investigation.

Design fiction-based approaches serve as one of the key methodological paradigms for materializing speculative design [36]. Design fiction revolves around generating insights and spaces for discussion about technology rather than focusing on finished products [37]. The central definition of design fiction stands at – “*the deliberate use of diegetic prototypes to suspend disbelief about change*”. In essence design fiction involves marrying perspectives about the product and the context envisioned through the story world. Particularly, the aim will be to use the method of futuristic autobiographies (FAB) that provides a method of implementing the diegesis stated by design fiction [38].

4.1. Futuristic Autobiographies

This method allows for embedding the user or study participant as a central character in the story world presented. Materialized in the form of fictional autobiographic experiences that also help to elicit values, positions, and expectations of the stakeholders involved. The key features of this method include: (1) Expeditionary – sessions are usually 30 to 60 minutes in total and typically involve discussion on 2-3 themes; (2) Open-ended – scenarios are developed with some scope of discussion, yet given the endpoint is carved out, there is a guiding trajectory for participants to follow as they engage as central characters (3) Captivating content – the content or themes explored are developed with diverse context and experiences in mind (4) Values and ethics – centering themes such that they trigger discussions around values and ethics. Further, this method can be seen as an extension of qualitative interviewing and thus can be analyzed through constructivist grounded theory [39].

4.2. Plan for Data Collection and Analysis

The goal of this exploratory study is to lay the foundations and to build a more robust understanding of the issues as outlined in the research motivation. The population pool will engage those with some familiarity with technology and AI. Participants will be recruited by word of the mouth approach, through personal contacts of researchers, and through social media groups [40]. Presently, we plan on conducting two workshop sessions,

each for 1 hour. Each workshop will have approximately five to six participants. The workshops are envisioned to be conducted as semi-structured interviews with the participants and will also involve some co-design activities. At this time, we expect to conduct these workshops remotely (to afford geographical flexibility in terms of workshop attendance). Additional details such as compensation will be finalized based on recruitment status and as the plan of the design activities (e.g., the time needed and type of activities) develops throughout the course of this exploration.

5. Expected Contributions and Future Extensions

The expected contributions are to provide more insights into the way in which leadership considerations will impact the structure and workflows of human-autonomy teams. Secondly, the goal will be to elicit considerations and apprehensions around the use of automated leadership [41]. Further, from a methodological standpoint, the use of speculative design serves as a novel exploratory framework to investigate leadership in human-autonomy teams. Finally, the goal will be to elucidate how existing models that have been stated in the context of leadership (without the inclusion of autonomous teammates) will need to be adapted to suit the change in the relational fabric induced by the involvement of autonomous agents. Based on the insights collected, future explorations will embark on conducting experimental design studies to understand perceptions of leadership models and how these are impacted by agent features and roles in the teaming dynamic. Subsequently, survey analysis shall be conducted to better understand expectations and idealized perspectives around autonomous leaders, akin to the synergistic visions that have explored attributes of ideal artificial teammates [30]. The long-term contributory goal is to provide design recommendations for constructing and conceptualizing autonomous systems and to also robustly outline policy considerations to enhance the experience of humans operating with autonomous agents in teaming contexts [42].

References

- [1] E. A. Nabila, S. Santoso, Y. Muhtadi, B. Tjahjono, Artificial intelligence robots and revolutionizing society in terms of technology, innovation, work and power, IAIC Transactions on Sustainable Digital Innovation (ITSDI) 3 (2021) 46–52.
- [2] S. Pink, M. Ruckenstein, M. Berg, D. Lupton, Everyday automation: Setting a research agenda (2022).
- [3] J. Rix, From tools to teammates: Conceptualizing

- humans' perception of machines as teammates with a systematic literature review (2022).
- [4] N. J. McNeese, M. Demir, N. J. Cooke, C. Myers, Teaming with a synthetic teammate: Insights into human-autonomy teaming, *Human factors* 60 (2018) 262–273.
- [5] T. O'Neill, N. McNeese, A. Barron, B. Schelble, Human-autonomy teaming: A review and analysis of the empirical literature, *Human factors* 64 (2022) 904–938.
- [6] N. Ezer, S. Bruni, Y. Cai, S. J. Hepenstal, C. A. Miller, D. D. Schmorrow, Trust engineering for human-ai teams, in: *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, volume 63, SAGE Publications Sage CA: Los Angeles, CA, 2019, pp. 322–326.
- [7] D. Greenfield, The enactment of dynamic leadership, *Leadership in Health services* (2007).
- [8] J.-W. Hong, With great power comes great responsibility: inquiry into the social roles and the power dynamics in human-ai interactions, *Journal of Control and Decision* 9 (2022) 347–354.
- [9] S. D. Ramchurn, S. Stein, N. R. Jennings, Trustworthy human-ai partnerships, *Iscience* 24 (2021) 102891.
- [10] J. M. Burns, *Leadership*, Open Road Media, 2012.
- [11] C. Flathmann, B. G. Schelble, R. Zhang, N. J. McNeese, Modeling and guiding the creation of ethical human-ai teams, in: *Proceedings of the 2021 AAAI/ACM Conference on AI, Ethics, and Society*, 2021, pp. 469–479.
- [12] S. Sankaran, C. Zhang, M. Gutierrez Lopez, K. Väänänen, Respecting human autonomy through human-centered ai, in: *Proceedings of the 11th Nordic Conference on Human-Computer Interaction: Shaping Experiences, Shaping Society*, 2020, pp. 1–3.
- [13] R. J. Vender, Leadership: an overview, *Official journal of the American College of Gastroenterology* | *ACG* 110 (2015) 362–367.
- [14] L. Larson, L. A. DeChurch, Leading teams in the digital age: Four perspectives on technology and what they mean for leading teams, *The leadership quarterly* 31 (2020) 101377.
- [15] C. Flathmann, B. G. Schelble, N. J. McNeese, Fostering human-agent team leadership by leveraging human teaming principles, in: *2021 IEEE 2nd International Conference on Human-Machine Systems (ICHMS)*, IEEE, 2021, pp. 1–6.
- [16] A. Pierre, *Leadership of Human-Machine Teams in Military Environments: An Exploratory Framework*, Ph.D. thesis, Regent University, 2022.
- [17] J. Auger, Speculative design: crafting the speculation, *Digital Creativity* 24 (2013) 11–35.
- [18] J. Gardner, *On leadership*, Simon and Schuster, 1993.
- [19] R. Hogan, R. B. Kaiser, What we know about leadership, *Review of general psychology* 9 (2005) 169–180.
- [20] T. S. Nanjundeswaraswamy, D. R. Swamy, Leadership styles, *Advances in management* 7 (2014) 57.
- [21] H. Tohidi, M. M. Jabbari, Organizational culture and leadership, *Procedia-Social and Behavioral Sciences* 31 (2012) 856–860.
- [22] B. Omolayo, Effect of leadership style on job-related tension and psychological sense of community in work organizations: A case study of four organizations in lagos state, nigeria, *Bangladesh e-Journal of Sociology* 4 (2007) 30–37.
- [23] Z. R. Mulla, V. R. Krishnan, Transformational leadership: Do the leader's morals matter and do the follower's morals change?, *Journal of Human Values* 17 (2011) 129–143.
- [24] B. J. Avolio, S. Kahai, G. E. Dodge, E-leadership: Implications for theory, research, and practice, *The leadership quarterly* 11 (2000) 615–668.
- [25] J. E. Hoch, S. W. Kozlowski, Leading virtual teams: Hierarchical leadership, structural supports, and shared team leadership., *Journal of applied psychology* 99 (2014) 390.
- [26] K. Mehtab, A. ur Rehman, S. Ishfaq, R. A. Jamil, Virtual leadership: A review paper, *Social Sciences* 8 (2017) S1.
- [27] C. Wiradendi Wolor, S. Solikhah, N. F. Fidhyallah, D. P. Lestari, Effectiveness of e-training, e-leadership, and work life balance on employee performance during covid-19, *Journal of Asian Finance, Economics and Business* 7 (2020).
- [28] A. V. Roman, M. Van Wart, X. Wang, C. Liu, S. Kim, A. McCarthy, Defining e-leadership as competence in ict-mediated communications: an exploratory assessment, *Public Administration Review* 79 (2019) 853–866.
- [29] F. Contreras, E. Baykal, G. Abid, E-leadership and teleworking in times of covid-19 and beyond: What we know and where do we go, *Frontiers in psychology* 11 (2020) 590271.
- [30] R. Zhang, N. J. McNeese, G. Freeman, G. Musick, "an ideal human" expectations of ai teammates in human-ai teaming, *Proceedings of the ACM on Human-Computer Interaction* 4 (2021) 1–25.
- [31] R. W. Andrews, J. M. Lilly, D. Srivastava, K. M. Feigh, The role of shared mental models in human-ai teams: a theoretical review, *Theoretical Issues in Ergonomics Science* (2022) 1–47.
- [32] D. Siemon, Elaborating team roles for artificial intelligence-based teammates in human-ai collaboration, *Group Decision and Negotiation* 31 (2022) 871–912.
- [33] B. G. Schelble, C. Flathmann, N. J. McNeese,

- T. O'Neill, R. Pak, M. Namara, Investigating the effects of perceived teammate artificiality on human performance and cognition, *International Journal of Human-Computer Interaction* (2022) 1–16.
- [34] A. M. Smith, M. Green, Artificial intelligence and the role of leadership, *Journal of Leadership Studies* 12 (2018) 85–87.
- [35] C.-Y. Tsai, J. D. Marshall, A. Choudhury, A. Serban, Y. T.-Y. Hou, M. F. Jung, S. D. Dionne, F. J. Yammarino, Human-robot collaboration: A multilevel and integrated leadership framework, *The Leadership Quarterly* 33 (2022) 101594.
- [36] T. J. Tanenbaum, K. Tanenbaum, R. Wakkary, Design fictions, in: *Proceedings of the Sixth International Conference on Tangible, Embedded and Embodied Interaction*, 2012, pp. 347–350.
- [37] J. Lindley, P. Coulton, Back to the future: 10 years of design fiction, in: *Proceedings of the 2015 British HCI conference*, 2015, pp. 210–211.
- [38] E. Cheon, N. M. Su, Futuristic autobiographies: Weaving participant narratives to elicit values around robots, in: *Proceedings of the 2018 ACM/IEEE International Conference on Human-Robot Interaction*, 2018, pp. 388–397.
- [39] K. Charmaz, L. Belgrave, et al., Qualitative interviewing and grounded theory analysis, *The SAGE handbook of interview research: The complexity of the craft* 2 (2012) 347–365.
- [40] O. C. Robinson, Sampling in interview-based qualitative research: A theoretical and practical guide, *Qualitative research in psychology* 11 (2014) 25–41.
- [41] P. Feshchenko, Algorithmic leadership and algorithmic management: a systematic literature review (2021).
- [42] J. Qadir, M. Q. Islam, A. Al-Fuqaha, Toward accountable human-centered ai: rationale and promising directions, *Journal of Information, Communication and Ethics in Society* (2022).