Robots in Power

Extended Abstract†

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ABSTRACT

While power affects interactions in every work group, we know little about its role in human-robot teams. In this paper, we propose a framework to address power in Human-Robot Interaction (HRI). We discuss why power has been neglected by the research community and why in certain situations robots in high power roles might be preferred. We also discuss the source of their power, how it functions in groups, and questions regarding designing robots for these roles. We also investigate possible power structures and their consequences. We suggest that understanding power is crucial to understanding group dynamics in mixed human-robot teams, and why this is a topic worthy of the community's attention.

CCS CONCEPTS

• Human-centered computing → Human computer interaction (HCI) → HCI theory, concepts and models

KEYWORDS

Human-robot collaboration; power; management; groups and teams; group dynamics

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1 INTRODUCTION

The role of robots in teamwork has gained much attention in recent years [4, 11, 15]. However, most of these studies focus on robots as a human's subordinate or their equal. Few have investigated the opportunities of robots in higher power positions, or more generally, how power functions in HRI.

Power is, according to Foucault, omnipresent. It is "in every relation, from one point to another…power is everywhere" [7]. He believes that any relation has some form of inequality, and this power imbalance is one of the main forces which drive social dynamics. In psychological and managerial studies, power can be defined as "the ability to get things done the way one wants them to be done" [22], or more specifically in interpersonal relationships, "the capacity of one party (the agent) to influence another party (the "target")" [28]. It is arguably what affects in-group interactions the most. For example, when asking another person to do a task, group leaders can legitimately order their subordinates to perform an action. Colleagues, or those with equal power may have to involve strategies such as bargaining to achieve the same goal. Finally, someone with lower power may be hesitant express the thought of wanting something done for them. If the idea that "power is everywhere" seems too assertive, "power is in every teamwork" is almost certainly true, and human-robot teamwork is no exception.

It is without surprise that when people first hear about robots in power, their first action is doubt or even fear. Prevalent in popular culture is the fear that humans will be replaced or ruled by these intelligent agents. However, we argue that there are certain situations where human leaders do not do well and robots in higher power roles may be preferred. If in those cases the robots in higher power can contribute to better group performance, we suggest not broadly excluding them of fear. Another reason that "robots in power" may make people worry is not only from the word "robots", but more so from the concept of "power". Many managerial studies on power have to elaborate and justify why they must do so [20, 22]. Some even state that "power has such a bad name that many good people persuade themselves they want nothing to do with it." [9], and "Power is America's last dirty word…… People who have it deny it; people who want it do not want to appear to hunger for it" [16]. But when current technologies are gradually taking over the work once belonging exclusively to people in power, we argue it is better to study and understand the phenomenon.

As of today, algorithm-based management is already widely used in industry. It is especially prevalent in the handling of large amounts of data, assigning tasks and evaluating employee's performance [17]. For example, many companies are using algorithms to screen applicants' resumes before being viewed by human recruiters, and share-economy firms like Ubers often utilize algorithms to automatically parse massive amounts of data.

With algorithm-based management on the rise, automated technologies have already been given positions of power. It is therefore not too farfetched to consider robots in these power positions. Actually, some news media has been aware of this possibility [2, 12, 27]. In a broader sense, it could also be said that power has been in HRI studies for years—for example, building robots that influence people through facial expression [3], or collaborations in which some subtasks must be done by robots [13] —but we have not viewed them systemically from the perspective of power. As people interact and collaborate increasingly with robots, it is important to understand the power dynamics in HRI. However, it is not yet clear how power functions in a mixed human-robot team. What is the human-robot interaction when robots have more power? And what implications does this have for designing a robot? We believe that these questions might lead to insights for creating an optimal human-robot teaming.

In the following sections of this paper, we propose a framework for discussing power in HRI. We highlight previous research on power in organizational psychology and discuss how robots can come into a position of power, how power functions to influence behavior, and the possible configurations of power hierarchy. We also suggest possible topics for future research.

2 WHY WE NEED ROBOTS IN POWER?

Despite many intelligent systems aiming at helping administrative work, most leaders are still humans. However, in some situations, they are vulnerable to leadership failures due to the limitation of human nature and cognitive ability. We argue that these are situations in which it might be advantageous to have a robot in control of the team.

One such example is emergency responsiveness. People's cognitive system are not able to process huge amounts of data in cases of emergency. Fear and time pressures have been shown to hamper decision making [24]. In Karl E. Weick's analysis of the Mann Gulch disaster where 13 firefighters died [26], he stated that "Mann Gulch disaster can be understood as a dramatic failure of leadership" which in turn resulted in the collapse of the team structures. We would like to suggest that in this case, it is possible that a robot leader may be more resilient and thus can better maintain the team structures. Further studies are needed to understand how people will react to an authoritative robot, and what kind of team building will be needed beforehand.

Another scenario where human leaders often fall short is dealing with interpersonal conflict in teams, especially when leaders themselves are involved. Robots, on the other hand, are further away from team members' interpersonal tension thus in a better position to resolve these conflicts. Studies have shown the potential of robots aiding conflict regulation in teams [18]. It is known that people will adopt different strategies to cope with conflicts when in different positions: obliging with superiors, integrating with subordinates, and compromising with peers [21]. It is very possible that this regulation effect will be different, most likely better, when robots are in a powerful position.

3 HOW POWER FUNCTIONS IN A MIXED HUMAN-ROBOT TEAM?

3.1 Source of Power

Be it a human or robot leader, power is not created out of vacuum. In French and Raven's classical analysis on the source of power in an organization [8], they proposed five possible origins: legitimate power, reward power, referent power, coercive power, and expert power. Most of the other frameworks can be mapped onto these five sources, and therefore, we will adopt this model in this paper to discuss how a robot comes into a power position.

Legitimate power is the power derived from the hierarchical position in an organization. Anyone who is appointed by the organization, suitable or not, gains power in this sense. For example; if a robot is assigned a supervisor position it has power over its subordinates. However, it is not clear if this still holds true when positions are taken by robots. Does a hierarchy still operate as we understand it if managers are all robots? What if the highest position in an organization is also occupied by a robot? Can a robot boss be equally legitimate as a human boss?

Reward power, on the other hand, is the power to distribute incentives among other members. If a robot has influence on employees' salary or a promotion, or whether a member gets better scores or more praise, this robot has reward power. This source of power, like legitimate power, is organizational. If a person or a robot was appointed as the leader, they gain these types of power. In another word, these two are both from the parental organization and are thus considered exogenous. Some algorithms have already got this exogenous power. For example, system which screens resumes decides who gets interview and who doesn't, and this decision is endorsed by the company. For incoming new employees, this system certainly owns power over them.

But why do algorithms seldom make us feel that they have power? It may be because they lack the other three kinds of power. Referent power, coercive power and expert power are from inner characteristics. Their focus is on "what kinds of people are more likely to be in a powerful position" rather than the position itself. In the context of HRI, they hint the answer to the question "what design makes this robot, but not that robot, more likely to be in power?"

Referent power comes from personal charisma, which is highly related to personal traits, such as gender, height, physique, facial appearance, personality, and interpersonal skills. It is the ability to perceive self and other's feelings, attitudes, beliefs and adjust one's own behavior accordingly. It has also been shown that nonverbal cues, such as voice tone, facial expression and gestures, are also related to power [10]. It would be an interesting or future research to see how these factors function in robots. For example, is a male robot perceived as more powerful than a female robot? Or a neutral-gendered, machine-like robot actually has more authority than gendered human-like robots?

Coercive power depends on the ability to convince others, either by persuasion or by force. There have been much research in persuasive robots, showing that gender and non-verbal cues are crucial factors [5, 23]. It might be worth investigating whether there is an interaction between these factors and power. Also, people can be suspicious about persuasion when power disparity is involved. We hypothesize that robots are in a better position to persuade because their behavior may be perceived as less motivated by self-interest.

The last source of power, expert power, is probably the most interesting one in the context of HRI. It suggests that whoever is most competent is prone to be in a position of power. Unlike previous sources that originate from organization or social interaction, expert power is about understanding concrete domain knowledge. Therefore, a robot good at completing a high skill task is in a good position to grab power, as it will be perceived as more capable to supervise and give advice. The expert power also affects whether power has an incremental or detrimental effect on group performance. Tarakci and Greer [25] have shown that power disparity (or power hierarchy) in a group is beneficial only when power holder's task competence is high. If this finding is applicable to human-robot interaction, the fact that robots are getting better and better as employees in some fields probably hints that there is a growing potential for robots to be team leaders in these fields.

3.2 Competition for Power

Besides gaining power from different sources, some power studies focus on the maintenance and the loss of power [1]. The conflict theory suggests that in a group of higher power hierarchical difference, members will have more behaviors competing against each other. It is also known that in a group, members of numerical majorities are more influential than numerical minorities [14], and thus more likely to be in power after competition. Will this imply possible conflicts in human-robot teaming when a robot is in a position of power over multiple human members? Given the dissimilarity between humans and robots, it would be interesting to see whether these human members will be reluctant to cooperate and obey the order from a superior who is a non-human.

3.3 Using Power to Influence Behavior

The core of power is influence [19], that a leader will try to influence the behavior and mindset of other people. For our research question, it is essential to know how robots wield their power to influence the behavior of other team members.

In organizational psychology, there have been extensive studies on tactics to exert influence. For example, Yukl have suggested nine ways that a leader can use to influence others: Rational Persuasion, Apprising, Inspirational Appeals, Consultation, Exchange, Collaboration, Personal Appeals, Ingratiation, Legitimating Tactics, Pressure, and Coalition Tactics [28]. We do not yet know, however, whether these tactics can be applied to a robot in power. For example, the tactic Personal Appeals is the ability to ask for help out of friendship. Does this apply to a robot leader? If yes, how? Ingratiation is about complimenting and praising. But will people react well to all kinds of robot's compliment? We might accept if robots compliment us on a proofreading task which can be objectively evaluated, but what about creative tasks? What if your robot boss says they love your painting because it is sentimental and wants you to do more? It is essential to investigate how these tactics work with robots so that we know how to design proper interaction for robots in power.

3.4 Power Structure in Human-Robot Relationships

Although previous discussion mainly focuses on robots in higher power positions, there are actually three possible configurations in the power structure between a robot and a human: the robot in a lower, equal, or higher power position comparing to the human (see Figure 1).

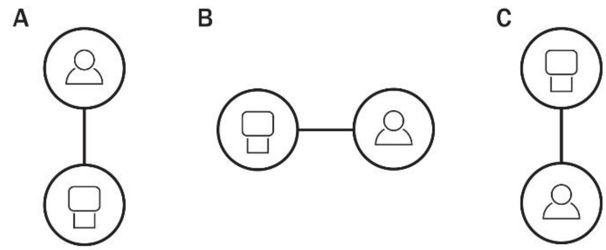

Figure 1. Three possible configurations in human-robot dyads. A robot can be in a lower (A), equal (B), or higher (C) power position comparing to the human.

We have seen many service robots which are designed clearly in a lower power position. People generally feel less intimidated in these cases, and this will probably increase interaction. However, as already observed in kids interacting with a voice assistant, people tend to be impolite to these agents [3], and this could affect how people interact with others.

When robots and humans are equal in power, this relationship resembles that of teammates. While collaboration is most frequent in this configuration, because robots and humans are likely assigned different roles that fit them the best, there will still be conflicts arising from different roles. Therefore, the equality of power is not really static. It is better understood as a dynamic equilibrium where the power relation depends on the context.

Having robots in powerful positions, on the other hand, has received fewer attention in research than the other two. While we believe that it could be beneficial in some scenarios, it is true that people may feel intimidated and offended when dominated by non-human. More research is needed in order to investigate this space and find potential ways to alleviate these negative emotions by redesigning how a robot interacts, as well as the organizational structure.

4 DISCUSSION

Power is in every interpersonal relationship, but it has received little attention in HRI. People are reluctant to talk about power and are generally skeptical about the idea of robots in power. However, we would like to point out that to have robots in power is to better cope with situations where human leaders are not well suited. These situations include dealing with emergencies, decreasing interpersonal conflicts, or creating a sense of fairness and objectiveness. We propose that in these scenarios, a robot in a leading role might be of benefit.

To be able to do so, we need to understand how power functions in HRI. From theories in social and organizational psychology, we know about how a person can gain, maintain, and lose power. We would like to point out, however, that not all of these results can be applied to robots directly. If we are designing a robot manager, for example, we should be aware that imitating a human manager might not always be the best solution. It is important to note that certain behaviors of people in power can be harmful to the team, such as arrogance, unrealistic optimism [6], corruption, and shifting focus from group-serving to self-serving. These behaviors, though human-like, should be avoided when we are designing robot superiors.

There are also other interesting questions that involve relationships between team members in power hierarchy. If we expend our power structure to groups of three, there will be many more configurations possible (see Figure 2), and more interesting

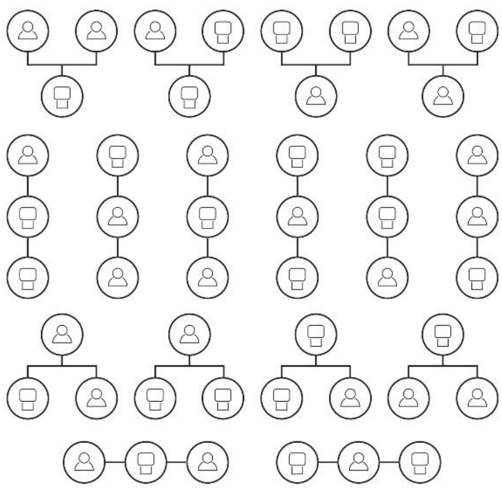

Figure 2. Possible human-robot power configurations in a group of three.

questions emerge. For example, it might be interesting to see how a robot manager's behavior will change the group dynamics. What if it compliments one member while expressing dissatisfaction to another? And what about a robot manager co-managing the team with a human manager? How should we allocate managerial responsibilities between these two? The good cop and the bad cop? Or the task-oriented and the relationship-oriented? These questions can all lead to insightful research to understand robots in power, and how we can design their interaction for teamwork.

5 CONCLUSIONS

This paper aims at discussing how power plays a role in human-robot interaction, especially when robots are in a higher power positions. We aim to outline some of the key concepts that someone looking to conduct research in this space should consider. Since there are fundamental differences between a human and a robot in power, further investigations are needed in order to better understand how power functions in human-robot collaboration and its implications in robot design.

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