

What Will People Think? Workers' Perception of Social Judgment When Using Collaborative Robots

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Abstract

Imagining others' opinions is a powerful social mechanism that shapes our decisions and well-being. Workers, like all individuals, form mental representations of how they believe others perceive them in relation to their work. While the deployment of collaborative robots can greatly improve efficiency and workers comfort, the way in which activities are reshaped and robots are deployed may significantly impact workers' mental representations of how they are judged by others. Understanding how the use of robots affect workers' perceptions of external judgment is crucial, as these perceptions can play a significant role in workers' actions, engagement, performance, and well-being. In this workshop paper, we bring this socio-psychological dynamic to light and propose a set of potential dimensions and shaping factors to consider when studying how the deployment of cobots might influence workers' perceptions of others' judgements.

Keywords

Human-Robot Interaction, Theory of Mind, Reflected Appraisal, Social Robotic, Collaborative Robot

1. Introduction

The integration of collaborative robots (cobots) in the workplace holds significant potential to enhance efficiency, productivity, and worker comfort by automating repetitive tasks and reducing both physical and mental strain. The growing adoption of cobots reflects a broader trend toward automation in various industries (Industry 4.0 [1]), driving the progressive transformation of labor and production systems through increased digitalization. While the benefits of cobots for task performance, ergonomics, and operational efficiency are well-documented, significant concerns have emerged regarding the socio-psychological impacts they may have, including insecurity and resulting maladaptive behaviors at work [2]. Despite this, the socio-psychological consequences of cobot integration remain largely misunderstood and are not yet adequately addressed.

This gap is important because, as technological integration accelerates in the workplace, the mental and emotional aspects of human-robot interaction (HRI) cannot be overlooked. Workers may be reluctant to adopt technology that negatively affects their mental well-being. Even if workers are mandated to use robots, it may lead to long term detrimental socio-psychological impact from loss of engagement, motivation, and performance to burnout [3].

One critical aspect of this socio-psychological dynamic is *reflected appraisal*, the process by which individuals form mental representations of how they believe others perceive them [4]. Building on the Theory of Mind (ToM) [5, 6, 7], which is our ability to ascribe mental states to others, this process plays a key role in social dynamics, as it governs how people understand their social image based on the judgments they believe others make about them [8]. This perception in turn influences self-perception [9], including self-esteem [4] which is directly related to work performances [10]. Importantly, reflected appraisal can differ significantly from both how others actually perceive them and how they perceive themselves [9], making it essential to consider this phenomenon in conjunction with these two perspectives.

Symposium on Human-Computer Interaction for Work (CHIWORK) 2025, Contribution to the workshop: The Future of Human-Robot Synergy in Interactive Environments: The Role of Robots at the Workplace, June 23-25, 2025, Amsterdam, The Netherlands

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In the case of cobots, workers' perceptions of how their use is judged by others can significantly affect their emotional well-being and work performance.

As robots assist in or take over tasks, and operate in the vicinity of others (e.g., colleagues, bystanders), it is likely that cobots will reshape how workers think others perceive them, at various scales (e.g., local, organization, societal). Workers may fear being seen as less competent, over-reliant on technology, or replaceable [11]. This concern becomes particularly pronounced in public-facing roles, where workers' activities are under continuous scrutiny. In these settings, workers might worry about being perceived as annoying due to the robot's presence and its potential to disrupt bystanders. These concerns, whether perceived or real, can have significant psychological consequences.

This workshop paper proposes an initial framework for understanding this socio-psychological phenomenon when using robot in the workplace. We introduce a set of dimensions and influential factors that operate across multiple scales, offering a foundation for further exploration. We hope that our contribution will stimulate valuable discussions and provide insights that can guide the development of positive and fulfilling working experiences with robots.

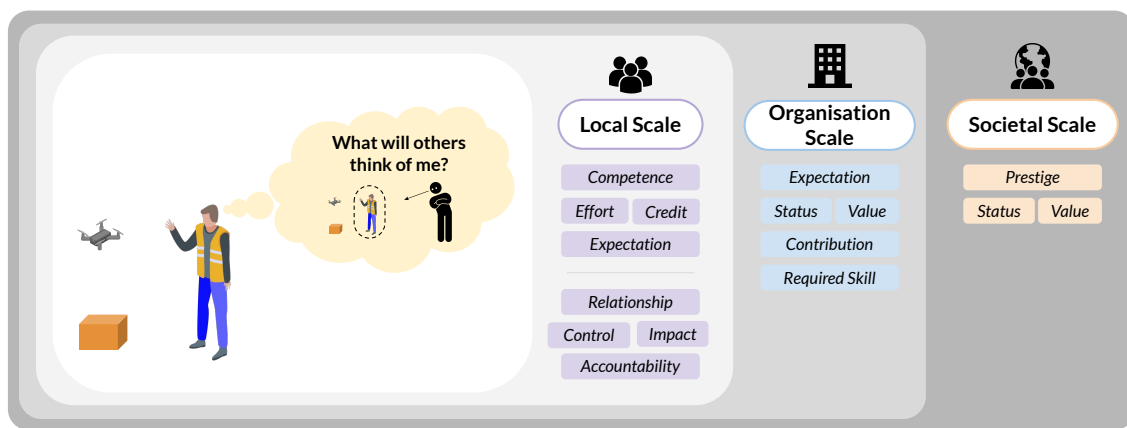


Figure 1: Schematic representation of the dimensions workers may imagine others judge them across local, organizational, and societal scales.

2. Others Judgment - Local, Organisational, Societal

The projection of oneself into others' minds can take various forms and encompass multiple dimensions across different scales. Importantly, we focus on how workers are judged individually, rather than in combination with the cobot, as this distinction may specifically influence their self-perception and well-being. While it could be insightful to compare both perspectives, our primary focus is on how workers perceive others judgment of themselves, independent of the robot's influence. This isn't about how they view themselves, but rather how they think others view them.

Workers may consider how they are judged in situational contexts, within the organization to which they belong, and more broadly, as part of society.

2.1. Local Scale

The local scale focuses on the situational judgment that workers imagine others will make when the worker is currently using the cobot. This is linked to contextual elements, as it emphasizes the here and now. Consideration arises at the moment when workers believe that others can form judgments about what they are currently doing, even if those judgments aren't actually being made. "Others" can include co-workers but also bystanders, people who may not be directly involved in the work but are in the vicinity of the activity. This is common in public-facing roles such as postmen, policemen,

or construction workers operating in public settings. The concept of “others” is important because the mechanisms of judgment differ depending on whether the worker is projecting perceptions about specific individuals or broader, generalized groups of people. For example, judgments about a specific individual may be based on direct, contextual information (e.g., what the worker knows about their colleagues), while judgments about a broader population might stem from general assumptions or stereotypes about how a group might perceive the worker [6].

When it comes to the specific activity being performed, workers may project various dimensions of judgment. These projections might relate to work-related dimensions, such as:

- *Competence*: How workers think others will perceive how intrinsically skilled they are in performing the task with the robot’s assistance. For example, a worker operating a cobot-assisted assembly line might wonder whether their supervisor perceives them as less skilled because they’re relying on the robot for certain tasks, or if they’re seen as more efficient due to the robot’s assistance.
- *Effort*: How workers think others will perceive the effort required from them to complete the task. A worker may fear that if the cobot takes over the repetitive or physically demanding parts of their job, others may think they are not putting in as much effort, even though they’re contributing in other meaningful ways, such as overseeing the robot’s work.
- *Credit*: How much credit workers think others will give them for accomplishing the task. For example, they may wonder if their use of the robot will diminish the credit they feel they deserve. For instance, a worker might worry that using a robot to perform complex calculations will make others attribute the success of the project to the robot, rather than recognizing the worker’s expertise in managing the robotic system.
- *Expectation*: What level of productivity or quality workers think others expect from them in the given situation. For instance, a worker using a robot to clean windows may feel that customers expect the work to be done faster and more efficiently than if they were doing it alone. They might worry that higher expectations lead to more pressure.

In relation to the robot itself, workers might also consider:

- *Relationship*: How others perceive their relationship with the robot. For instance, a worker may feel that if the robot is seen as a “colleague”, others might expect them to treat it like a human worker, giving it instructions, talking to it politely, or even adjusting their actions based on how they think the robot might perceive their behavior.
- *Control*: How much control the worker feels they have over the robot. For example, a worker managing an autonomous robot for deliveries might think that others will believe they have no control over the robot’s actions, which could lead to others feeling uncomfortable or even scared about the robot’s unpredictability.
- *Accountability*: How responsible the worker feels for the robot’s actions and their impact on others. For instance, if an autonomous robot makes a mistake, such as delivering the wrong item, a worker might worry that others will hold them accountable for the error, even if the mistake was not directly their fault.
- *Impact*: How workers think the robot’s presence or actions will impact others. For example, if a worker is using a drone in a public setting, they might worry that others will think they are spying on them or invading their privacy.

While these judgments are situational, they can have lasting effects on higher-scale judgments or more general attitudes toward cobots and workers using them. This is not an exhaustive list, and future research may uncover additional dimensions based on specific use cases and contexts, and also verify whether they align with workers’ reflected appraisal. These dimensions of others’ judgment may carry varying weight for different workers; some may not care much about whether they get credit, but may place greater importance on other factors, such as impact.

2.2. Organization Scale

At the organizational scale, judgments are made considering the worker as part of a broader system or entity to which they are affiliated. Workers may have mental representations of how they think others perceive them within the organization. While these judgments may stem from the local scale, they are more general and focus on overall perceptions rather than situational judgments. They can include:

- *Expectations*: Workers may envision that others expect performance metrics to significantly change with the use of cobots. They might worry that if the robot is involved but performance doesn't improve, others will view them as underperforming or less efficient, or that expectations placed on them are unrealistic based on what the cobot can actually deliver.
- *Organizational Status*: Workers may perceive that their status within the organization could either increase or decrease due to cobot deployment. For example, they may feel their role becomes more important if they are seen as a leader in robot-assisted tasks, or less important if robots take over more of their responsibilities, diminishing their perceived status in the workplace.
- *Organizational Contribution*: Workers may reflect on how they think others perceive their overall contribution to the organization's success. They might wonder if the use of cobots makes them seem contributing less, as some of their success might be attributed to the robot rather than their own efforts.
- *Value/Replacability*: Workers may consider how valuable or replaceable they are within the organization, especially in the context of automation. They may question whether their role is seen as indispensable or if the introduction of cobots has made their contributions seem less significant or easily replaceable [11].
- *Complexity of Their Job/Skill Requirements*: Workers may think about how their role is perceived in terms of complexity and the skills required. They may wonder if their job is now seen as requiring less expertise because robots handle more labor-intensive or complex tasks, or if they are perceived as more skilled due to their ability to work alongside advanced technologies like cobots.

These perceptions are crucial, as they can significantly impact how workers feel within their organization and influence the general attitude they believe others have toward their use of cobots. This, in turn, shapes their own attitudes and engagement. The way workers think they are judged within the organization when working alongside robots may affect their motivation, perceived recognition, job satisfaction, and acceptance of cobots.

2.3. Societal Scale

At the societal scale, judgments are made regarding how workers are perceived in relation to the broader societal context. Workers may reflect on how they think society views them, particularly in relation to their job and the use of cobots. In short, it refers to what workers imagine others will think of them when they say, "I'm doing *this* job." These judgments can include:

- *Social Prestige*: How workers think others in society perceive their prestige based on the nature of their work. Workers may wonder if the use of cobots affects their social standing, whether it makes their job seem more innovative, high-tech, or prestigious, or if it leads to perceptions of their role as less important or less respected.
- *Societal Value*: How workers think their value is perceived in society, particularly in relation to their collaboration with cobots. They might question whether their role is seen as indispensable, or if the integration of cobots makes their contributions seem less essential or meaningful. They may also reflect on whether society views them as playing a crucial role in the workforce or as part of a system where robots are gradually taking over their tasks.
- *Social Status*: How workers think their status in society is influenced by their work. This can relate to both the perceived social standing of their job and how the introduction of cobots impacts

their perceived rank within the professional landscape. For example, some workers might feel that working alongside advanced technologies like cobots elevates their status, while others might feel that it lowers their status if their role becomes too reliant on robots.

In summary These scales raise different considerations, with potentially longer-lasting and more impactful effects at the higher levels (societal and organizational) and more temporary effects at the local scale. Importantly, while we've highlighted some examples indicating the potential detrimental effects of cobot usage, there is also the possibility that cobots can foster positive outcomes in terms of reflected appraisal. In the following section, we explore some potential influencing factors that may shape these reflected perceptions.

3. Influential Factors

In this section, we reflect on a set of factors that may influence how workers perceive themselves in relation to others' judgments when working alongside collaborative robots. These factors, while not exhaustive, provide an initial framework for understanding how various elements could shape the judgments workers believe others make about them. These influential factors can be broadly categorized as follows:

- *Organizational Factors:* These factors refer to organizational-level elements that may influence how workers imagine others' judgments. For example, how the robot is introduced within the organization, how it is framed [12], and how communication about its role is managed may all shape workers' perceptions of how they are viewed by others. Identifying these factors can help organizations develop actionable guidelines for introducing and communicating about cobots in a way that minimizes the risk of negative reflected appraisals. Another factor may be the role of the robot within the organization, which could range from being a subordinate, to functioning at an equal level, or even acting as a supervisor to the worker [1]. In particular, assigning robots higher roles within a collaborative setting can be a source of frustration [13], potentially negatively impacting reflected appraisal.
- *Individual Factors:* These factors stem from the worker themselves. How workers judge their own work performance, their personality, initial reflected appraisal, and their own attitude towards to cobot can significantly shape how they imagine others perceive them. In particular workers who have a high self-esteem might be biased in their reflected appraisal process as shown in previous works [14]. One factor we explore further is the perceived relationship with the robot, which can have a profound impact on workers' reflections of how they are judged.
- *Contextual Factors:* Particularly relevant at the local scale, these factors relate to the environment in which the robot is used and the type of audience present. The physical and social context, for example, whether the worker is in a public-facing role or working behind the scenes, could affect the perceived scrutiny they are under. The type or specific individuals observing the worker (e.g., colleagues, customers, or superiors) may also shape their perceptions of how they are being judged and how much their judgment impact them [14].
- *Activity-Related Factors:* These factors concern the nature of the work being done and how the task is affected by the robot's involvement. For example, task complexity and how the worker interacts with the robot (e.g., what aspect of the task is altered) may influence how workers think others perceive the worker's competence and contribution.
- *Design Factors:* Finally, the design of the robot itself. For instance, if the robot is designed in a way that may disrupt non-direct users, it could influence workers' perceptions of its impact on others and make them more reluctant to use it, especially if they feel others will hold them accountable for any disruptions it causes.

Tool vs. Extension vs. Social Collaborator In social robotics, researchers aim to leverage humans' natural tendency to apply social perception to non-living entities to enhance interaction and user

well-being [15]. However, this tendency may also lead to unintended socio-psychological consequences. In this section, we aim to explore workers' perceived relationship with robots. We hypothesize that whether the robot is viewed as a tool, a colleague, or an extension of oneself may shape how workers perceive others' social judgments. Below, we make a hypothetical comparison of how accountability and credit, two critical dimensions at the local scale, could be influenced by how workers perceive their relationship with the robot.

- *Tool*: If the robot is perceived as a tool by the worker, they may not feel that the robot holds much social significance in their activity, resulting in a limited socio-psychological impact. They might think that others would attribute all the credit to them, with little responsibility for the robot's impact on others or any potential malfunctions, as the robot is seen as belonging to the company, not to them individually.
- *Extension of Self*: Conversely, if the robot is perceived as an extension of the worker [16], the worker may think that others will consider both the robot's actions and the worker's actions as interconnected. The worker might perceive that the robot's actions will be their own, and that others will give them full credit and accountability, for better or worse.
- *Colleague*: If the robot is perceived as a colleague, it takes on a more distinct social identity, which could lead to workers considering that others will think the robot assumes more responsibility for both accountability and credit. This perception could introduce a potential conflict if workers believe that others will no longer view the output of their collaboration as their own work but instead as a joint effort with the robot. It could also create a competitive dynamic, where workers feel their contributions may be overshadowed by the robot's capabilities.

4. Conclusion

The integration of collaborative robots (cobots) in the workplace presents significant opportunities to improve efficiency, productivity, and worker well-being. However, as robots become more embedded in daily work activities, their socio-psychological impact, particularly regarding how workers perceive others' judgments (i.e., reflected appraisal), becomes an important area of exploration.

In this workshop paper, we introduced an exploratory framework to better understand the scale of this phenomenon and the potential factors that may influence it. We also proposed a hypothetical comparison of how different perceptions of the robot, whether seen as a tool, an extension of oneself, or a colleague, may influence reflected appraisal and, in turn, affect work dynamics.

Ultimately, our goal is to foster a discussion about the socio-psychological impacts of cobots, beyond their apparent objective benefits. We aim to motivate future work that further explores reflected appraisal, assessing how it influences workers' mental state and behavior, and helping us develop guidelines for the design and deployment of cobots that promote not only operational success but also worker well-being.

Declaration on Generative AI

During the preparation of this work, the authors used GPT-4 in order to: Grammar, spelling check and rephrasing. After using these tool(s)/service(s), the author(s) reviewed and edited the content as needed and take(s) full responsibility for the publication's content.

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