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COMMENTARY

Facilitating timelier research with a novel classification of workplace technology

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By reviewing the influence of a series of "individual technologies" on work outcomes, White et al. (2022) emphasize the theoretical significance of technology research in the field of industrial-organizational (I-O) psychology and offer considerable promising research opportunities for I-O psychologists. Consistent with our observations in the recent review (Wang et al., 2020), White et al. also identified that we "lack an understanding of 'how' and 'why' new technologies affect employees" (p. X). We argue that the omission of a general technological classification has (at least partially) led to this theoretical challenge. The existing literature has mainly focused on the use of specific technological tools and related work outcomes, whereas limited effort has been made to integrate these fragmented studies. Classification connects various theoretical concepts and plays a crucial role in accumulating knowledge and developing theories. Thus, a comprehensive understanding of *how* and *why* current new technologies affect employees requires a more appropriate classification of workplace technologies.

In this commentary, we will first introduce Murray et al.'s (2021) approach to categorizing technologies based on a technology's capacity to exercise intentionality over protocol development or action selection, resulting in four meaningful categories. We then will discuss how these four categories of technologies contribute to timelier technology research.

A general classification of workplace technologies

Given the nuanced differences among technologies, more and more scholars have started to explore the effects of using specific technological tools (Wang et al., 2021). We do believe that this approach helps to produce timely technology research. However, research currently remains segregated across different focal technologies.

We argue that categorizing various technologies into several handleable typologies is conducive to theory development. This commentary introduces Murray et al.'s (2021) novel classification of workplace technologies. Murray et al. argue that different technologies differ in their capacities to determine rules and guidelines for what to do (i.e., develop protocols) and make choices of what to do (i.e., select actions). Based on a two-by-two matrix, workplace technologies can be classified into four categories—namely, assisting technologies, arresting technologies, augmenting technologies, and automating technologies.

Assisting and arresting technologies have been widely discussed in the existing technology research. According to Murray et al.'s (2021) classification, assisting technologies neither have the capacity to develop protocol nor to select actions, which means that the effect of assisting

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technologies on employee outcomes is highly dependent on how people use them in daily practices. Representative assisting technologies include enterprise social media and office software. Although arresting technologies cannot develop protocol either, they can automatically execute work tasks without human intervention (e.g., the autonomous assembly line).

Compared with traditional technologies, augmenting and automating technologies are able to determine rules and guidelines for what to do. However, augmenting technologies cannot make choices of what to do. A structured machine intelligent algorithm is the typical representative of augmenting technologies. It relies on massive data and information for recognition training and modeling. Automating technologies are more powerful than augmenting technologies due to their capacity to select actions. This kind of technology has self-learning and self-innovation abilities, so it can produce the most drastic and unpredictable changes in organizational practices (e.g., artificial intelligence robots).

Facilitating timelier research with a novel technology classification

Based on the work design perspective, we further propose that this novel classification helps to produce timelier technology research, thereby having a more comprehensive understanding of how and why new technologies affect employees. Work design is defined as "the content and organization of one's work tasks, activities, relationships, and responsibilities" (Parker, 2014, p. 662). The basic tenet is that new technologies affect employees through shaping a set of work characteristics (e.g., Parent-Rocheleau & Parker, 2021; Parker & Grote, 2019; Wang et al., 2020).

In what follows, we will adopt the work design perspective and discuss effects of each of the above four different technologies on critical work characteristics. Given the well-established work design literature, scholars and managers can easily link changes in work characteristics to employee outcomes.

Assisting technologies

Employees are dominant in the human–assisting technology relationship. As a tool designed to improve efficiency and productivity, assisting technologies are conducive for employees to reduce physical and cognitive demands in routine work. However, working with assisting technologies also creates a set of new demands (Wang et al. 2020). For example, employees must invest extra resources to learn and master new technologies or functions and to deal with various technical hassles (e.g., incompatibilities). In terms of the relational aspect of work, assisting technologies enable people to interact with colleagues and customers in a more convenient way without constraints of time and space. Notably, although technology-mediated communications help to expand one's social network, it's a huge challenge to build expressive social ties due to limited social cues in technology-mediated communications.

Arresting technologies

Arresting technologies can make choices of what to do by technologies themselves. When certain conditions are satisfied, arresting technologies will automatically perform tasks without human intervention. Thus, those technologies indeed can prevent people from tedious work but sacrifice job autonomy. As it's not easy for end users to modify or change technology protocols, users (workers) usually have limited control over their work. Employees who work with arresting technologies are less likely to schedule their daily work, determine work procedures, and choose preferred methods of working.

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Augmenting technologies

Augmentation is a coevolutionary process that involves humans and technologies. On one hand, technologies analyze data and generate different models to provide predictive suggestions. On the other hand, humans use their expertise to evaluate, select, and supplement machine outputs to eliminate unreasonable biases. Augmenting technology has the potential to change organizational management in influential ways, with its significant effect on both the nature of work and workers (Kellogg et al., 2020). Specifically, organizations and managers usually employ augmenting technologies, especially smart algorithms, to improve work efficiency and productivity, which may ultimately lead to work intensification. *Digital Taylorism* is an extreme example. Algorithms are used in goal setting and performance evaluation, attempting to keep activities, tasks, and procedures standard, mechanistic, inflexible, and precise. Besides, pursuing the most efficient, least costly, and most productive way to work may overlook the relational aspects of work. That is because, in the increasingly intelligent and standardized workplace, people tend to invest most resources to work rather than socialize.

Automating technologies

Automating technologies are able to substitute for humans in organizational practices. Specifically, all end users need to do is set a goal; the technology then will analyze amounts of unstructured data and learn how to achieve this goal by developing protocols and selecting actions. The effects of implementing automating technologies depend on which type of task has been automated. Introducing automating technologies to perform routine and time-consuming tasks allows employees to save personal resources and focus on more valuable and meaningful work. In this sense, automation increases job autonomy and reduces the workload to some extent (Raisch & Krakowski, 2021). However, implementing automating technologies in the workplace also has limitations. Relying heavily on automating technologies may lead to skill degradation, making employees confined to established routines. More importantly, using automating technologies may also decreased perceived job significance and meaningfulness. As primary tasks can be completed by technology's self-developed protocols and self-selected actions, most employees must assist technologies, in terms of training algorithms, explaining controversial results, and ensuring the technology is functioning properly. Individuals' perceived self-worth might be diminished in this process.

In addition to theoretical insights generated from this approach, using this classification and these work design theories also can facilitate practice-oriented technology research. Work design theories view an organization as a whole and divide it into technical and social subsystems. Managers can optimize working experiences by altering the social subsystem (i.e., the human side of the relationship) and technical subsystem (i.e., tools, techniques, procedures, skills, and devices used to accomplish organizational tasks).

For example, to cope with skill degradation caused by automating technologies, managers can increase the diversity and complexity of work tasks so that employees are able to use a wide range of knowledge, abilities, and skills. In addition to altering the social subsystem, organizations also can improve the technical subsystem. In the face of the challenges brought by technology, Parker and Grote (2019) argue that the needs of humans in the workplace should be taken into consideration in the development and design stage of new technologies to minimize potential negative consequences. In the implementation stage of technology, managers should evaluate the effect of the function of new technology on a series of relevant work characteristics. For example, in automating work monitoring systems, employees should be allowed to modify or change algorithmic scheduling or task allocation decisions. Giving employees a voice in challenging or discussing automating management decisions can help them maintain sufficient autonomy over their work.

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Conclusion

This commentary integrates and moves beyond the existing technology research by introducing a novel classification of workplace technologies (Murray et al., 2021). Building upon work design theories, we discuss how proposed four categories of technologies affect employees via shaping the nature of work and further propose that the joint optimization of social and technical subsystems is helpful for improving human–machine interaction experience. Thus, the current commentary provides a viable approach for timelier technology research in the current digital workplace.

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