When Digital Technologies Enter the Factory – Improving Blue-Collar Workers' Attitudes Towards New Technologies

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Chapter 1: General Introduction

Digital technologies have become an indispensable part of today's work. An organization's ability to adopt new technologies is, thus, undoubtedly crucial to ensure its competitiveness and success (e.g., Bleicher & Stanley, 2016; Bloom et al., 2013, Giorcelli, 2019). Importantly, implementing digital technologies entails enormous potential for organizations and their employees: They might enable better services, products, and global networking, simplify and accelerate work processes, and augment employee performance (Parker & Grote, 2020). Regarding the latter, digital technology may *enrich* employees' jobs (e.g., Cascio & Montealegre, 2016). This may be especially true for employees in production—so-called blue-collar workers, who perform mainly manual labor (Peissner & Hipp, 2013; Roblek et al., 2016). Here, robotic technology may, for instance, take over simple, monotonous or physically demanding tasks, allowing workers to engage in more advanced, autonomous and varied work. Thus, new technologies provide the potential to enhance work motivation and job satisfaction within this work context (e.g., Morrison et al., 2005; Parker & Grote, 2020).

Notwithstanding, implementing new technology represents a major challenge for organizations. Indeed, the success rate of technology implementation projects is constantly below 30 percent, with even lower rates in traditional industries, such as the automotive sector, as well as within large organizations with more than 50.000 employees (McKinsey & Company, 2018)—leading to huge financial losses (e.g., Koch, 2004). A main reason for implementation failures is that employees often are not motivated to support technological changes, but have a rather *negative attitude* towards new technology (Gnambs & Appel, 2019)—as they might fear being replaced by it (e.g., Manyika, 2017) or do not want any changes to the status quo (Kim & Kankanhalli, 2009)—eventually leading to the rejection of a new technology (e.g., Brynjolfsson & Hitt, 2000; Tiersky, 2017). These obstacles are supposed to be especially prevalent among lower skilled employees, such as blue-collar workers—as new technology might resemble a threat to their current work and status. Consequently, blue-collar workers often are supposed to have the highest risk of being replaced by new technology (e.g., Dellot & Wallace-Stephens, 2017; Ebrahim, 2018; Manyika, 2017; Gnambs & Appel, 2019).

Taking a closer look at the current developments within the blue-collar context, technological change is driven by the rapid innovations of the Forth industrial revolution (Schwab, 2017). This so-called *Industry 4.0* involves—starting from a further advancing digitalization—the introduction of new technologies, such as industrial robots, smart technology based on artificial intelligence, and industrial internet, at a rapid pace (Brougham & Haar, 2018). For example, the investment outlook for industrial robotic technology is expected to grow with double-digit margins, entailing a further diversification of robotic applications and products (International Federation of Robotics, 2017). In line with this, the interaction among blue-collar workers with new robotic technology is expected to increase significantly (Brougham & Haar, 2018). Thus, implementing new technology is likely to change blue-collar work fundamentally (Brougham & Haar, 2018), among others, by influencing organizational structures and employees' work.

To ensure the benefit of new technology in blue-collar work, it is essential that employees have a positive attitude towards it. However, knowledge about technology implementation in blue-collar work is limited—as blue-collar workers represent a sample that is difficult to reach (e.g., Baruch et al., 2016; Liebermann et al., 2013). In this regard, research needs to identify *drivers* and *implementation strategies* that contribute to the formation of workers' positive attitude towards new technologies (e.g., increase their enthusiasm about new technologies and decrease their job insecurity and resistance; Parker & Grote, 2020; Venkatesh & Bala, 2008). The current dissertation seeks to address this gap in two ways: First, the current dissertation aims to (1) identify *antecedents* of blue-collar workers' attitudes towards new technology; and second, (2) develop and test *interventions* that seek to improve those attitudes. By that, the current dissertation aims to contribute to the knowledge about successful technology implementation in the important, yet under-researched field of blue-collar work.

Relevant Attitudes Towards New Technology in Blue-Collar Work

Several theoretical models with a background in psychology, sociology, and information technology have been developed to study how individuals' perception of a new technology affect their technology adoption intention and behavior (Venkatesh et al., 2003). One of the most popular models, the *Technology Acceptance Model* (TAM; starting with the work by Davis, 1985; final version by Venkatesh & Davis, 1996), is based on the Theory of Reasoned Action (Fishbein & Ajzen, 1975) and posits that the intention to use a technology is determined by two beliefs: (1) *perceived usefulness*, representing an individual's perception that the technology will lead to enhanced work performance, and (2) *perceived ease of use*, defining the perception of effort needed to use the technology. These two constructs are influenced by external variables (e.g., characteristics of the technology, social influence). The behavioral intention to use the technology determines actual technology usage (Davis, 1985; see Figure 1.1). Over the years, the model has been extended by adding social (i.e., subjective norm, image) and cognitive external variables (i.e., job relevance, output quality, result demonstrability) that influence intention to use and usage (TAM2; Venkatesh & Davis, 2000); as well as anchors (e.g. computer self-efficacy, computer playfulness) and adjustments (e.g., perceived enjoyment, objective usability) of perceived ease of use (TAM3; Venkatesh & Bala, 2008).

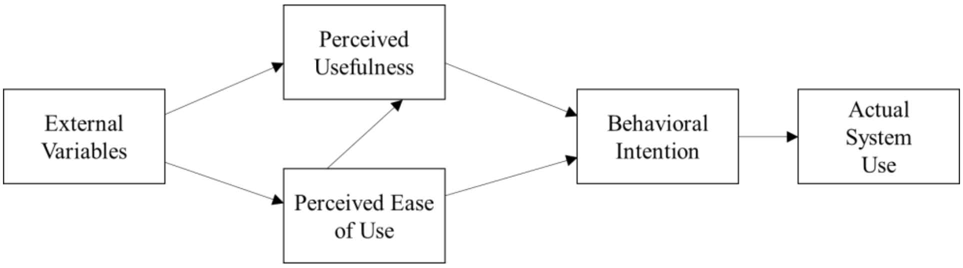
Another prominent model on technology acceptance, the *Unified Theory of Acceptance and Use of Technology* (UTAUT; Venkatesh et al., 2003) aimed at unifying previous theorizing on technology adoption. It posits that the intention to use a new technology depends on four aspects: (1) *performance expectancy* (i.e., the perception that a technology will enhance job performance), *effort expectancy* (i.e., the perception of ease related to using a technology), *social influence* (i.e., an individual's perception that a technology should be used according to important others), and *facilitating conditions* (i.e., the perception of organizational and technical support to use a technology; see Figure 1.1). Both models (i.e., TAM and UTAUT) have been widely used and validated in previous research (e.g., Awwad & Al-Majali, 2015; King & He, 2006; Welch et al., 2020).

However, these approaches have also been criticized, among others, for a lack of practical applicability (e.g., Ajibade, 2018; Chuttur, 2009; King & He, 2006; Shachak et al., 2019). One main shortcoming refers to the examined variables—as they only take a narrow perspective on technology adoption behavior by focusing on (a) *proximal* outcomes that cover positive aspects related to technology usage (e.g., perceived usefulness), and (b) *voluntary* technology use (e.g., Chuttur, 2009; Shachak et al., 2019; Yang & Yoo, 2004). Other, more distal outcomes that have been found to also contribute to individuals' technology adoption behavior—such as barriers related to technology adoption, like resistance to change (e.g., Kim & Kankanhalli, 2009)—have not been taken into account (e.g., Lunceford, 2009). Moreover, the models may not be able to fully explain technology adoption in business environments, where technology usage often is mandatory, as it is the case in blue-collar work (Ajibade, 2018; Chuttur, 2009; King & He, 2006). For instance, when technology usage is mandatory, the behavioral intention to use cannot be considered a meaningful variable. Thus, research has called to investigate technology adoption by taking a more holistic approach and considering a more global evaluation of technology (e.g., Chuttur, 2009).

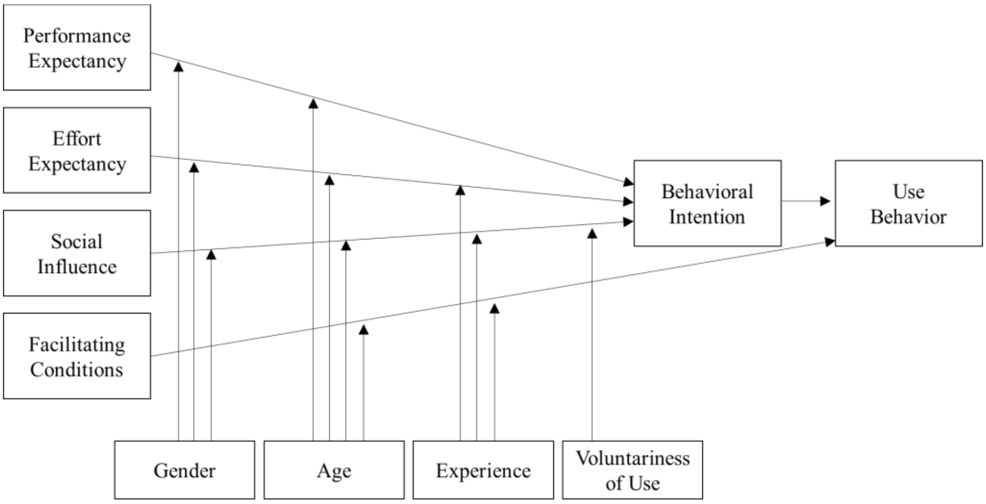
Figure 1.1

(a) Technology Acceptance Model (TAM) by Venkatesh and Davis (1996) and (b) Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. (2003)

(a)



(b)



Another, so far widely neglected approach to examine technology adoption from a more global perspective is to focus on more *distal attitudes* towards new technology – such as resistance to change or the fear of job loss. Attitudes can be defined as “a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor” (Eagly & Chaiken, 1993, p. 1). Accordingly, attitudes include both the positive and negative evaluation of the attitude object (here: a technology) and are formed based on online experience (Fazio, 1986) as well as previous experiences, memory, and implications about its use and associated consequences (Schwarz & Bohner, 2001)—thus representing complex judgements about a technology. Importantly, attitudes have been found to be reliable predictors of subsequent behavior (such as using new technology; Ajzen, 2012). Therefore, focusing on attitudes towards new technology provides the basis for a more global approach to understand technology adoption.

Which attitudes are particularly relevant within the context of blue-collar work? Blue-collar work still entails special working conditions today and is very different as compared to white-collar work (i.e., largely physical instead of clerical or administrative work; Hu et al., 2010; Huang, 2011). As stated above, blue-collar work includes monotonous, repetitive, and simple tasks with short cycle time (e.g., Nielsen & Abildgaard, 2012; Schreurs et al., 2011). Thus, these jobs offer poorer working conditions and often require lower qualifications as compared to white-collar work (e.g., Karasek & Theorell, 1990). Importantly, new (robotic) technologies are likely to change work in the blue-collar context fundamentally (Brougham & Haar, 2018), and technology usage in this context is mostly mandatory. Based on previous research, three indicators of attitudes, thus, might be particularly relevant in determining technology (and especially robot) adoption within this context: (1) *technology enthusiasm*, as considered a more proximal, positive attitude that is similar to constructs captured in technology acceptance literature (e.g., TAM); as well as (2) *resistance to change* and (3) *technology-based job insecurity*, both representing distal attitudes that have been widely ignored in technology adoption literature so far, but that are crucial obstacles to successful technology implementation in blue-collar work. These three attitudes serve as potential outcomes in the present work; thereby bringing together research from (1) technology acceptance, (2) resistance to change, and (3) job insecurity literature. I now elaborate more on each of these dimensions.

Technology Enthusiasm

First, besides the economic advantages, new technologies entail benefits for blue-collar workers (e.g. Cascio & Montealegre, 2016; Roblek et al., 2016). For example, new intuitive robotic systems might enable blue-collar workers to use and program robots themselves, thereby expanding their range of tasks and skills and allowing for more autonomy at work—and thus to enrich their jobs (e.g., Peissner & Hipp, 2013; Perzylo et al., 2016). Hence, such robots offer the potential to *enthuse* blue-collar workers (i.e., motivate them intrinsically to work with them). This *technology enthusiasm* (also: perceived enjoyment, Venkatesh & Bala, 2008) reflects the general joy or pleasure in using a technology in its own rights, apart from performance consequences (Davis et al., 1992). Technology enthusiasm has been widely studied within the technology acceptance literature and has been found to be an important predictor of the intention to use technology and actual use (e.g., Agrifoglio et al., 2012; Moon & Kim, 2001; Venkatesh et al., 2012). Importantly, technology enthusiasm represents a decisive variable in the context of mandatory technology use, as employees who are enthused by a technology are motivated to use it on their own accord (Kurkinen, 2014). Accordingly, the current dissertation studies *technology enthusiasm* as central indicator of positive attitudes towards newly introduced robotic technologies in blue-collar work, whereas the following two components capture barriers or negative components of attitudes.

Resistance to Change

Second, one main obstacle to effective technology implementation is that employees' *resist* using a new technology (e.g., Kim & Kankanhalli, 2009; Oreg, 2006). Reasons for such *resistance to change* are the fear of the unknown, perception of threat to intra-organizational power structures (i.e., to the current role and status; Lapointe & Rivard, 2005; Marakas & Hornik, 1996), insufficient personal resources to deal with the upcoming changes (Martinko et al., 1996) and that adopting new technology requires additional effort (e.g., Parker & Grote, 2020). Resistance to change might be particularly relevant regarding technology adoption among blue-collar workers, as new robots produce fundamental changes to their work and power structures (e.g., Lapointe & Rivard, 2005; Parker & Grote, 2020). Blue-collar workers might not feel able to deal with technological changes due to limited education or experience with such technology. Importantly, resistance to change has been found to be negatively related to technology implementation success (e.g., Hong & Kim, 2002; Mahmud et al., 2017)– consequently, it should be taken into account when studying technology adoption in blue-collar work.

Technology-Based Job Insecurity

Finally, blue-collar workers are often assumed to have the highest risk of being replaced by new technology and automation (e.g., Manyika, 2017; Gnambs & Appel, 2019). Although analyses on the impact of digital change within Industry 4.0 suggest that new technologies might replace tasks within an occupation, but not the occupation as a whole (e.g., Brynjolfsson et al., 2018), this (subjective feeling of) *technology-based job insecurity* represents an important obstacle to technology implementation success in blue-collar work (Dau-Schmidt, 2014; Manyika, 2017). Indeed, blue-collar workers have been found to be particularly afraid of being replaced by new technology (Gnambs & Appel, 2019; Schwabe & Castellacci, 2020). Technology-based job insecurity is associated with lower work-related outcomes such as performance and job satisfaction (e.g., De Cuyper et al., 2014; Furaker & Berglund, 2014; Reisel et al., 2010). Building upon this, the current dissertation studies *technology-based job insecurity* as another important indicator of attitudes towards new technology in blue-collar work.

Taken together, prior technology adoption research focused on proximal outcomes and voluntary technology use (e.g., the perceived usefulness of a technology; Chuttur, 2009). To this end, the current work captures technology enthusiasm as central proximal indicator of positive attitudes in blue-collar work, where technology use is mandatory. In addition and going beyond the earlier approaches like TAM and UTAUT, the current dissertation covers also two more distal attitude dimensions—that might be crucial in determining technology adoption in blue-collar work, namely resistance to change and technology-based job insecurity.

Implementing New Technology in Blue-Collar Work

As mentioned above, implementing new technology represents a major challenge for organizations. The enthusiastic start of technology implementation projects often goes along with the disillusioning reality that employees do not want to use the new technology—and consequently, the benefits of the technology cannot be realized. Why do technology implementation projects fail so often? A main reason for this is that implementers often do not consider technology introduction as a major *change* for the workforce—while employees, who are sought to use the new technology, do so (Bankins et al., 2020; Kellogg et al., 2020). Accordingly, a common problem during the implementation of new technology is that the focus on the technological aspects is high, while the focus on human or social aspects related to this change is limited (e.g., Lorenzi & Riley, 2000).

However, having promising new technology alone does not ensure successful implementation. Indeed, research has long stressed the importance of considering the interaction of social and technical aspects within an organization, as these aspects are dependent on each other. In this vein, the *Sociotechnical Systems Theory*, which can be traced back to research conducted at the Travistock Institute in London in the 1950s (Rice, 1958; for a review, see Mumford, 2006) emphasizes that technology, organization and individuals should only be jointly optimized. A sociotechnical system constitutes two inter-related sub-systems: A *technological sub-system* including technology, machines, tools, and equipment; and a *social sub-system* referring to the individuals and teams working within the organization, their needs, abilities, and interrelationships. Changes in one system directly produce changes to the other system. Accordingly, implementing new technology has, among others, an impact on an individual’s work routines, teams structures, work characteristics, and perception of own competency. Consequently, technology implementation without the consideration of the employees’ perspective is likely to fail (e.g., Clegg & Shepherd, 2007; Waterson et al., 2015).

Antecedents of Attitudes Towards New Technology in Blue-Collar Work

In line with this reasoning, to ensure successful technology adoption, it is essential to understand the *drivers* (i.e., *antecedents*) of attitudes towards new technology. As stated above, new technologies, such as intuitive robotics, will fundamentally affect blue-collars' work (i.e., the *characteristics* of their workplace; Brougham & Haar, 2018; Parker & Grote, 2020). For instance, new robotic systems might contribute to higher task and skill variety, and lower physical demands (e.g., Parker & Grote, 2020). Thus, attitudes towards such new technology are likely to depend on the *current* and/or *desired characteristics* of employees' workplace, such as the extent to which an employee actually experiences task or skill variety; and desires it, respectively. For instance, employees who desire to take on more demands (e.g., a higher workload) might be particularly enthusiastic about a new technology. Likewise, employees currently perceiving low work enrichment might be afraid to lose their work due to a new technology, as their jobs seem to be easily replaceable.

In fact, research has demonstrated that how individuals perceive their current work situation determines their evaluation of organizational change (and that is what introducing new technologies is; Beckhard & Harris, 1987; Behringer & Sassenberg, 2015). For example, employees with high current job demands, such as a high workload or time pressure, exhibit lower openness to change (e.g., Petrou & Demerouti, 2010). However, prior research investigating the role of work characteristics has been conducted mainly in white-collar work (e.g., Morgeson & Humphrey, 2006; Stansfeld et al., 2013; Wu et al., 2018; for exceptions see Hu et al., 2010; Huang, 2011); thus, knowledge about their role in blue-collar work is limited.

Furthermore, research explicitly linking research on work motivation (e.g., work characteristics) and technology adoption is scarce (Parker & Grote, 2020). The few studies that exist were conducted in white-collar contexts and focused on technology other than robots (e.g., Kettenbohrer et al., 2015; Lee et al., 2009). Notably, however, research found that the adoption of robots depends on individual factors (e.g., age; Taipale et al., 2015; prior robot experience; Savela et al., 2018; Turja & Oksanen, 2019; gender and education; De Graaf & Allouch, 2013; Turja & Oksanen, 2019)—but these studies did not focus on factors related to work motivation. Taken together, research examining the relation between work characteristics and attitudes towards new technology in blue-collar work remains scarce.

Along these lines, the first aim of the current dissertation is to identify antecedents of blue-collar workers' attitudes towards new technology. More specifically, the present dissertation seeks to answer the question how *actual* and *desired work characteristics* (as they have been established in research on work motivation, starting with Hackman & Oldham, 1975), relate to blue-collar workers' attitudes towards new, to-be-introduced (robotic) technology. By targeting this question, the present work seeks to shed light into the motivational factors contributing to the formation of a positive or negative attitude towards new technologies within the context of blue-collar work.

Interventions to Improve Attitudes Towards New Technology in Blue-Collar Work

Another key factor to successful technology adoption is to have specific *strategies* on how to implement new technologies and improve attitudes towards them (Jasperson et al., 2005). Such *interventions* are especially important from an organizational point of view, as technology implementers and managers need to have actionable guidance on how to implement new technology effectively (Venkatesh & Bala, 2008). Particularly, interventions may improve employees' attitudes by helping them to form an adequate picture about the technology (e.g., its features and benefits) as well as their own ability to use it (i.e., self-efficacy)—and, thus, should make employees realize that the technology represents an opportunity (Venkatesh & Bala, 2008). Indeed, research suggests that most implementation failures are caused by inadequate implementation strategies (e.g., Jasperson et al., 2005). Accordingly, without such strategies, the expected benefits associated with a new technology are likely to remain missing. However, research examining strategies to introduce new technology is scarce (e.g., Venkatesh, 1999; Venkatesh & Bala, 2008), especially in blue-collar work (Molino et al., 2020). Hence, research has called to identify adequate interventions on how to implement new technology and improve attitudes towards it (e.g., Jasperson et al., 2005; Venkatesh & Bala, 2008).

The current dissertation follows this call. In this vein, the second aim of the current research is to contribute to the knowledge about successful interventions to implement new technology in blue-collar work. To do so, I have developed and examined two interventions that aim to improve attitudes towards new technology in blue-collar work: (1) a communication strategy that illustrates a technology's benefits by speaking to employees' needs, namely *needs-oriented communication*; and (2) an intervention aiming to increase employees' self-efficacy beliefs, namely *enactive mastery experience*. I now elaborate more on the reasoning behind each of these interventions.

Intervention 1: Illustrating a Technology's Benefits Through Needs-Oriented Communication

Traditional theorizing on organizational change has long stated that one key factor for managing change successfully is *communication* (e.g., Barrett, 2002; Kotter, 1995; Lewis & Seibold, 1998; Quirke, 1995). In fact, prior research found that the more satisfied employees were with the communication during organizational change, the more positively they responded to the changes (e.g., Allen et al., 2007; Bull & Brown, 2012). Importantly, to improve individuals' attitudes towards a new technology, they need to recognize the technology's *benefits* for their work (e.g., Karaali et al., 2011). The communication of the benefits that a new technology entails has thus the potential to improve individuals' attitudes towards new technology. Hence, applying a communication strategy highlighting those benefits in the process of technology introduction should be promising.

Along these lines, the current dissertation develops and experimentally tests a communication strategy to introduce new technology that seeks to speak to employees' needs and thereby illustrates a technology's benefits. More precisely, this so-called *needs-oriented communication* emphasizes that a new technology serves blue-collar workers' work-related needs (i.e., improves their work characteristics). By that, needs-oriented communication aims to improve attitudes towards new technology (i.e., enhance technology enthusiasm, and reduce resistance to change as well as technology-based job insecurity).

Intervention 2: Increasing the Self-efficacy to Use New Technology Through an Enactive Mastery Experience

Another decisive factor in managing (technological) change successfully is that employees feel capable of using the new technology (i.e., feel *self-efficient* to deal with the new technology and the associated changes). Indeed, perceived self-efficacy in using technology has been included as a central predictor of technology usage in most of the prominent models on technology acceptance (e.g., TAM: perceived ease of use, Davis, 1985; UTAUT: effort expectancy, Venkatesh et al., 2003) and has been found to be a crucial determinant of positive attitudes towards technology (e.g., Venkatesh, 2000; Zhao et al., 2008). Research indicates that the most effective way to increase self-efficacy beliefs is to let people actively perform the designated behavior (here, use the new technology)—which generates a so-called *enactive mastery experience* (Bandura, 1977; Billiny, 2019). Prior work in white-collar contexts (e.g., education, health and social sector) found that an enactive mastery experience enhances self-efficacy in general (e.g., Ashford et al., 2010; Beatson et al., 2018; Reubsaet et al., 2003), technology-related self-efficacy (e.g., Faseyitan et al., 1996; Kim, 2005) and a positive technology evaluation (e.g., perceived usefulness and perceived ease of use; Luse et al., 2013). However, studies examining enactive mastery experience in the blue-collar context is missing. Furthermore, these studies did not test for self-efficacy as a mediator (for an exception, see Reubsaet et al., 2003).

Going beyond, the current dissertation targets the effectiveness of enactive mastery experience in the blue-collar context, comparing it to an alternative (a vicarious experience) in improving workers' attitudes towards new technology. Additionally, to shed light into the underlying psychological mechanism of enactive mastery, self-efficacy in using the technology serves as potential mediator. Taken together, by investigating these two interventions, the current dissertation seeks to contribute to the knowledge about successful (simple and easy-to-be implemented) interventions to introduce new technologies in blue-collar work.

The Current Dissertation

The current dissertation investigates how digital technology can be successfully implemented in blue-collar work. More specifically, the current research seeks to improve *attitudes* towards new technology in blue-collar work, thereby focusing on three important indicators of attitudes within this context—namely (1) *technology enthusiasm*, (2) *resistance to change* and (3) *technology-based job insecurity*, the former representing a central proximal indicator of positive attitudes in blue-collar work, whereas the two latter are more distal attitudes and potential obstacles in the technology implementation process in this work context.

As stated above, implementing new technology successfully represents a major challenge for organizations, as blue-collar workers often fear losing their jobs due to a new technology—and thus resist using it. To overcome this problem, it is essential to understand how to implement new technology successfully within this context; yet, research examining technology implementation in blue-collar work is scarce (e.g., Baruch et al., 2016; Liebermann et al., 2013). In line with this reasoning, research needs to identify (1) *predictors* of attitudes towards new technology, as well as (2) *interventions* on how to implement new technology and improve attitudes towards it (Venkatesh & Bala, 2008). The three empirical parts of this dissertation aim at addressing these issues by (1) investigating how actual and desired work characteristics relate to blue-collar workers' attitudes towards new technology and (2) testing the effectiveness of two interventions (i.e., implementation strategies) that seek to improve those attitudes. These research questions are addressed in the following three chapters.

Chapter 2 focuses on antecedents of blue-collar workers' attitudes towards new technology. More precisely, Study 1 investigates the relation between (both actual and desired) work characteristics (as they have been established in research on work motivation, starting with Hackman & Oldham, 1975), and workers' (general) attitudes towards new robotic technology at work. A correlational field study among blue-collar workers shows that work characteristics, indeed, are associated with attitudes towards new technology, whereas different work characteristics are differentially related to the three attitudes. This chapter, thus, sheds light into the motivational factors contributing to the formation of positive or negative attitudes towards new technology in blue-collar work.

Chapters 3 and 4 present and experimentally test two interventions that seek to improve attitudes towards new technology (i.e., increase technology enthusiasm, and reduce resistance to change as well as technology-based job insecurity). *Chapter 3* investigates the effect of *needs-oriented communication*—a communication strategy that illustrates a technology's benefits. A field experiment among blue-collars shows that needs-oriented communication, indeed, can improve attitudes towards new technology (i.e., increase technology enthusiasm) among employees perceiving low job demands (and thus feel capable to use the technology), but does not result in these positive effects among those who already perceive high job demands. *Chapter 4* examines the effect of *enactive mastery experience*—an intervention that aims to increase self-efficacy beliefs through hands-on experience with the technology. A field experiment with blue-collar workers supports the pre-registered hypothesis that an enactive mastery leads to higher technology enthusiasm as compared to a vicarious experience (that includes viewing another person engage with the technology), and that this effect can be explained by increased self-efficacy. Furthermore, enactive mastery also decreased resistance to change and technology-based job insecurity. Thus, Chapters 3 and 4 demonstrate that applying simple, yet effective interventions can contribute to a successful technology adoption in the important, yet under-researched field of blue-collar work.

Finally, *Chapter 5* includes the *General Discussion* of the empirical evidence presented in Chapters 2, 3 and 4. In this chapter, the findings are summarized and implications for technology adoption research, as well as future research directions are presented. Furthermore, strengths and limitations of the current findings are discussed. The chapter closes with a discussion about implications for practitioners' strategies to introduce new technologies.

Please note that the empirical Chapters 2, 3 and 4 are structured in a way that they can be read independently. As the predictions derived in the three chapters build upon similar theoretical assumptions, they may show some content overlap. Additionally, Chapters 2, 3 and 4 use the term “we” instead of “I” with regard to the authors, as the studies reported within these chapters were conducted in collaboration.

Declaration on the Proportion of Collaborative Publications for Chapter 2 (Hampel, Sassenberg, Scholl, & Reichenbach, 2021)

Author	Author position	Scientific Ideas %	Data generation %	Analysis & interpretation %	Paper writing %
Hampel, Nora	1	60	100	70	60
Sassenberg, Kai	2	30	0	25	25
Scholl, Annika	3	0	0	5	15
Reichenbach, Matthias	4	10	0	0	0
Title of paper:		Introducing digital technologies in the factory: Determinants of blue-collar workers' attitudes towards new robotic tools			
Status in publication process:		Published			

Chapter 2: Introducing Digital Technologies in the Factory: Determinants of Blue-Collar Workers' Attitudes Towards New Robotic Tools[1]

As part of the current digital transformation, new computer technologies and robotic applications are adopted in organizations at a rapid speed. Ensuring that employees are willing and motivated to use these new technologies at work is one of the most important strategic challenges in achieving organizational success (e.g., Tiersky, 2017). While the financial and strategic benefits of a new technology are apparent for the organization, employees often do not see the advantages in using it—as such new technology requires additional effort on their part by changing existing work processes, routines, structures, and roles (e.g., Brynjolfsson & Hitt, 2000; Kaiser, 2015; Tiersky, 2017). Thus, new technologies do not sell themselves and are not easily implemented. Often, employees are not motivated to use a new technology or even refuse it, especially *prior* to the actual implementation of a new system (Mahmud et al., 2017; Markus, 2004). This applies, in particular, to so-called blue-collar workers (i.e., workers carrying out manual labor, for instance, in production)—as they are often assumed to lose their jobs due to digital technologies (Ebrahim, 2018).

Notwithstanding, new intuitive interfaces might allow this group to expand their work activities and, thus, to enrich their jobs (e.g., Peissner & Hipp, 2013; Perzylo et al., 2016). To allow blue-collar workers and their employers to capitalize on this opportunity, it is essential to understand the *determinants* of blue-collar workers' attitudes towards a new technology at work. In doing so, the present work seeks to contribute to the knowledge about predictors of blue-collar workers' general willingness to accept new robotic technologies; to do so, we focused on their willingness *before* the implementation of a concrete digital technology was even started—in contrast to most prior research that focused on the acceptance of technologies during the implementation phase (for a summary see Venkatesh & Bala, 2008; see Hornbæk & Hertzum, 2017 for an exception). In other words, the current study aims to identify the correlates of blue-collar workers' attitudes towards new, to-be-introduced robotic technology.

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In this phase, attitudes towards the introduction of a new digital technology at work are likely be driven by the actual and/or desired *characteristics* of people's workplace, such as the extent to which workers perceive their job as demanding or would like to take on more demands. Indeed, there is initial evidence that actual work characteristics (and especially actual work demands) are related to technology-related outcomes, such as technology enthusiasm and user resistance to change, in technology other than robots (e.g., Kettenbohrer et al., 2015; Lee et al., 2009). Moreover, previous research found that the adoption of robots depends on individual factors (e.g., age; Taipale et al., 2015; prior experience; Savela et al., 2018; Turja & Oksanen, 2019; gender and education; De Graaf & Allouch, 2013; Turja & Oksanen, 2019). However, research linking robot adoption to work motivation is, to the best of our knowledge, missing. To address this gap, the present research studied the relation between (both perceived actual and desired) work characteristics (as established in research on work motivation; Hackman & Oldham, 1975) and workers' attitudes (e.g., enthusiasm) towards a new robotic technology at work.

Notably, prior work examining the role of work characteristics has mainly focused on white-collar work (e.g., Morgeson & Humphrey, 2006; Stansfeld et al., 2013; Wu et al., 2018; for exceptions see Hu et al., 2010; Huang, 2011); not much is known yet about their role in blue-collar work—as the latter represents a work field that is difficult to reach. To go beyond, the current study thus aimed at shedding light into the motivational factors that contribute to the formation of a positive or negative attitude towards new technology within the blue-collar work context.

Theoretical Background: Individual Attitudes Towards New Technology as Outcomes

Previous research on technology and especially robot adoption established three main dimensions of individual attitudes towards new technologies that likely foster robot adoption in blue-collar work (e.g., Fink et al., 1992; Hampel & Sassenberg, 2021; Peissner & Hipp, 2013; Schilperoort, 2019). These three dimensions will serve as main outcomes in the present work. First, new robotic systems that are easy to use and program might enthuse blue-collar workers (e.g., Peissner & Hipp, 2013; Perzylo et al., 2016). Accordingly, people's intrinsic motivation (i.e., *technology enthusiasm*) to use the new technology as the concept most closely related to this aspect should be included when studying workers' attitudes towards robotic technologies. Second, introducing new technology is often accompanied by the problem that users intend to prevent the implementation and use of new technologies, thus exhibiting *user resistance to change* (e.g., Kim & Kankanhalli, 2009). Third, the implementation of a new robotic technology might imply changes to blue-collar workers' current role and work habits, which workers cannot easily anticipate. As such, blue-collar workers often fear automation and the potentially associated loss of jobs (Ebrahim, 2018; Frey & Osborne, 2017; Manyika et al., 2013). Building upon this, *technology-based job insecurity* may represent a main hurdle to technology implementation in this work context.

Prior work mainly focused on proximal outcomes related to technology acceptance (e.g., perceived usefulness, perceived ease of use based on usage experience). To go beyond direct usage experience, the current research aimed at covering a broader conceptualization of individual attitudes towards new technology, thereby also taking plausible obstacles in the implementation process into account. To this end, we considered (1) *technology enthusiasm* (considered in the technology acceptance literature) as a proximal indicator of individual attitudes towards a to-be-introduced new technology, but also (2) *user resistance to change* as well as (3) *technology-based job insecurity* as more distal attitudes that represent plausible (broader) obstacles in the implementation process in blue-collar work. Accordingly, we targeted these three outcomes—as indicators of individual attitudes towards the new technology.[2] We now elaborate more on each of these outcomes.

Technology Enthusiasm

Technology enthusiasm can be defined as the general intrinsic motivation or joy to use new technology, apart from any performance consequences (Malone, 1981; Venkatesh, 2000). Many prominent and well-validated models on attitudes towards technology—here referred to as technology acceptance—distinguish between the effects of people's extrinsic and intrinsic motivation, respectively, on technology acceptance (Technology Acceptance Model 3, TAM3, Venkatesh & Bala, 2008; Motivational Model, MM, Davis et al., 1992; Model of PC Utilization, MPCU, Thompson et al., 1991). The system-dependent extrinsic motivational component (i.e., TAM3: perceived usefulness; MM: extrinsic motivation; MPCU: job-fit) describes the perceived usefulness of a *specific* technology for the context of use. It is, thus, not relevant for the motivation to adopt new technologies in the pre-implementation phase, as examined here—

[2] Notably, as the current study focuses on the pre-implementation period, other concepts related to individual attitudes (e.g., perceived usefulness, perceived ease of use of the new technology) could not be reliably assessed in this phase, as workers still lacked knowledge about the concrete features of the new technology.

because at that stage, workers do not know any details yet about the usefulness of the specific technology to-be-implemented.

In contrast, the system-independent intrinsic motivational *technology enthusiasm* (TAM3: computer playfulness, MM: intrinsic motivation, MPCU: affect towards use) is relevant in this phase. This concept reflects that people, in general, encounter technologies with interest or joy and perceive such technologies as an opportunity or challenge (Malone, 1981; Venkatesh, 2000). A substantial body of evidence illustrates the predictive validity of technology enthusiasm for users' higher behavioral intentions and actual usage (e.g., Agrifoglio et al. 2012; Moon & Kim, 2001). Technology enthusiasm is, thus, an important component of individual attitudes towards new technologies.

User Resistance to Change

Another line of research deals with the problem that users may intend to prevent the introduction and use of new technologies (and, thus, exhibit according behavior; e.g., Kim & Kankanhalli, 2009). Such *user resistance to change*, reflecting another individual attitude that the present research focuses on represents an adverse (Hirschheim & Newman, 1988) or opposing reaction towards new technology (Markus, 1983), and it often occurs while introducing a new technology (e.g., Laumer et al., 2016).

User resistance can manifest itself in a broad range of behaviors, such as sabotage (Day, 2000; Moreno, 1999), destructive behavior (Ferneley & Sobreperez, 2006), or denial (Kim & Kankanhalli, 2009), and is negatively related to system implementation success (e.g., Hong & Kim, 2002; Mahmud et al., 2017). Specifically, user resistance prior to the actual introduction of a technology is a critical aspect for the subsequent implementation success (Markus, 2004). Taken together, user resistance to change plays an important role in the implementation of a new technology—thus, we take it into account as a second component of individual attitudes towards new technology.

Technology-Based Job Insecurity

Another attitude component is the fear of losing one's job due to a new technology. Introducing digital technologies most likely causes changes in people's current job; thus, technological change may serve as a stressor and resemble a threat to job security and/or the further existence of one's current role or status (Ashforth & Lee, 1990), in particular among blue-collar workers. This so-called *technology-based job insecurity* defines a "powerlessness to maintain desired continuity in a threatened job situation" (Greenhalgh & Rosenblatt, 1984,

p. 438; applying the more general concept of job insecurity, e.g., Ashford et al., 1989, to the domain of introducing new technology).

Krovi (1993) suggests that especially systems characterized by efficiency (which is true for new technologies in production work) pose a threat to existing power structures and job security. Prior studies indicate that new technologies create a sense of loss of control and fear, as they endanger the psychological contract between employee and organization (e.g., by taking jobs away; Dau-Schmidt, 2014; Manyika, 2017) and, thus, promote role ambiguity (i.e., a lack of information on job requirements; Ayyagari et al., 2011; Keim et al., 2014). Job insecurity predicts lower job outcomes, such as organizational commitment and job satisfaction (Furaker & Berglund, 2014; Reisel et al., 2010). As such, we consider technology-based job insecurity as third aspect of individual attitudes towards new technology.

Determinants of Individual Attitudes in Blue-Collar Work

When do people show more positive attitudes towards the adoption of robots? Importantly, the adoption of robots is known to depend on individual and workplace-related factors (Turja & Oksanen, 2019). For example, with regard to the former, younger (e.g., Taipale et al., 2015), male, and higher educated individuals more likely adopt robots (De Graaf & Allouch, 2013; Turja & Oksanen, 2019). Perhaps the strongest predictor is knowledge about and experience with the technology at hand (i.e., to have a high robot user experience, e.g., Savela et al., 2018; Turja & Oksanen, 2019). Experiences of this type lead to the feeling of self-efficacy (i.e., the feeling of being competent to use the technology; e.g., Katz & Halpern, 2014). Regarding the latter, the point in time is also important: robots are accepted less in the pre-implementation phase than after implementation (e.g., Heerink, 2011; Louie et al., 2014; Nomura et al., 2006). We go beyond this prior work by investigating the role of people's *work characteristics* as predictors of their attitudes towards new technology (i.e., technology enthusiasm, user resistance to change, and technology-based job insecurity).

Work Characteristics as Determinants of Individual Attitudes

Which workplace-related factors might contribute to these three types of attitudes towards new technology? First, technology enthusiasm is—as indicated above— a specific instantiation of intrinsic motivation. Consequently, factors influencing intrinsic motivation might also affect technology enthusiasm. Especially the motivating aspects of the work itself, so-called *work characteristics*, have been found to increase intrinsic motivation by enriching people's work (e.g., Gagné et al., 1997; Gagné et al., 2015; Hackman & Oldham, 1975; Morgeson & Humphrey, 2006).

One of the most prominent models on (intrinsically motivating) work characteristics is the Job-Characteristics-Model (JCM, Hackman & Oldham, 1975). It postulates that five job characteristics lead to positive work outcomes (such as intrinsic motivation) through three psychological states (i.e., experienced meaningfulness of the work, experienced responsibility for work outcomes, and knowledge of results). These job characteristics are: (1) autonomy (i.e., the freedom and independence that a person has in doing the work), (2) skill variety (i.e., the degree to which a person needs to use various skills in the job), (3) task identity (i.e., the degree to which a person can complete a whole piece of work), (4) task significance (i.e., the extent to which the job has an important impact on others' lives) and (5) feedback from the job (i.e., the extent to which the job itself provides feedback on one's performance).

As the model still reflects the motivating aspects of many of today's workplaces, it is frequently used in current research (e.g., Carpenter et al., 2019; Rai & Maheshwari, 2020). Yet, the model has also been criticized regarding its dimensionality (e.g., Fried & Ferris, 1987; Kauffeld & Grote, 1999). Though the model assumes that the five job characteristics are distinct and independent, prior work found intercorrelations between the five job characteristics (e.g., Dunham, 1976; Fried & Ferris, 1986) and suggested that the number of dimensions can vary between occupational fields. The five-factor structure was replicated among management, staff, young and educated employees, but not among non-managers, older and lower-educated workers (Fried & Ferris, 1986)—for which less dimensions were found (i.e., two, three, or four). This indicates that the factor structure of job characteristics varies depending on situational, contextual, and personal aspects and thus should be adapted to the sample and context in focus. Over the years, the model has been extended by adding social (e.g., social support, interdependence), work-contextual (e.g., physical demands, work conditions), as well as knowledge-related characteristics (e.g., job complexity, information processing); accordingly, in addition to other enriching aspects, this model also considers the demanding aspects of work (i.e., work demands; Humphrey et al., 2007; Morgeson & Humphrey, 2006).

Applied to the present research, it is, thus, likely that these work characteristics serve as determinants of individual attitudes towards new technology; indeed, initial evidence showed that work characteristics (especially work demands) are related to technology-related outcomes (e.g., technology enthusiasm and user resistance to change; Kettenbohrer et al., 2015; Lee et al., 2009).

The Case of Blue-Collar Work: Considering (Actual vs. Ideal) Work Characteristics as Determinants

Notably, however, existing theorizing on the effects of work characteristics have mainly been developed for and studied within the context of white-collar work (e.g., Morgeson & Humphrey, 2006; Stansfeld et al., 2013; Wu et al., 2018; for exceptions see Hu et al., 2010; Huang, 2011). In contrast, blue-collar work (as we focus on) still provides special working conditions today (i.e., mainly physical instead of in the office) and is very different compared to white-collar work. Blue-collar workers, for instance, work on average on less complex tasks with a shorter cycle time and, often, lower qualifications are required for their work (compared to white-collar workers).

Do people who work under these conditions, then, desire different work characteristics? It remains to be tested whether these theories can be applied to blue-collar workers. For example, *task identity* may be important for intrinsic work motivation among white-collar workers (as research in this domain has shown) but might not matter that much in blue-collar work due to the less complex and less enriched work. In fact, there is initial evidence that the conceptualization of work characteristics by blue- and white-collar workers differ (Hu et al., 2010; Huang, 2011). Specifically, Hu et al. (2010) compared the conceptualization of various work aspects (e.g., co-workers, pay, and the work itself) and found that the conceptualization did differ; each of the examined work aspects comprised fewer dimensions among blue-collar workers (as compared to white-collar workers). Accordingly, white-collar workers seem to hold a more multidimensional and differentiated conceptualization of work characteristics than blue-collar workers. As such, work dimensions in blue-collar work as investigated here may likewise include fewer dimensions.

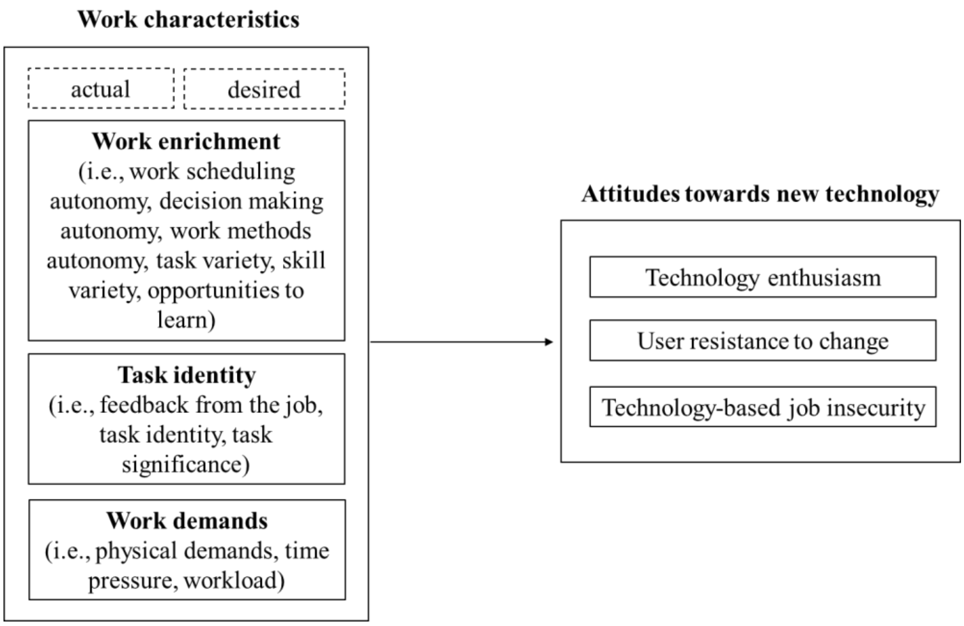
Moreover, we propose that focusing on the *actual* work characteristics that blue-collar workers perceive in their current job is not sufficient to understand their attitudes and work environment. Rather, it may be important to also take their level of aspiration into account—in other words, which characteristics they *desire* (or ideally want) to have at work. Self-Determination Theory (SDT; Deci & Ryan, 1985, 1991; Ryan & Deci, 2000) postulates that intrinsic motivation can be elicited only if people experience competence (besides autonomy and relatedness). Thus, a balance between actual work characteristics and workers' ability or aspiration is a precondition for intrinsic motivation. Similarly, other approaches suggest that employees hold more positive attitudes towards work and perform better, the more their actual work environment fits their aspirations (e.g., Cable & Edwards, 2004; Kristof-Brown et al., 2005). Applying this to the context of blue-collar workers means that—rather than (only) their actual work characteristics—both their actual *and* desired work characteristics should be considered (for a similar approach see Li et al., 2014).

The Proposed Research Model: How (Actual and Ideal) Work Characteristics Predict Individual Attitudes

In the current research, we therefore test whether blue-collar workers' attitudes towards new technologies depend on their actual and desired work characteristics (see Figure 2.1).

Figure 2.1

Conceptual Model of the Relation Between Actual and Desired Work Characteristics and Attitudes Towards New Technology (Study 1, N = 127)



Note: In the tested model, age, gender, and robot user experience were included as control variables.

How do actual and desired work characteristics as determinants relate to our outcomes (i.e., the three attitude dimensions)? First, research has shown that the attitudes towards a new technology depend on a person's readiness to invest capacities to get to know the new technology and especially robots (e.g., Parasuraman, 2000; Lin et al., 2007; Turja & Oksanen, 2019). For example, a higher readiness to use e-service technology was associated with a higher intention to use it (Lin et al., 2007). This readiness is reflected in the work characteristic willingness to accept high work demands, such as a high workload (i.e., high *desired work demands*). Thus, we expect that people who are more willing to face (desire more) demands at work have positive expectations about a new technology and, thus, might perceive it as a fun challenge to be mastered (i.e., exhibit a high technology enthusiasm). Therefore, we hypothesize:

Hypothesis 1: Desired work demands are positively related to technology enthusiasm.

Second, *technology-based job insecurity* results from the fact that new technologies threaten the contract between employee and organization, for instance, by taking jobs away (e.g., Dau-Schmidt, 2014). Along these lines, we expect that those employees who have a less complex job are particularly afraid of losing their work, because their work seems more easily replaceable (Frey & Osborne, 2017; Manyika, 2017). The more complex the job, the less likely it may be that the job will be replaced by new technology. A complex job is one that is enriched—for instance, with work characteristics like a high degree of autonomy, skill variety, and responsibility over complex tasks and activities (Choudhary, 2016; Lunenburg, 2011). Accordingly, blue-collar workers who currently hold an enriched job (i.e., showing the respective work characteristics) might evaluate new technologies less as a threat to their job. Thus, we expect:

Hypothesis 2: Enriching work characteristics are negatively related to technology-based job insecurity.

Third, *user resistance to change* is mainly dependent on the usefulness of the technology for the specific workplace. Also, contextual conditions relate to resistance to change (Lapointe & Rivard, 2005; Rivard & Lapointe, 2012). Given that there only exists a relatively limited body of research, we had a hard time to derive predictions regarding the dimension of attitudes towards technology. Therefore, we exploratively investigate the relation between work characteristics and user resistance.

Study 1

The present research sought to provide insights about the antecedents of attitudes towards new technologies among blue-collar workers in the pre-implementation phase. To do so, we examined how actual and desired work characteristics predict blue-collar workers' attitudes towards new technology at work—considering three key components of attitudes: technology enthusiasm, user resistance to change, and technology-based job insecurity. To examine this question, we first assessed a broad range of work characteristics and factor-analyzed them to contribute to the understanding of relevant dimensions of work characteristics among blue-collar workers. Then, we tested our predictions on how actual and desired work characteristics relate to attitudes towards new technologies. We included age, gender, and robot user experience as control variables to prevent that the predicted relation between work characteristics and individual attitudes is inflated by the role of these individual characteristics.

Methods

Participants

The study implemented a cross-sectional design and surveyed blue-collar workers within nine different manufacturing halls at four different sites of a multinational industrial corporation in Germany. There were no significant differences between responses at the four sites regarding work characteristics or attitudes towards new technology dimensions, all Fs < 2.7, all ps > .05. Data collection took place from March to May 2019. One-hundred and forty-six workers without any additional function (e.g., system manager, quality controller) voluntarily participated during their working time in their break room. They were recruited by their supervisors who were contacted via their organizational e-mail (response rate: 67%). Nineteen participants were excluded from data analysis reported below because they either did not complete the questionnaire (15 participants), did not speak German fluently (3 participants), or alternatingly marked the same numbers one after the other (1 and 5; 1 participant). The final sample consists of 127 participants (13 female, 114 male). An a-priori power analysis for multiple regressions with six predictors, $\alpha = .05$, $1\text{-}\beta = .80$, and $f^2 = .083$ (small-to-medium effect) for each predictor indicated a minimum sample size of $N = 97$. According to a sensitivity analyses with $\alpha = .05$, $1\text{-}\beta = .80$ the collected sample size of $N = 127$ is suitable to detect an effect size of $f^2 = .06$ with $\alpha = .05$, $1\text{-}\beta = .80$ – which is smaller than most effects reported below. Thus, the collected sample size should be sufficient to test for correlations based on statistical power.

Age was measured in four categories along with the guidelines of the organization's work council to ensure anonymity: 20% of the participants were 18 to 25 years old, 32% were between 26 and 35 years old, 33% were between 36 and 50 years old and 15% were 51 years and older. This distribution represents the age structure of employees in the metal and electrical industry in Germany quite well (German Statistical chamber, 2018): The three age groups from 18 to 50 years almost perfectly fit the age structure of the total population, whereas the oldest age group is slightly underrepresented. In sum, the recruited sample seems to reflect a relatively close representation of the total population in the factories. Six percent of the participants were working less than 3 years in the company, 25% between 3-5 years, 21% between 6-10 years, 32% between 11-25 years and 17% longer than 25 years. One percent had no educational degree, 31% had a lower secondary school diploma, 52% had a secondary school diploma, 13% had an either advanced technical college certificate or a general qualification for university entrance, and 2% indicated having any other educational degree.

Procedure

Participants were approached individually. One to six people filled in the paper-pencil questionnaire at a time while being seated at separate tables. The booklet started with an introductory text which informed participants that the study focused on production employees' perception of their work, that their participation in the study was voluntary, and that the data was anonymized after completing the questionnaire (about 150 words). Afterwards, the actual study started. The questionnaire included items regarding perceived actual and desired *work characteristics*, the *attitudes* towards new technology at work, and ended up with the assessment of *experience with robotic systems* and *sociodemographic variables*.

All items were in German and rated on a 1 (does not apply at all) to 5 (applies completely) point scale. To ensure that participants understood materials, all items were worded in easy language (with the online engine *languagetool*, see www.languagetool.org/de/leichte-sprache).

Measures

Actual and Desired Work Characteristics. Overall, 12 different work characteristics were assessed on five pages. *Work scheduling autonomy*, *decision making autonomy*, *work methods autonomy*, *task variety*, *task significance* (adapted to context), *task identity*, *feedback from the job*, *skill variety*, and *physical demands* were assessed with the Work Design Questionnaire (WDQ, Morgeson & Humphrey, 2006). The *opportunities to learn* items were adopted from the Questionnaire on the Experience and Evaluation of Work (QEEW, Van Veldhoven & Meijman, 1994), and the *time pressure* and *workload* items from the Quantitative Workload Inventory (QWI, Spector & Jex, 1998).

Items were aligned to the response scales but were not changed in meaning. For each work characteristic, participants completed an actual-target comparison item, first indicating how they *actually* perceive their work at the moment (actual work characteristic; actual WC; e.g., "My job allows me to plan how I do my work.") and then indicating how they *would like it* to be (desired work characteristic; desired WC; e.g., "I wish my job allowed me to plan how I do my work."; for a similar procedure, see Cable & Edwards, 2004). Sample items, the number of items per scale, and internal consistencies can be found in Appendix B (Table A1). Responses were averaged across items for each actual and desired work characteristic.

As the separate work characteristics were highly intercorrelated and the structure of work characteristics among blue-collar workers has not yet been established, we conducted an exploratory factor analysis (principal component analyses with varimax rotation) for actual WC and desired WC. The Kaiser-Guttman criterion (factors with eigenvalues > 1.0) and the Cattel method (factors with a substantially higher eigenvalue than the factor with the next highest eigenvalue) indicated that a three-factor solution would be appropriate for both analyses. The factor structure was highly similar for actual and desired WC. Scales were formed by computing means across the work characteristic indices loading on one factor. Factor 1 was called *work enrichment* (i.e., actual, $\omega = .90$; desired, $\omega = .90$), Factor 2 was named *work demands* (i.e., actual, $\omega = .80$; desired, $\omega = .71$), and Factor 3 was labeled *task identity* (i.e., actual, $\omega = .65$; desired, $\omega = .85$). An overview about which specific work characteristics were included in each of the three factors is presented in Appendix B (Table A2).

Attitudes Towards New Technology at Work. In order to assess attitudes towards new technology, a self-developed measure with 10 items adopted from previous research (i.e., Elias et al., 2012; Fleming & Artis, 2010; Kim & Kankanhalli, 2009; Venkatesh & Bala, 2008) was used. It included questions on our three attitude dimensions technology enthusiasm, user resistance to change, technology-based job insecurity (as there was no scale available assessing exactly what we aimed to assess). A list of all items used is included in Appendix C (Table A3).

To determine how to summarize the items into indices, we again conducted an exploratory factor analysis with varimax rotation using the Kaiser-Guttman criterion and the Cattel procedure to determine the number of factors. We excluded one item that had an ambiguous meaning and unexpected factor loadings. The results indicated that a three-component solution would be adequate. Factor 1 summarized 6 items assessing *technology enthusiasm* ($\omega = .84$), Factor 2 consisted of one item about *technology-based job insecurity*, and Factor 3 combined two items about *user resistance to change* ($r = .31$, $p < .001$). For the final factor structure and the associated items see Appendix C (Table A4).

Robot User Experience. We assessed experience in using robots as control variable following the approach applied in earlier research (e.g., Behringer & Sassenberg, 2015; Venkatesh et al., 2003). It was measured with one item ("*How do you rate your experience with robots?*", 1 = *no experience at all* to 5 = *a lot of experience*).

Data Analysis

All statistical analyses were conducted with the statistics program SPSS (version 25, SPSS Inc., 2003). To test our hypotheses, we conducted multiple regression analyses on the relevant attitude (i.e., technology enthusiasm, user resistance to change, or technology-based job insecurity) with desired WC (i.e., desired work enrichment, desired work demands, desired task identity, Hypothesis 1) or actual WC (i.e., actual work enrichment, actual work demands and actual task identity, Hypothesis 2) as predictors.

In every regression, we controlled for age, gender, and robot user experience. Robot user experience was included because it is known to assert a substantial influence on attitudes towards technology implementation (e.g., Behringer & Sassenberg, 2015; Venkatesh et al., 2003). Tests for the preconditions of multiple regression showed that kurtosis and skewedness were, except for one case (skewedness in the case of technology-based job insecurity: g_m = -0.466, *SE* = 0.215, p = .032), not significant (*p*s > .05). In addition, there was no evidence for multicollinearity or heteroscedasticity. Therefore, it seemed appropriate to us to compute multiple linear regressions. We identified four outliers based on cook's *D* and studentized deleted residuals. Excluding these cases did not substantially alter the results. Therefore, we report the analyses for the full sample. Results from the regressions with actual WC on technology enthusiasm, user resistance to change, and technology-based job insecurity can be found in Table 2.2, corresponding regressions with desired WC are depicted in Table 2.3.[3]

Results

Preliminary Analyses

Descriptive statistics and bivariate correlations between all variables included into the analysis below are presented in Table 2.1. The means of all variables are close to the midpoint of the scale with two exceptions: desired work enrichment and desired task identity. This suggests that participants are, on average, doing relatively monotonous jobs and see some potential to cope with job enrichment, which implies that they might enjoy the benefits of introducing new technologies.

Most predictors are not at all to moderately correlated. Only desired work enrichment and desired task identity are highly correlated. Given that both variables show differing correlations

[3] Results of all regression analysis do not change substantially neither when controlling for the other technology dimensions not examined in the respective regression nor when excluding outliers based on studentized residues (*N* = 4); hence, we do not discuss this control variable in more detail.

with the outcomes, it seemed justified to us to treat them as separate predictors in the subsequent analyses. Overall, the predictors can be considered as sufficiently distinct. Technology enthusiasm and technology-based job insecurity are correlated to some of the work characteristics, whereas user resistance to change is not.

Table 2.1

Descriptive Statistics and Intercorrelations for All Variables (Study 1, N = 127)

	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11
Controls													
1. Robot User Experience	3.09	1.13											
2. Age	2.43	0.98	.02										
3. Gender	1.90	0.30	.28**	.15									
Predictor Variables													
4. Actual Work Enrichment	2.35	0.90	-.10	.02	.05								
5. Actual Work Demands	3.64	0.88	-.09	-.02	-.07	-.29***							
6. Actual Task Identity	3.72	0.76	.06	-.06	-.17	.35***	-.11						
7. Desired Work Enrichment	4.10	0.69	-.04	.23**	.02	-.21*	.10	.13					
8. Desired Work Demands	2.39	0.75	.02	.11	-.05	.26**	-.28**	-.02	-.13				
9. Desired Task Identity	4.39	0.65	.07	-.16	-.09	-.16	.18*	.32***	.69***	-.13			
Outcome Variables													
10. Technology Enthusiasm	3.67	0.78	.29**	-.09	.18*	.17*	-.15	.07	.23**	.14	.11		
11. User Resistance to Change	2.33	0.85	-.16	.20*	-.07	.04	-.04	.00	-.03	-.09	-.05	-.39**	
12. Technology-Based Job Insecurity	3.54	1.19	-.04	-.02	.09	-.41***	.17	-.06	.11	-.17	.17	-.16	.02

Note: Age was coded as 1 = up to 25 years old, 2 = 26 to 35 years old, 3 = 36 to 50 years old and 4 = 51 years and older. Gender was coded as 1 = female and 2 = male. $^{*}p<.05$; $^{**}p<.01$; $^{***}p<.001$.

Hypotheses Testing

As expected, a multiple regression analysis on technology enthusiasm with the predictors desired work enrichment, desired work demands, and desired task identity yielded a significant negative relation of desired work demands and technology enthusiasm, *B* = 0.20, *SE* = .09, $t(116) = 2.20$, $p = .029$ (see Table 2.3). No other significant relation between actual or desired WC and technology enthusiasm was found, all $|t|$s < 1.9, *p*s > .07. This indicates that the more workers desired to have high work demands, the more enthusiasm they reported towards the new technology, thus supporting Hypothesis 1.

Furthermore, a multiple regression analysis on technology-based job insecurity with the predictors actual work enrichment, actual work demands, and actual task identity revealed that only actual work enrichment predicted technology-based job insecurity, *B* = -0.60, *SE* = .12, $t(116) = -4.81$, $p < .001$ (see Table 2.2). No other significant relation between actual or desired WC and technology-based job insecurity was found, all $|t|$s < 1.6, *p*s > .14. This means that the higher employees perceived their actual work enrichment, the less technology-based job insecurity the perceived. The results therefore also give support for Hypothesis 2.

Table 2.2

Regression Models on Actual Work Characteristics (Study 1, N = 127)

	Technology Enthusiasm			User Resistance to Change			Technology-Based Job Insecurity		
Predictor	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Age	-.11	.07	-.14	.19*	.08	.22	.04	.10	.04
Gender	.30	.23	.12	-.17	.26	-.06	.60	.34	.15
Robot User Experience	.17**	.06	.25**	-.12	.07	-.16	-.09	.09	-.08
Actual Work Enrichment	.12	.08	.14	-.03	.10	-.03	-.60***	.12	-.45***
Actual Work Demands	-.08	.08	-.09	-.07	.09	-.08	.07	.12	.05
Actual Task Identity	.01	.09	.01	-.02	.11	-.01	.18	.14	.11
R^2	.14			.08			.20		
Adjusted R^2	.10			.03			.16		
F(6, 117)	3.25**			1.62			4.95***		

Note: B = unstandardized regression coefficients. *SE* = standard error. *β* = standardized regression coefficients. **p*<.05; ***p*<.01; ****p*<.001.

Table 2.3

Regression Models on Desired Work Characteristics (Study 1, N = 127)

	Technology Enthusiasm			User Resistance to Change			Technology-Based Job Insecurity		
Predictor	*B*	*SE*	*β*	*B*	*SE*	*β*	*B*	*SE*	*β*
Age	-.03	.07	-.03	.20*	.08	.23*	-.04	.12	-.04
Gender	.41	.23	.16	-.26	.26	-.09	.41	.38	.11
Robot User Experience	.14*	.06	.20*	-.12	.07	-.16	-.07	.10	-.07
Desired Work Enrichment	.25	.14	.22	.19	.16	.15	-.07	.22	-.04
Desired Work Demands	.20*	.09	.19*	-.10	.10	-.09	-.21	.15	-.14
Desired Task Identity	-.01	.14	-.01	-.15	.16	-.11	.33	.23	.18
R^2	.17			.09			.06		
Adjusted R^2	.13			.04			.01		
$F(6, 117)$	3.97**			1.94			1.28		

Note: *B* = unstandardized regression coefficients. *SE* = standard error. *β* = standardized regression coefficients. $^*p<.05$; $^{**}p<.01$; $^{***}p<.001$.

Exploratory Analyses

In order to explore the effect of actual and desired WC on user resistance to change, we conducted parallel regression analysis with actual and desired WC for work enrichment, work demands, and task identity as predictors. Regressions yielded no significant relation between actual and desired WC with resistance to change, all $|t|$s < 1.3, ps > .23. This indicates that user resistance to change is independent of perceived actual as well as desired work enrichment, work demands, and task identity (see Tables 2.2 and 2.3).

We further explored whether one specific work characteristic (composed in the work demands and work enrichment factor) drives the relation between desired work demands and technology enthusiasm on the one hand, and actual work enrichment and technology-based job insecurity on the other hand. To this end, we conducted a multiple regression analysis with single desired work demands (i.e., physical demands, time pressure and workload) on technology enthusiasm. Only *desired workload* predicted technology enthusiasm, $B = 0.24$, $SE = .08$, $t(117) = 2.97$, $p = .004$, all other $|t|$s < 1.07, ps $> .25$. This indicates that technology enthusiasm correlates positively with the willingness to deal with a high workload, but not with physical strain or time pressure. Moreover, we conducted a multiple regression analysis with the single actual work enrichment scales (i.e., the three autonomy dimensions, task variety, skill variety, opportunities to learn) on technology-based job insecurity. Since multi-collinearity between the predictors was high (.28 < *tolerance* < .51), we summarized the three autonomy dimensions into one variable (autonomy), and the other three work characteristics into another variable. *Autonomy* stood out as the main predictor, $B = -0.38$, $SE = .14$, $t(118) = -2.84$, $p = .005$. This means that technology-based job insecurity is primarily related to the perception of a lack of (actual) autonomy.

Discussion of Chapter 2

The current research studied the relation between actual and desired work characteristics and attitudes towards new technology within the context of blue-collar work. We investigated three dimensions of attitudes towards new technology: Technology enthusiasm, user resistance to change, and technology-based job insecurity. The factor analysis suggested three dimensions of work characteristics in blue-collar work: *work enrichment* (including work scheduling autonomy, decision making autonomy, work methods autonomy, task variety, skill variety, and opportunities to learn), *work demands* (including physical demands, time pressure, and workload), and *task identity* (including task significance, task identity, and feedback from the job). In other words, the current study indicates that the 12 examined work characteristics—that are sought to be distinct and independent variables based on research in white-collar context—consisted of these three dimensions in (the present) blue-collar work context. Accordingly, in line with the findings from prior research (e.g. Fried & Ferris, 1986; Hu et al., 2010), the conceptualization of work characteristics here seemed to differ from white-collar work, such that it comprises fewer dimensions.

Importantly and in line with our predictions, the results suggest that work characteristics, indeed, are related to blue-collar workers' attitudes towards new technology. First, the higher the workers' willingness was to accept high *work demands* (especially a high workload), the more enthused they were by new technologies to-be-implemented at work. Second, the lower the degree of *work enrichment* (especially the degree of autonomy) workers experienced in their current job, the more fearful of losing their job because of new technologies they were. The results thus support our hypotheses. Finally, we found that user resistance to change was not related to work characteristics and, thus, seems to be independent of the evaluation of the current (or desired) work characteristics.

The findings of the study give insights about an important, so far understudied relationship between work characteristics on the one hand and attitudes towards new technology on the other hand. In line with previous research, we found that positive work outcomes, such as technology enthusiasm (which is a construct similar to intrinsic motivation), are positively related to the presence of high personal resources (here: the ability to cope with high demand, also: resilience, Van Wingerden et al., 2017). Thus, people being more willing to face demands seem to have positive expectations about a new technology and, thus, might perceive it as a challenge to be mastered (rather than a threat that they cannot cope with). This is in line with prior research indicating that a high level of personal resources is positively related to high work engagement in various work contexts (e.g., Bakker et al., 2007; Mache et al., 2014; Moon et al., 2013).

In addition, our results on technology-based job insecurity fit with research on general job insecurity, which indicates that employees with a lower education feel more insecure about their work (e.g., Moore et al., 2004; Keim et al., 2014). Moreover, research on automation has long argued that job replacement is a function of employees' skill levels (e.g., Acemoglu & Autor, 2011). Similarly, in accordance with our findings, research on industrial robots (Schwabe & Castellacci, 2020) showed that employees who fear losing their work due to robot automation in the future are less satisfied with their current work, and that this negative relation was driven by employees with low skills (i.e., those who perform routine-tasks and, thus, only perceive a low degree of work enrichment). A reason for this might be that they perform work or jobs that are more easily replaceable. They, thus, might not see many alternative options on the labor market and experience a greater threat to the psychological contract between the individual and the organization (Bellou, 2009; Näswall & De Witte, 2003). In line with this, previous research shows that the lower the individuals' skill level (and thus the higher the perceived threat to the current position), the less likely they are to use technology (e.g., Agyei & Voogt, 2011). Likewise, our results show that technology-based job insecurity depends on the subjectively experienced threat that a new technology can pose to the individual's current job position—as a function of the degrees of freedom an employee experiences in his or her current job (i.e., the amount of enrichment, especially of autonomy).

Contributions to Research on Attitudes Towards Technology and Blue-Collar Work

The findings go beyond existing research in two ways. First, to our knowledge, this is the first study linking work characteristics to attitudes towards new technology (and in particular robotic systems) that is yet to be implemented. The results of this research show that the evaluation of one's current work does predict attitudes towards new technologies, whereas different work characteristics are differentially related to these attitudes. Linking work motivation research to technology adoption research, thus, contributes to a better understanding of *why* the implementation of new technologies sometimes succeeds or fails.

Second, the present work has implications for the research on blue-collar work. Not much research has been conducted among blue-collar workers, as it is a sample that is difficult to reach. The findings of the current study give insights about this group of employees and their conceptualization of work. In addition, they shed light into the motivational factors contributing to the formation of positive or negative attitudes towards new technology within this work context.

Strengths, Limitations, and Future Avenues

An important strength of the current study is that it is of high external validity and has practical relevance—as it has been conducted within an organizational context and with the relevant target sample (i.e., blue-collar workers). This adds to our understanding of this group of employees. Nevertheless, one could argue that the reported findings are specific for the organization in focus. It has, however, long been argued that the fit between factors on the individual and organizational level is crucial for a successful implementation of new technologies (e.g., Trist, 1981; Pee & Min, 2017). Accordingly, the results of this study may not be directly transferable to other organizations. For this reason, in future research, the findings of this study should be examined in other organizations.

A limitation of the current study is its cross-sectional design that prevents drawing causal conclusions. To resolve this, future research should opt for a longitudinal design. Notably, however, conducting a longitudinal study in the field of technology implementation is very difficult to realize with an appropriate time interval between the decision to introduce a new technology and its actual introduction. As this study focused on the pre-implementation phase, this almost prevented us from conducting a study with a longitudinal research design.

In addition, our sample size was relatively small when considering generalizability. At the same time, data collection was carried out individually in our study and was, therefore, effortful. Our sensitivity analysis demonstrated that the sample size is sufficient to test for correlations with sufficient statistical power; notwithstanding, further studies should replicate the findings with a larger sample size. Furthermore, though the response rate among potential participants was relatively high (67%), we cannot rule-out that our sample is biased (e.g., pro-technology use). Thus, future studies should seek to implement a representative sample procedure.

Moreover, the self-developed scale assessing "attitudes towards new technology" has not been used in prior research. Although we conducted an exploratory factor analysis to determine how to summarize the items into indices, further research should replicate the factor structure from the current study. Additionally, one might raise concerns about the fact that we used single source measures, causing common-method bias. To counter this, we considered several aspects in the design of the survey (following the suggestions from Chang et al., 2010) that strengthens confidence in the findings. This included the order of questions, thereby assessing independent and dependent variables separately with other variables unrelated to the research questions in between. In addition, participants were made aware of their anonymity in the consent form, as well as the fact that there were no right or wrong answers, and that they should answer as honestly as possible. Still, further studies should replicate the findings including objective measures or data from other sources. We believe that the current study offers a good starting point for this. Finally, future research focusing on the period of actual technology implementation might consider other more proximal outcomes of technology acceptance (e.g., perceived usefulness, perceived ease of use) when studying the relation between work characteristics and technology adoption.

Implications for Practice

Moreover, the results have practical implications for technology implementers. Given that attitudes towards new technology fundamentally influence its successful implementation, it is essential for organizations to understand the determinants of employees' attitudes towards new technology. Insights about this topic allow for deriving suitable implementation programs and practices. Following this idea, our research provides decision-makers in the domain of technology implementation with a set of practical strategies that can help to increase the potential of new technologies.

First, the current research highlights the importance of considering *individual level factors* when introducing new technologies. Being able to identify employees who have a positive or negative attitude towards new technology (i.e., those who see new technology as challenge or threat) helps designing adequate implementation strategies. This can be valuable, for example, when choosing a pilot group or ambassadors (i.e., people who are chosen to interact with a technology first and who can then show the technology to others) for the implementation process. In this case, our data indicates that, among blue-collar workers, those employees who are willing to accept higher *work demands* (i.e., desired workload) are especially suitable.

Second, knowing which employees encounter a new technology with fear can help directly *addressing* these concerns within this group in the implementation process. Our findings indicate that, among blue-collar workers, especially those employees who currently do not experience much *enrichment* in their work exhibit high technology-based job insecurity. Thus, designing interventions that directly address these fears can help decrease negative expectations about a new technology prior to the actual introduction, and can help prevent possible obstacles in the actual implementation process.

Third, in including an *actual-desired comparison* of work characteristics, in line with previous research (e.g., Behringer & Sassenberg, 2015), our research shows that the current work situation and the individual (dis)satisfaction with it seems to be a crucial predictor of attitudes towards new technology. Often, new technologies provide advantages that can improve the employees' work situation. Employees might more likely form a positive attitude towards new technologies if they realize their benefits. Hence, technology implementers should clearly point to these benefits during technology introduction; for instance, with implementation material (e.g., introduction videos, note sheets for implementers) that conveys the technology's benefits for the employees' work (and the specific work aspects that are perceived as deficient). Likewise, this can involve conducting workshops with employees in which they elaborate the potential advantages of using the technology for their work themselves. To sum up, the present work sheds light into challenges that practitioners might encounter when introducing a new technology. The suggestions can support technology implementers in the successful introduction of new technologies in blue-collar work.

Conclusion

In conclusion, the present research contributes to the understanding of how individual perceptions and expectations of the current work (characteristics) translate into attitudes towards new technology among blue-collar workers. How workers evaluate their current work, prior to technology implementation, is related to their attitudes towards a new technology and, thus, serves as valuable information that can help guiding and tailoring effective technology implementation strategies.

Declaration on the Proportion of Collaborative Publications for Chapter 3 (Hampel & Sassenberg, 2021)

Author	Author position	Scientific Ideas %	Data generation %	Analysis & interpretation %	Paper writing %
Hampel, Nora	1	70	100	70	70
Sassenberg, Kai	2	30	0	30	30
Title of paper:		Needs-oriented communication results in positive attitudes towards robotic technologies among blue-collar workers perceiving low job demands			
Status in publication process:		Published			

Chapter 3: Needs-Oriented Communication Results in Positive Attitudes Towards Robotic Technologies Among Blue-Collar Workers Perceiving Low Job Demands[4]

The ability to adapt to constant change is crucial for organizational success in the time of digital change (Kaiser, 2015; Tiersky, 2017). Digital change is altering the distribution of tasks between people and innovative technologies. These changes will also affect the employees in production. The so-called blue-collar workers (i.e., workers performing mainly manual labor) are supposed to take on new tasks in working with new technologies (Kaiser, 2015). For example, they may learn how to program and use intuitive robot systems. The introduction of digital technologies employees have not worked with might increase the feeling of insecurity, among other things because blue-collar workers are supposed to be the first to lose their jobs through digital technologies (e.g., Ebrahim, 2018). It is thus not surprising that employees often do not embrace digital technologies with enthusiasm: They are not motivated to use them or even reject them (e.g. Kim & Kankanhalli, 2009; Laumer et al., 2016; Mahmud et al., 2017).

Nevertheless, as new digital technologies for production are often designed to be intuitive, they actually represent great opportunities for blue-collar workers (Bucher, 2017). They can make production jobs – which have hitherto been characterized by monotony and heavy physical labour – more pleasant and varied, and thus enrich their work by fulfilling employees' needs (e.g., Perzylo et al., 2016; Ramsauer, 2013). Research suggests that in order to improve the employees' attitudes towards a digital technology, they must realize the benefits of the digital technology for their job (e.g., Karaali et al., 2011). The communication of the benefits associated with the adoption of a digital technology has thus the potential to reduce the resistance to this change among workers and to increase their enthusiasm about the technology. Accordingly, applying the right communication strategy can be considered a game changer in the process of technology adoption.

Along these lines, the current work presents and tests a communication strategy that aims to speak to employees needs and thereby seeks to improve their attitudes towards a digital (robotic) technology among blue-collar workers prior to its implementation. Specifically, the

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strategy aimed to increase the enthusiasm to work with the new technology and reduce technology-based job insecurity and resistance to change. To do so, the communication stressed that the technology serves employees' work-related needs. In an experiment among blue-collar workers, we tested the effects of this needs-oriented communication. Thereby, the current research contributes to the knowledge about successful communication strategies for the introduction of digital technologies.

Relevant Attitudes Towards New Technology at Work

Based on previous research on technology implementation, there are three key dimensions of attitudes towards new technology that might substantially influence a successful adoption (especially in blue-collar work). We, thus, take these dimensions as potential outcomes into account. First, intuitive digital technologies offer the potential to enthuse blue-collar workers (Peissner & Hipp, 2013). Accordingly, the *enthusiasm to use the technology* should be investigated when studying technology adoption within this context. Second, introducing new technology in blue-collar work likely changes the current roles and work processes, and the associated consequences for blue-collar workers are often difficult to predict. Consequently, in the adoption period, blue-collar workers are often afraid to lose their jobs due to the new technology (e.g., Ebrahim, 2018). Accordingly, we suggest that *technology-based job insecurity* may be a main obstacle to successful technology adoption in blue-collar work. Third, another hurdles in the adoption period is that people often resist using the new technology and thus intent to prevent its implementation (e.g., Kim & Kankanhalli, 2009). This *resistance to change* represents the third dimension of attitudes towards new technology we take into account. Accordingly, we targeted these three outcomes in the current research.

Technology Enthusiasm

The first component, *technology enthusiasm* (also: perceived enjoyment; Davis et al., 1992; Venkatesh, 2000), represents the enjoyment or pleasure of using a technology and has been discussed in the technology acceptance literature (e.g., Davis et al., 1992; Heerink et al., 2008; Venkatesh, 2000). It is defined as the degree to which people enjoy using a technology itself, without the consideration of consequences related to technology usage (Davis et al., 1992). Hence, technology enthusiasm emphasizes the immediate satisfaction associated with technology usage. A significant body of research provides evidence for the predictive validity of technology enthusiasm for users' intention to use various forms of technology (e.g., Balog & Pribeanu, 2010; Park et al., 2014; Ramayah & Ignatius, 2005; Venkatesh, 2000; Venkatesh et al., 2012). In particular, technology enthusiasm has been found to be related to the acceptance of and intention to use robots (e.g., Heerink et al., 2010; Heerink et al., 2008; Park & Del Pobil, 2013). Thus, technology enthusiasm seems to be an important precondition for successful technology adoption. With the introduction of new intuitive robots in production that offer the potential to enthuse blue-collar workers, technology enthusiasm is likely to be a decisive aspect of attitudes towards new (robotic) technology in production.

Technology-Based Job Insecurity

Another line of research deals with employees' fear of losing their jobs due to the introduction of a new technology. Such *technology-based job insecurity* is defined as the powerlessness to maintain the desired status quo in a job-threatening situation (Greenhalgh & Rosenblatt, 1984); applying the more general concept of job insecurity to the field of technology adoption. Digital technologies may increase role ambiguity (Ayyagari et al., 2011; Keim et al., 2014) and pose a threat to the psychological contract between employees and companies (e.g., by eliminating jobs; Ashford et al., 1989; Dau-Schmidt, 2014; Manyika, 2017). Furthermore, as the introduction of a new technology is likely to cause changes to the current work, it may be seen as a threat to the further existence of the current status or role and job security (Ashforth & Lee, 1990; Lee et al., 2018).

This is particularly relevant in blue-collar work, as blue-collar workers are often assumed to be the first to lose their jobs due to a new technology (Ebrahim, 2018). Specifically in the adoption period, the consequences associated with the new technology are often difficult to predict and biasing assumptions and prejudices associated with the new technology may be prevalent. As a consequence, blue-collar workers are often afraid to lose their jobs due to the new technology (Ebrahim, 2018). Job insecurity negatively predicts key attitudinal outcomes, such as job satisfaction, organizational commitment (De Cuyper et al., 2009; Debus et al., 2012; Ito & Brotheridge 2007; Jiang & Probst, 2016), or work engagement (Park & Ono, 2017; Vander Elst et al., 2012). Since introducing robotic technology in blue-collar work is often discussed to be associated with job replacement (Ebrahim, 2018; Manyika, 2017), technology-based job insecurity is an important variable to be considered when studying technology adoption in this context.

Resistance to Change

The third attitude component deals with inhibitive usage. In extreme cases, people try to prevent the implementation or usage of a technology, often occurring in the adoption of new technologies (e.g. Laumer et al., 2016). This so-called *resistance to change* is defined as an adverse reaction (Hirschheim & Newman, 1988) or an opposition towards a new technology (Markus, 1983), based on which users may exhibit a corresponding behavior (e.g., Kim & Kankanhalli, 2009). More specifically, resistance to change has been found to be negatively associated with the intention to use a technology (e.g., Bhattacherjee & Hikmet, 2007) and successful technology implementation (e.g., Hong & Kim, 2002; Mahmud et al., 2017). Furthermore, resistance before technology implementation is a decisive factor for the later success of the project (Markus, 2004). Particularly, introducing new robotic technology in blue-collar work is often discussed to elicit resistance to change, as it is assumed to cause critical changes to the current work situation (e.g., Krovi, 1993; Rivard & Lapointe, 2012; Salvini et al., 2010). In sum, technology enthusiasm, technology-based job insecurity, and resistance to change play a critical role in the adoption of (robotic) technologies in blue-collar work, which is why we consider them as components of attitudes towards new technology.

Needs-Oriented Communication in Technology Adoption

We define *needs-oriented communication* as a communication strategy that stresses how a targeted object (here a digital technology) serves employees' *needs*. It, thus, emphasizes the benefits of the object targeted in the communication for the recipient. *Information-focused communication*, in contrast, merely presents facts about the target object. As needs-oriented communication additionally illustrates the target objects' benefits for the recipient, it should have positive effects regarding its evaluation as compared to information-focused communication.

In fact, previous research has shown that the fit between the communication content and the recipients' needs can lead to a more positive evaluation of the target object. Aaker and Lee (2001), for instance, found that the evaluation of a targeted object (here a commercial product) was more positive when the way information about it was presented (here stressing the fulfillment of eagerness vs. security needs) fitted the need a recipient was currently focusing on (i.e., eagerness in a so-called promotion focus and security in a so-called prevention focus). Moreover, research in the field of health communication has repeatedly shown that this type of fit increases the effectiveness of health communication and improves the attitudes towards health behaviors and interventions across different outcomes and domains (for overviews see Ludolph & Schulz, 2015; Sassenberg & Vliek, 2019). In line with this notion, when introducing a new technology, communicating how a technology serves employees needs should result in the formation of a positive attitude towards that technology.

Specifically, needs-oriented communication for introducing a digital technology at work should convey that the digital technology fits the recipient's *work-related needs*. In other words, the communication should focus on positive work characteristics (e.g., Hackman & Oldham, 1975; Morgeson & Humphrey, 2006) that resonate with employees needs and are thus motivating. The Job-Characteristics-Model (JCM, Hackman & Oldham, 1975) assumes that five work characteristics contribute to intrinsic work motivation and other positive work outcomes, because they resonate with employees' needs. These characteristics include autonomy, skill variety, task significance, task identity, and feedback from the job. This list of work characteristics has been extended over the years by adding work-context (e.g., ergonomics), social (e.g., social support) and knowledge characteristics (e.g., information processing; Humphrey et al., 2007; Morgeson & Humphrey, 2006).

A new technology might improve the workplace regarding these work characteristics. Thus, needs-oriented communication addresses the positive changes regarding work characteristics and stresses that employees could expect a higher fit between the work characteristics and their needs after the adoption of the technology. For example, if a new technology contributes to a higher degree of autonomy in the current job, needs-oriented communication emphasizes the change regarding this work characteristic need. In doing so, the recipient may realize the technology's benefits, and, as a result, form a more positive attitude towards the technology.

The Effect of Needs-Oriented Communication on the Three Attitude Dimensions

Which specific effects of needs-oriented communication can be expected for the three attitude dimensions examined? First, we suppose that needs-oriented communication influences *technology enthusiasm*, because it conveys the change towards work characteristics by the adoption of the technology that are known to elicit intrinsic motivation (e.g, Gagné et al., 1997; Gagné et al., 2015; Morgeson & Humphrey, 2006). Accordingly, needs-oriented communication should lead to an increased enthusiasm to use the technology.

Second, needs-oriented communication may also have an effect on *technology-based job insecurity* and *resistance to change*, as it may reduce the feeling of stress. As described above, new technologies might be perceived as a threat because of potential restructuring and streamlining caused by the new technology (Ashford et al., 1989). Hence, employees might be afraid to lose their jobs. Furthermore, employees may want to avoid the effort of getting to know a new technology as it represents a demand, and consequently, demonstrate resistance to change. The Job Demands Resources Model (JDR; Demerouti et al., 2001) suggests that people experience stress when the demands at work are high but their resources are low. Resources – such as work characteristics like autonomy and task variety (Van Emmerik et al., 2009) – can buffer stress resulting from high demands (Bakker et al., 2005).

In this sense, needs-oriented communication informing about changes in work characteristics fitting work-related needs might strengthen individual resources and serve as a stress buffer. As a result, employees might be less afraid of losing their job due to the new technology in the case of needs-oriented communication compared to information-focused communication. Moreover, as needs-oriented communication highlights the benefits of a technology to the employee, it may reduce the evaluation of effort required to learn the new technology. Consequently, needs-oriented communication might also lower resistance to change. Therefore, we hypothesize:

Hypothesis 1: Needs-oriented communication leads to higher technology enthusiasm, lower technology-based job insecurity and lower resistance to change as compared to information-focused communication.

Currently Perceived Work Characteristics as Moderators of Needs-Oriented Communication

As mentioned above, the adoption of a new technology provides the potential to change work characteristics in line with workers' needs, but it also represents a new demand for the employee (e.g. learning how to use the technology, changes in the current workflow; Carlson et al., 2017). Following the rationale of the JDR (Demerouti et al., 2001), the attitude towards the new technology should also depend on the evaluation of the individual's resources to cope with this new demand and thus on the assessment of the individual's perceived *self-efficacy* to use the new technology. In line with this reasoning, a large body of research on technology acceptance shows that the evaluation of a technology depends on the perceived self-efficacy to use it (e.g., Behringer & Sassenberg, 2015; Holden & Rada, 2011; Venkatesh, 2000).

As needs-oriented communication stresses the changes of the work characteristics resonating with workers' needs and, thus, positive side effects of the planned changes, workers' response might dependent on their perceived resources to implement such changes. Their current level of resources (i.e., the currently perceived work characteristics) might, thus, moderate the effect of needs-oriented communication on the attitudes towards new technology. In line with this notion, research has shown that the perception of the current work situation is decisive for the evaluation of organizational change (and that is what implementing a new technology is; Beckhard & Harris, 1987; Behringer & Sassenberg, 2015). Employees experiencing a high level of work demands, such as workload or time pressure, are for instance less open to change (e.g., Petrou & Demerouti, 2010). These people simply lack the resources to take on other tasks or to learn new skills required to adopt the new technology. As a result, they will not expect to benefit from the positive changes in work characteristics described in the need-oriented communication, even though the new work characteristics could in principle serve their needs. Thus, needs-oriented communication may only be effective for those employees who experience a low degree of current work demands, but not for those experiencing a high degree of work demands. Based on this, we also predict:

Hypothesis 2: The *currently perceived work demands* moderate the effect of needs-oriented communication on attitudes towards new technology (i.e., technology enthusiasm, technology-based job insecurity, and resistance to change).

Study 2

Taken together, the present research examined the effect of needs-oriented communication on attitudes towards new technology (i.e., technology enthusiasm, technology-based job insecurity, and resistance to change) in blue-collar workers. To do so, we exposed blue-collar workers to a video presenting a novel intuitive robotic technology for production, experimentally manipulating the mode of communication (i.e. needs-oriented versus information-focused). We expected that needs-oriented communication leads to a higher technology enthusiasm, a lower technology-based job insecurity, and a lower resistance to change as compared to information-focused communication (Hypothesis 1). Furthermore, we expected that the currently perceived work demands moderate the effect of needs-oriented communication on the three attitude dimensions examined (i.e., technology enthusiasm, technology-based job insecurity, and resistance to change; Hypothesis 2).

In a preliminary study with N = 127 blue-collar workers, we investigated the relation between work characteristics and various forms of motivation (i.e., extrinsic material, extrinsic social, introjected, identified, and intrinsic; based on Gagné et al., 2015) in blue-collar work.[5] Examined work characteristics included a large list of work characteristics relevant to the target group (based on Morgeson & Humphrey, 2006; Spector & Jex, 1998; and Van Veldhoven & Meijman, 1994). The results suggested that work characteristics in blue-collar work consist of three separate dimensions (in the following called *work characteristics needs*): (1) *work enrichment* (consisting of work scheduling autonomy, decision making autonomy, work methods autonomy, task variety, skill variety, and opportunities to learn), (2) *work demands* (consisting of physical demands, time pressure, and workload), and (3) *task identity* (consisting of task identity, feedback from the job, and task significance). We found that *work enrichment* was the most important predictor of intrinsic motivation. For this reason, we address this work characteristics need in needs-oriented communication.

Methods

Participants and Design

One-hundred and thirty-seven blue-collar workers (7 female, 119 male, 11 did not indicate their gender) within four different manufacturing sites of a multinational industrial corporation in Germany voluntarily participated in an experiment during their working time in their respective break room. They were recruited via their supervisors who were contacted via company e-mail. All participants indicated to speak German fluently – the language used in the presented materials. Age was measured in four age groups: 12% of the participants were 18 to 25 years old, 38% were between 26 and 35 years old, 42% were between 36 and 50 years old and 8% were 51 years and older. 26% had a lower secondary school diploma, 51% had a secondary school diploma, 23% had an either advanced technical college certificate, a general qualification for university entrance, or a university degree. Participants were randomly allocated to one of two communication conditions: needs-oriented (N = 68) vs. information-focused (N = 69).

Procedure

Participants were approached individually. Before the actual study started, participants were informed in the consent form that the study focused on the introduction of a new robotic system called lightweight robot, that their participation was voluntary, and that the data was anonymized right after they completed the questionnaire (about 160 words). After providing consent, participants completed a paper-pencil questionnaire assessing the three work

[5] The preliminary study has been conducted as part of Study 1 reported in the current dissertation.

characteristic needs identified in the preliminary study (i.e. *work enrichment*, *work demands*, and *task identity*; about 3-5 minutes). Then, they watched a video about the function and programming of an intuitive lightweight robot for screwdriving on a laptop (duration 5:19 min). In the video, the lightweight robot was first briefly introduced. Then, it was shown how the robot can be intuitively programmed via a touch interface for screwdriving by creating a new program and performing the three steps that need to be executed to set up a program (i.e. screwdriving, testing and releasing). The programming in the video was performed by a male, about 20-year old person. The visual information presented was the same in both conditions.

The spoken information included the *experimental manipulation*. It was either presented in a needs-oriented (796 words) or an information-focused version (664 words) and was spoken by a male, uninvolved speaker. The two text versions contained the same technical information, but differed in two ways. First, we found – as indicated above – in our preliminary study, that *work enrichment* (i.e., autonomy, task variety, skill variety and opportunities to learn) was most predictive of intrinsic motivation in blue-collar work. On that account, the needs-oriented version highlighted the benefits of the robot by using needs-oriented statements relevant to this work characteristics need. The information-focused version did not include such sentences. Second, the needs-oriented version addressed the participants personally using phrases like "*you'll get the possibility…*", whereas the information-focused did not use such wordings and used neutral wording (e.g., "one") when talking about employees. For the comparison of an exemplary text passage, see Table 3.1.

After watching the video, a second paper-pencil questionnaire included items regarding the attitudes towards new technology (i.e., *technology enthusiasm*, *resistance to change*, and *technology-based job insecurity*) and sociodemographic variables (about 5 minutes). Finally, participants were thanked for their participation.

All items were rated on a 1 (does not apply at all) to 5 (applies completely) point scale. To ensure that the participants understood the items linguistically, all items were worded in easy language (with the online engine *languagetool*, accessed on www.languagetool.org/de/leichte-sprache). Other variables assessed in the questionnaires, which were unrelated to the current research question can be found in Appendix G.

Table 3.1

Exemplary Text Passage for Needs-Oriented vs. Information-Focused Communication Regarding the Work Characteristics Need Task Variety (Study 2, N = 137)

Needs-Oriented Communication	Information-Focused Communication
To teach in the lightweight robot, ***you*** use a tablet. The easy handling ***provides everyone with the opportunity*** to train the robot for its use without any programming skills. ***You as a production employee get the chance to teach the robot yourself and to expand your field of activity.***	To teach the lightweight robot, a tablet ***is used***. The easy handling ***means that everyone*** can train the robot for its use without programming skills.

Measures

Work Characteristics Needs. Overall, three work characteristics needs (i.e., *work enrichment*, *work demands*, and *task identity*) were assessed. *Work enrichment* was assessed with one item each on work scheduling autonomy, decision making autonomy, work methods autonomy, task variety, skill variety, and opportunities to learn (e.g., "My job allows me to decide on the order in which things are done on the job."; α = .86) adapted from the Work Design Questionnaire (WDQ, Morgeson & Humphrey, 2006) and the Questionnaire on Experience and Evaluation of Work (QEEW, Van Veldhoven & Meijman, 1994). *Work demands* were assessed with one item each on *physical demands*, *time pressure*, and *workload* (e.g., "My job requires a lot of physical effort."; α = .69) adapted from the WDQ (Morgeson & Humphrey, 2006) and the Quantitative Workload Inventory (QWI, Spector & Jex, 1998). Finally, *task identity* was assessed with one item each on task identity, feedback from the job, and task significance (e.g., "My job is arranged so that I can do an entire piece of work from beginning to end."; α = .62), adapted from the WDQ (Morgeson & Humphrey, 2006).

Technology Enthusiasm. To assess technology enthusiasm, we used a self-developed measure with six items adopted from previous research (i.e. Fleming & Artis, 2010; Elias et al., 2012; Venkatesh & Bala, 2008; e.g., "The introduction of the robot makes my work much more interesting."; α = .82).

Resistance to Change. To assess resistance to change, two self-developed items based on Kim and Kankanhalli (2009) were used (e.g., "If the robot is introduced in production, I prefer to continue my usual activity without the robot."; r = .34, p < .001).

Technology-Based Job Insecurity. Three self-developed items were used to assess technology-based job insecurity (e.g., "The robot could replace me as a worker."; α = .85). Items were derived from previous research on job insecurity (i.e., Elias et al., 2012; Vander Elst et al., 2014). A list of all items on technology enthusiasm, resistance to change, and technology-based job insecurity can be found in Table 3.2.

Table 3.2

List of All Items on Technology Enthusiasm, Resistance to Change, and Technology-Based Job Insecurity (Study 2, N = 137)

Dependent Variable	Item
Technology Enthusiasm	I consider the robot for my work as an opportunity and not as a risk.
	If the robot is introduced into production, I want to use it for my work.
	When the robot is introduced into production, I am excited about technical progress.
	The introduction of the robot in production makes my work much more interesting.
	I enjoy getting to know the robot for my work.
	I enjoy learning how to use the robot for my work.
Resistance to Change	If the robot is introduced in production, I prefer to continue my usual activity without the robot.
	The robot makes my work more difficult than easier.
Technology-Based Job Insecurity	The robot could replace me as a worker.
	The introduction of the robot could make my current workplace superfluous.
	If the robot is introduced in production, it could take over my tasks.

Results

All statistical analyses were carried out with the statistics program SPSS (version 25, SPSS Inc., 2003). Descriptive statistics and bivariate correlations between all variables included into the analysis below are presented in Table 3.3.

Hypotheses Testing

We predicted that needs-oriented communication leads to higher technology enthusiasm, lower resistance to change, and lower technology-based job insecurity as compared to information-focused communication (Hypothesis 1). Two-sample *t*-tests showed no difference between the two conditions neither regarding technology enthusiasm ($M_{needs\text{-}oriented}$ = 4.06, *SD* = 0.76 vs. $M_{information\text{-}focused}$ = 3.87, *SD* = 0.83), $t(134) = -1.41$, $p = .16$, nor technology-based job insecurity ($M_{needs\text{-}oriented}$ = 3.23, *SD* = 1.22 vs. $M_{information\text{-}focused}$ = 2.99, *SD* = 1.40), $t(133) = -1.09$, $p = .278$, nor resistance to change ($M_{needs\text{-}oriented}$ = 2.10, *SD* = 0.86 vs. $M_{information\text{-}focused}$ = 2.20, *SD* = 1.01), $t(132) = 0.62$, $p = .535$. The results thus do not support Hypothesis 1.

Table 3.3

Descriptive Statistics and Intercorrelations for All Variables (Study 2, N = 137)

	Mean	*SD*	1	2	3	4	5
Predictor Variables							
1. Work Enrichment	3.03	1.02					
2. Work Demands	3.64	0.85	.02				
3. Task Identity	4.03	0.84	.22**	.15			
Outcome Variables							
4. Technology Enthusiasm	3.96	0.80	.15	-.04	.17*		
5. Resistance to Change	2.15	0.94	-.11	.09	.03	-.53***	
6. Technology-Based Job Insecurity	3.11	1.32	-.40***	.13	.09	-.20*	.26**

Note: *p<.05; **p<.01; ***p<.001.

We further predicted that work demands moderate the effect of needs-oriented communication on technology enthusiasm, technology-based job insecurity, and resistance to change (Hypothesis 2). To test this prediction, technology enthusiasm, technology-based job insecurity, and resistance to change were regressed on work demands, communication, and the interaction among the two. We also computed analog analyses for work enrichment and task identity for exploratory purposes (see Table 3.4).[6] Communication was effect-coded (information-focused = -1; needs-oriented = 1), all other variables were z-standardized. To dissolve significant interactions, we conducted simple slope analyses (Aiken & West, 1991).

Table 3.4

Standardized Coefficients from Multiple Regression Analyses of Technology Enthusiasm, Resistance to Change, and Technology-Based Job Insecurity on Communication, the Three Work Characteristics Needs (i.e., Work Enrichment, Work Demands, and Task Identity) and the Interactions of Communication and Work Characteristics Need (Study 2, N = 137)

Work Characteristics Need	Predictor	Technology Enthusiasm	Resistance to Change	Technology-Based Job Insecurity
Work Demands	Communication	.12	-.06	.09
	Need	-.06	.10	.14
	Communication × Need	-.20*	.08	.07
	R^2	.05	.02	.03
	Adjusted R^2	.03	.00	.01
	$F(3, 132)$	2.51	.76	1.37
Work Enrichment	Communication	0.12	-.06	.09
	Need	0.16	-.11	-.40***
	Communication × Need	0.01	.07	.08
	R^2	0.04	.02	.17
	Adjusted R^2	0.02	.00	.16
	$F(3, 133)$	1.80	.95	9.29***
Task Identity	Communication	.10	-.06	.08
	Need	.16	.04	.08
	Communication × Need	-.05	-.01	.20*
	R^2	.04	.01	.05
	Adjusted R^2	.02	-.02	.03
	$F(3, 133)$	1.89	.21	2.47

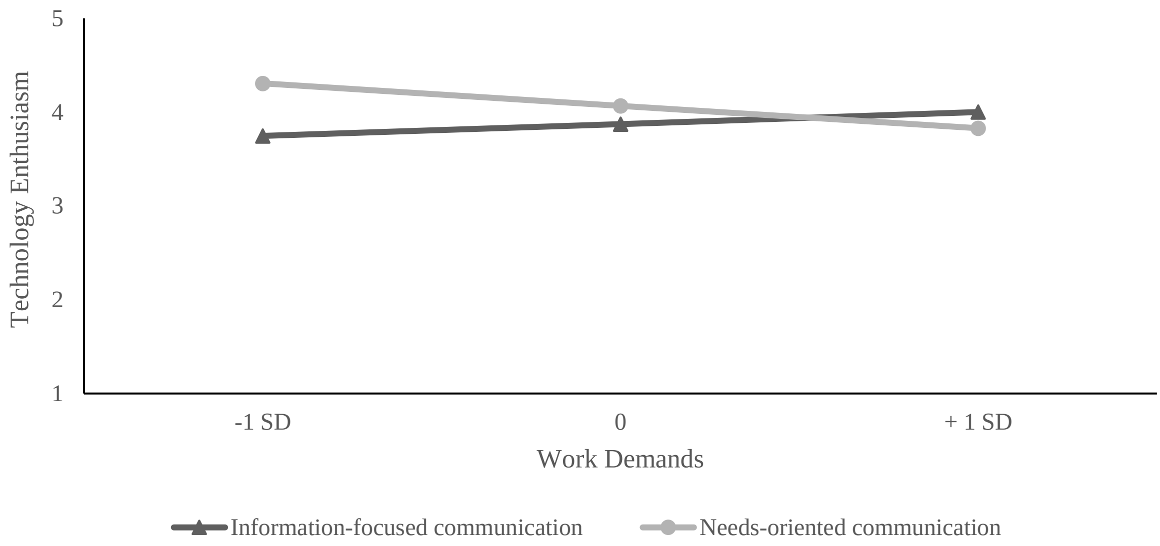
Note: *p<.05; **p<.01; ***p<.001.

[6] As the sample size in this study was too small in order to conduct one multiple regression analysis with all work characteristics needs together, we report the separate regression analyses for each work characteristics need. Nevertheless, when conducting this one multiple regression analysis, results do not change substantially.

Multiple regression analysis on *technology enthusiasm* with communication, work demands and its interaction as predictors yielded a significant interaction of work demands and communication, β = -.20, t(132) = -2.30, p = .023 (see Figure 3.1). For participants perceiving low work demands (1 *SD* below the mean), technology enthusiasm was higher with needs-oriented as compared to information-focused communication, β = -.26, t(132) = -2.04, p = .044, whereas no difference between the conditions was found for those perceiving high work demands (1 *SD* above the mean), β = .14, t(132) = 1.18, p = .241. In line with Hypothesis 2, needs orientation worked better for those perceiving low task demands and, thus, having capacity to take on new task rendering their work more need satisfying. No such effects where found for the other two attitude dimensions.

Figure 3.1

Effects of Communication and Work Demands on Technology Enthusiasm (Study 2, N = 137)



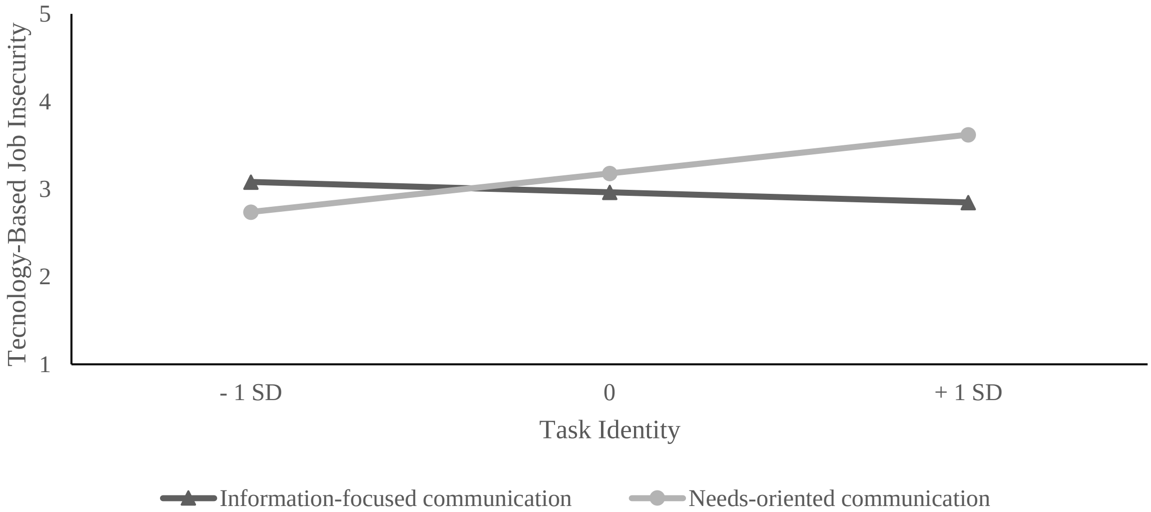
Exploratory Analysis

Multiple regression analysis on *technology-based job insecurity* with communication, work enrichment and its interaction as predictors showed that work enrichment predicted technology-based job insecurity, β = -.40, t(133) = -5.05, p < .001. This indicates that the greater workers perceived their current work enrichment to be, the less technology-based job insecurity they perceived. In other words, workers with more complex jobs perceived their job to be more save even after the new robots are introduced (independent of the communication). This is in line with the general idea that simpler jobs are easier automatized.

Furthermore, multiple regression analysis of technology-based job insecurity yielded a significant interaction between task identity and condition, $\beta = .20$, $t(133) = 2.31$, $p = .023$ (see Figure 3.2). For participants perceiving a high degree of task identity (1 *SD* above the mean), technology-based job insecurity was higher with needs-oriented as compared to information-focused communication, $\beta = .28$, $t(133) = 2.30$, $p = .023$. No difference between the conditions was found for those perceiving low task identity (1 *SD* below the mean), $\beta = -.11$, $t(133) = -0.94$, $p = .347$. This finding corresponds with the idea that workers having more capacity (here to do more complex tasks) benefit more from the needs-oriented communication.

Figure 3.2

Effects of Communication and Task Identity on Technology-Based Job Insecurity (Study 2, N = 137)



Discussion of Chapter 3

The current research examined the effect of needs-oriented communication on attitudes towards new technology (i.e., technology enthusiasm, technology-based job insecurity, and resistance to change) within the context of blue-collar work. The results did not support the hypothesis that needs-oriented communication leads to a general advantage regarding the three attitude dimensions. Thus, needs-oriented communication did not overall lead to higher technology enthusiasm, lower technology-based job insecurity, and a lower resistance to change as compared to information-focused communication. In contrast, we found that the effectiveness of needs-oriented communication depended on the currently perceived work characteristics. More precisely, needs-oriented communication led to higher technology enthusiasm when perceived work demands were low, but not when they were high. Moreover, needs-oriented communication increased technology-based job insecurity when the current task identity was high, but not when it was low. Therefore, the results suggest that resources available to incorporate the beneficial features of the new technology in one's work are crucial for the effectiveness of needs-oriented communication. Workers need to feel that they have the capacity, the time, or a task that allows for the changes of their job due to the technology, which than contributes to higher satisfaction of the work needs.

Accordingly, the finding that needs-oriented communication only led to higher technology enthusiasm when perceived work demands were low, can be explained by the emphasis on change and additional tasks caused by the technology in needs-oriented communication. Employees who were already working at full capacity may have had the feeling that the change brought about by the technology represents an additional demand they cannot master (i.e., had a low self-efficacy). As a result, they were less enthusiastic when exposed to needs-oriented communication. On the other hand, employees with currently fewer work demands might have perceived those changes as positive. They still had the resources to adapt to and the self-efficacy to learn to use the new technology. Consequently, they were enthusiastic when exposed to needs-oriented communication. Hence, the results suggest – as with organizational change in general (e.g., Petrou & Demerouti, 2010) – that employees experiencing a high level of work demands are less open to technological change as compared to those experiencing low work demands and therefore do not benefit from this change-focused way of communication. In contrast, perceptions of low work demands may lead to an increased tolerance for adopting new technology.

Similarly, needs-oriented communication increased technology-based job insecurity when perceived task identity was high. This is in line with the assumption that the effectiveness of needs-oriented communication depends on self-efficacy beliefs. Here, again, the emphasis on change in needs-oriented communication might have been additionally frightening for those employees already being satisfied with their current level of task identity and thus do not want any changes in their work caused by the new technology.

In summary, the findings of the current study indicate that needs-oriented communication is an effective tool to introduce new technology but only under certain conditions, namely for individuals who currently perceive low work demands, and thus feel competent to use the new technology. Therefore, although needs-oriented communication appears to be a promising tool for companies to implement new technologies, it did not have the expected positive effects on attitudes towards new technology across the board. The results even suggest that the use of needs-oriented communication can have negative consequences (e.g., when the current task identity is high).

Nevertheless, the findings of the current study go beyond existing research, as this research is the first to examine a communication strategy to improve attitudes towards new technologies. The present research identifies the conditions under which needs-oriented communication can influence attitudes towards new technologies. It thus provides the basis for its examination in further research.

Strengths, Limitations, and Future Avenues

A strength of the current research is that it is of high external validity as it took place within the context of interest (i.e., an organization) with the relevant target sample (i.e., blue-collar workers). The findings are thus of high practical relevance and can be transferred to other technology implementations in production. Nevertheless, it might be argued that the results of the current study are only valid for the specific organization and the specific technology in focus. In fact, the fit between individual and organizational factors is decisive for successful technology adoption (e.g., Pee & Min, 2017). Thus, the current findings may not be directly applicable to other organizational contexts and should therefore be replicated in other organizations and with other technologies. Even though the data was collected in an internationally operating company, we cannot exclude that the results are contingent to conditions that are specific for Germany at the time of the data collection (e.g., strong unions, low unemployment rate). Additionally, a high self-efficacy was a precondition for the effectiveness of needs-oriented communication. Thus, it is plausible that needs-oriented communication may especially be useful among white-collar workers. For this reason, future research should investigate needs-oriented communication also in the context of white-collar work.

A limitation of the current study is that we only tested one version of needs-oriented communication. Since this was the first study realizing and testing needs-oriented communication, we intended to check the fundamental effectiveness of this intervention. Nevertheless, this should be seen as a starting point for further research on needs-oriented communication. For example, there might be other ways to address the employees' needs. Therefore, future research should look at other manipulations to address needs with communication that might be more effective. Moreover, in our version of needs-oriented communication, we decided to include two different ways of addressing the employees' needs. Thus, one might argue that it is not clear which of these manipulations is the most important to influence attitudes towards new technology. For this reason, future research should more precisely delineate the manipulation of needs-oriented communication and its effect on the three attitude dimensions.

Furthermore, the sample size in the current study was relatively small. Notably, however, data collection took place individually and was, thus, effortful. Nevertheless, future research should replicate the findings of the current study indicating different patterns for the dependent variables with a larger sample size. Moreover, due to the sample procedure, we cannot exclude that the sample is biased (e.g. pro technology). Therefore, further research should aim at a representative sample procedure.

How could we make needs-oriented communication also effective for individuals who were not reached by needs-oriented communication in the current study? As the effectiveness of needs-oriented communication depended on the employees' self-efficacy beliefs regarding the technology (i.e., the level of perceived work characteristics), an attempt is to increase these self-efficacy beliefs. This could be realized by adapting the communication contents to the current work situation, for example by putting more emphasis on the technology's intuitiveness or ease of use.

Another option is to increase the employees' self-efficacy by allowing them to *actively interact* with the technology so they become aware of their competence to use it. Bandura (1986) already suggests in his social cognitive theory that actively performing a task during experiential training, so-called *enactive mastery*, increases self-efficacy most strongly. This type of experience is compared to a *vicarious experience*, meaning that one only views another person actively performing the task. Research in the context of technology acceptance supports this assumption. For example, it has been shown that enactive mastery led to a higher self-efficacy of using the technology as compared to vicarious experience efficacy and, consequently, increased technology acceptance (Luse et al., 2013). Future research could therefore seek to increase self-efficacy by combining communication with enactive mastery, testing whether this is beneficial regarding the three attitude dimensions examined (as compared to video only). In this way, the adoption of technology might also be successful for those individuals who were not reached with needs-oriented communication in the current study.

Implications for Practice

The findings have implications for practitioners. First, our research shows that communication is important when introducing new technologies in production. There is constant communication within the organization – be it via the intranet, newsletters or employee events (Mast, 2014). Aaker and Lee (2001) already found that communication influences attitudes towards products. The current research also demonstrated an effect of communication: Needs-oriented communication in relation to several needs influenced attitudes towards new technologies. The results show that communication can have both positive and negative effects. Hence, in practice, communication and its effects should be planned thoughtfully when implementing new technologies. Based on the results of the present study, it should be taken into account that employees with different levels of work characteristics (and consequently self-efficacy beliefs) receive the content. Our research suggests that this is particularly relevant for information within the production context: When communicating the introduction of a new technology, it should not be presented as an additional demand. Rather, one should emphasize the opportunities it entails.

Second, the present study shows that needs indeed have an impact on attitudes towards new technology and matter in the implementation process. Often, a new technology entails several benefits for the employees that can enhance the current work situation. The current research suggests that employees will more likely be enthused by a new technology by realizing its potential benefits. Therefore, these advantages should clearly be emphasized in the implementation process. This can also be realized, for example, by designing implementation material other than video (e.g., note sheets for implementers, social media posts) in a way that addresses the benefits of the new technology for the specific work context.

Third, the findings of the current research show that self-efficacy plays a major role in the formation of a positive attitude towards new technology. Thus, it should be part of a technology implementation in the organization to take specific actions to strengthen the self-efficacy of the employees regarding the new technology (e.g. with hands-on sessions, emphasis on intuitiveness of the technology, providing information of further training opportunities).

To sum up, the present work addresses potential challenges that technology implementers and organizations face when implementing new technologies. The propositions can help decision-makers and other technology implementers to manage the implementation of new technologies more successfully.

Conclusion

The current research demonstrates that needs-oriented communication can help improve attitudes towards new technologies (i.e., increase technology enthusiasm), but only when the current work demands are low. Thus, the results indicate that needs-oriented communication is effective for individuals who feel competent to use the technology (i.e., who have a high self-efficacy to use it). Future research should attempt to additionally address the self-efficacy of employees during the introduction of technology in order to make needs-oriented communication more generally effective. The findings of the present research provide a starting point for this.

Declaration on the Proportion of Collaborative Publications for Chapter 4 (Hampel, Sassenberg, & Scholl, 2021)

Author	Author position	Scientific Ideas %	Data generation %	Analysis & interpretation %	Paper writing %
Hampel, Nora	1	70	100	65	60
Sassenberg, Kai	2	30	0	25	25
Scholl, Annika	3	0	0	10	15
Title of paper:		Enactive mastery experience improves attitudes towards digital technology at work – A pre-registered experiment among blue-collar workers			
Status in publication process:		Submitted for publication			

Chapter 4: Enactive Mastery Experience Improves Attitudes Towards Digital Technology at Work – A Pre-Registered Experiment Among Blue-Collar Workers[7]

Work contexts in organizations become increasingly digitalized. New digital technologies provide enormous potential for organizations to ensure its competitiveness and success (e.g., Bleicher & Stanley, 2016; Giorcelli, 2019), enable better services, and augment employee performance (Parker & Grote, 2020). With regard to the latter, new technology can enrich employees' work—especially among employees in production, so-called blue-collar workers, who perform primarily manual labor. Using new technologies, these employees get for instance the chance to learn how to program and use intuitive robotic tools, expand their range of tasks and skills (an aspect that contributes to job satisfaction; Morrison et al., 2005), and hand over demanding tasks.

Notwithstanding, introducing new technology represents a major challenge for an organization, as it implies an organizational change that disrupts work procedures (Bankins et al., 2020; Kellogg et al., 2020). For such a change to be successful, employees need to adapt and be motivated to use the new technology (e.g., Pulakos et al., 2000). However, employees often have a rather *negative attitude* towards new technology—as they fear losing their jobs (e.g., Alcover et al., 2021) or do not want to spend effort to learn how to use it; these negative attitudes can lead employees to reject a new technology (e.g., Brynjolfsson & Hitt, 2000; Tiersky, 2017). To address this problem, research needs to identify adequate *interventions* on how to implement new technology and improve attitudes towards it (Venkatesh & Bala, 2008).

The current research followed this call. To this end, we compared the success of two interventions (i.e., implementation methods) in the domain of blue-collar work in an organization. Perceived self-efficacy in using technology is central in predicting positive attitudes towards it (e.g., Venkatesh, 2000; Zhao et al., 2008). We, thus, tested the impact of an intervention that should increase workers' self-efficacy beliefs. The most effective way to do so seems to be to let people actively perform the behavior in question (here, engage with the new technology)—which creates a so-called *enactive mastery experience* (Bandura, 1977; Billiny, 2019). We compared the effectiveness of this intervention with an alternative (a

[7] Paper submitted for publication as:
Hampel, N., Sassenberg, K., & Scholl, A. (2021). Enactive mastery experience improves attitudes towards digital technology at work – A pre-registered experiment among blue-collar workers.

vicarious experience) in improving blue-collar workers' attitudes towards a new robotic technology (i.e., their enthusiasm, resistance to change, and job insecurity). To shed light into the underlying psychological mechanism, we assessed robot-specific self-efficacy as mediator. Our hypothesis and data analysis plan were pre-registered.

By targeting this question, the present work extends prior research and contributes to the literature in several ways. First, prior work on enactive mastery focused on educational contexts, white-collar work (e.g., Faseyitan et al., 1996; Kim, 2005), and proximal outcomes (e.g., the perceived usefulness of a technology; Luse et al., 2013). Going beyond, we target blue-collar work and focus on more distal attitude outcomes in an organizational context, such as workers' resistance to change and job insecurity. Second, we contribute to knowledge on the important, yet under-researched field of blue-collar work (Baruch et al., 2016; Liebermann et al., 2013). This domain offers poorer working conditions (Karasek & Theorell, 1990) and is characterized by highly physically demanding tasks (Schreurs et al., 2011) that are often carried out in a very standardized manner (Nielsen & Abildgaard, 2012)—all of which a new technology may address in a positive (enriching and supportive) manner, yet while potentially (subjectively) threatening their job security. Accordingly, we especially target those employees whose work will very much be prone to change. Third, the current research tests a simple, yet potentially highly effective intervention for introducing change (i.e., new technology) in an organization (see also Demerouti et al., 2020). Fourth, by shedding light on the mediating mechanism (self-efficacy), the present research provides a crucial starting point to design further interventions to improve employees' attitudes towards change. Finally, we take an experimental approach (manipulating and comparing two interventions) that allows for conclusions about causality of the patterns we may find.

The Relevance of Self-efficacy for Attitudes Towards a New Technology

Self-efficacy represents a person's cognitive appraisal of his or her ability to perform specific actions (e.g., Bandura, 2006). Originating from Social Cognitive Theory (Bandura, 1977), self-efficacy is defined as a person's belief of being capable to create and accomplish an activity, or to produce a designated effect. Self-efficacy helps people to view difficult tasks as a challenge that can be mastered (e.g., Gibbs, 2009; Ozgen & Baron, 2007) and is especially important in face of a threat to (change of) the status quo (Bandura, 1983).

Self-efficacy is a multi-level construct. People's perceived efficacy of using a very specific technology or performing specific technology-related tasks has been labelled *technology-specific self-efficacy* (here: the self-efficacy to operate a specific robot; e.g., Agarwal et al., 2000; Hasan, 2006). Technology-specific self-efficacy is a more direct and stronger predictor of technology acceptance (than general technology self-efficacy or technology experience; Agarwal et al., 2000); we thus focus on the latter as a means to improve attitudes towards a change (i.e., new technology) in blue-collar work.

Enactive Mastery Experience as a Means to Increase Self-Efficacy

What are ways to increase technology-specific self-efficacy? One of the most crucial determinants is that users have had previous experience with said technology (e.g., Dabholkar & Sheng, 2009; Mariani et al., 2013; Ren, 2000). In this respect, Bandura (1977) stressed the importance of "richness" of the experience and distinguished between four sources: Potential ways to enhance self-efficacy are (1) to reduce physiological signs of anxiety (physiological state), (2) to verbally persuade people (verbal persuasion), (3) to let people observe others in succeeding or failing (vicarious experience), or (4) to let them actively perform a behavior via hands-on experience and succeed in it, promoting behavioral accomplishment (enactive mastery experience). Of these four, *enactive mastery experience* is supposed to be the most effective source in increasing self-efficacy, which in turn drives internal motivation (Bandura, 1977). We, thus, compared this enactive mastery experience (versus a vicarious experience) as an intervention to enhance workers' self-efficacy and, thereby, attitudes towards it.

Indeed, prior work in other contexts (e.g., in the health and social sector or in education) supported the beneficial effects of enactive mastery experience on self-efficacy in general (e.g., Ashford et al., 2010; Beatson et al., 2018; Reubsaet et al., 2003), on technology self-efficacy (e.g., for in-service programs; Faseyitan et al., 1996), and positive evaluations of the technology (e.g., perceived usefulness, ease of use of a virtual reality gaming software; Luse et al., 2013). As such, Savela et al. (2018) in their systematic review concluded that studies actually *exposing* participants to robots were more likely to result in positive attitudes than those introducing the robots only hypothetically.

In sum, these studies support the relevance of enactive mastery—but, they typically focused on the health and social sector, did not test self-efficacy beliefs as a mediator (for an exception, see Reubsaet et al., 2003), and targeted proximal outcomes (e.g., perceived usefulness). Going beyond, we targeted the effectiveness of this intervention in the context of blue-collar work (which is still very different from white-collar sectors; Hu et al., 2010; Huang, 2011) and on more distal *attitudes* towards the new technology (i.e., the change) that are known to guide subsequent behavior.

Attitudes Towards New Robotic Technology: Enthusiasm, Resistance to Change, and Job Insecurity

To address this gap, the present work examined the effect of enactive mastery (as compared to vicarious experience) on blue-collar workers' attitudes towards a new technology—namely, a robot. Doing so, we targeted three important indicators of attitudes: (1) first and foremost, we considered the concept most closely related to self-efficacy beliefs, namely workers' internal motivation to use the technology (*technology enthusiasm*); we also explored potential obstacles in the technology implementation process, namely, workers' (2) *resistance to change* and (3) job insecurity due to the new technology (*technology-based job insecurity*).

Technology enthusiasm is a person's (anticipated) pleasure to use a technology in its own right, without considering system-related performance consequences (Davis et al., 1992; Heerink et al., 2010; Venkatesh, 2000). In the technology adoption literature, this outcome is considered a major factor that predicts the acceptance and usage intention of robots (e.g., Heerink et al., 2008; Park & Del Pobil, 2013). As new intuitive robotic tools in blue-collar work are easy to use and program, they do provide the potential to enthuse the employees in production (Peissner & Hipp, 2013; Perzylo et al., 2016). Accordingly, we study this central indicator of attitudes towards a newly introduced (robotic) technology.

The second component, *resistance to change*, is a major obstacle to organizational change processes (Oreg, 2006) and represents a person's inhibiting opposition towards changes to the status quo (e.g., the introduction of a new technology; Bhattacherjee & Hikmet, 2007; Kim & Kankanhalli, 2009). In the specific case of introducing a new technology, resistance to change is likely based on the perception of *threat* to intra-organizational power structures (i.e., to the current role and status; Lapointe & Rivard, 2005; Marakas & Hornik, 1996) or insufficient personal resources to deal with the upcoming changes (Martinko et al., 1996). As a result, people display resisting responses or even try to prevent the implementation of a change (Laumer et al., 2016). Indeed, resistance to change predicts less technology implementation success (e.g., Hong & Kim, 2002; Mahmud et al., 2017). In particular, industrial machinery and robots may be met with resistance to change—as they likely produce fundamental changes to blue-collar work (Rivard & Lapointe, 2012; Salvini et al., 2010).

Third and finally, change due to new technology is often accompanied by employees' fear of being replaced and losing their job (or at least a great amount of their tasks). This concept of job insecurity (e.g., Ashford et al., 1989; Gallie et al., 2017; Nam, 2019) can also be transferred to the context of technology introduction, a reflected in employees' perceived *technology-based job insecurity*. It represents the feeling of being powerless to maintain a desired stability in a threatened workplace situation (Greenhalgh & Rosenblatt, 1984) because of a new technology. Job insecurity predicts lower work-related outcomes, such as performance (e.g., De Cuyper et al., 2014), organizational commitment, and job satisfaction (Mauno et al., 2005; Reisel et al., 2010). Technology-based job insecurity is particularly relevant in the introduction of robots in production—as workers here are often assumed to lose their work because of it (e.g., Ebrahim, 2018; Manyika et al., 2013). Taken together, we focus on these three components—technology enthusiasm, resistance to change, and technology-based job insecurity—as relevant attitude dimensions regarding the adoption of new technology in blue-collar work.

The Present Work: The Impact of Enactive Mastery on Self-Efficacy and Attitudes

Bringing these approaches and findings together, we assumed that introducing a new (non-social) robotic technology with an enactive mastery experience (compared to a vicarious experience, e.g., viewing a video) should, above all, lead to a higher *technology enthusiasm*—as the former elicits an experience that the person feels able to master the technology and provides an experience of control (i.e., increases technology-specific self-efficacy), which in turn should foster technology enthusiasm (i.e., his/her *internal* motivation to use it).

Hypothesis: Enactive mastery experience leads to higher technology enthusiasm as compared to vicarious experience. This effect is mediated by robot-specific self-efficacy.

Moreover, enactive mastery experience generates higher and more generalized self-efficacy beliefs than other experiences (Bandura, 1977; Lippke, 2017). Hence, when individuals get to know a new technology by means of enactive mastery experience, they might be less likely to rely on superficial evaluations of the technology (Savela et al., 2018) and perceive it less as a threat. Employees might then revise their fear that robots in production may take over their current jobs and, thus, exhibit lower *resistance to change* (for a similar argument see Armenakis

& Bedeian, 1999; Armenakis & Harris, 2002) and lower *technology-based job insecurity*. Nevertheless, since these two attitude dimensions are much more broadly defined and complex (i.e., represent more differentiated judgements that probably also take implications into account), it is unclear whether the rather small intervention implemented here does have an effect. Thus, we *exploratively* investigate the effect of enactive mastery on resistance to change and technology-based job insecurity.

Study 3

In an experiment in the field, we introduced a new technology (a non-social robot) to blue-collar workers, experimentally manipulating the *type of intervention* (vicarious experience vs. enactive mastery experience) and assessing robot-specific self-efficacy (as mediator) and attitudes (as outcomes). In the vicarious experience condition, participants watched a video tutorial about the robot and its functionality. In the enactive mastery condition, participants watched the same video tutorial and directly practiced the use of the robot by direct hands-on training. Following the example of earlier research (e.g., Reubsaet et al., 2003), we included robot experience as control variable (which should capture general experience in working with robots or training related to robot programming), because this should substantially affect people's self-efficacy on the specific robot target here. Importantly, we wanted to prevent that the predicted indirect effect is inflated by the correlation of chronic aspects of robot-related self-efficacy (captured by our mediator) and technology enthusiasm about the current robot. The hypothesis as well as methods (i.e., planned sample size, measures) and analysis strategy were pre-registered (see Appendix O). The study was approved by the local ethics committee. All participants provided informed consent.

Methods

Participants and Design

One-hundred and nine (7 female, 100 male, 2 did not indicate their gender) blue-collar workers of a multinational industrial corporation in Germany participated in an experiment during their working time on a voluntary basis. Participants were recruited through their supervisors who were approached via company e-mail. All participants indicated to speak German fluently—the language utilized in the study materials. Three participants were excluded from data analysis due to technical problems. The final sample consisted of $N = 106$ participants (7 female, 97 male, 2 did not indicate their gender). Age was assessed in four age groups: 9% of the participants were 18 to 25 years old, 26% were between 26 and 35 years old, 37% were between 36 and 50 years old and 28% were 51 years and older. 27% had no degree or a lower secondary school diploma, 58% had a secondary school diploma, and 11% had either an advanced technical college certificate, a general qualification for university entrance, or a university degree.

We implemented two (between-participants) intervention conditions. Given that in the *enactive mastery condition* (but not the vicarious experience condition), data collection required the availability of the robot, we preregistered and implemented a 1:1.7 ratio of the cell size (enactive mastery: vicarious experience). An a-priori power analysis for an independent sample *t*-test with α = .05, 1-β = .80, *d* = .65 (medium-to-large effect) and a 1:1.7 ratio indicated a minimum sample size of *N* = 82. In line with the planned ratio, we collected *N* = 39 in the enactive mastery and *N* = 67 in the vicarious experience condition. Based on this sample size, the data set is suitable to detect an effect of *d* = .57 with α = .05, 1-β = .80.

Data was collected in two different structurally similar manufacturing halls. As the robot was only available in one of the halls, random allocation to the experimental conditions was only realized in this hall. However, participants in both conditions were comparable based on collected work characteristics (i.e., work enrichment: $t(104) = -0.07$, $p = .938$; work demands: $t(103) = 0.28$, $p = .782$; task identity: $t(104) = 0.24$, $p = .811$), as well as robot experience, $t(103) = -1.07$, $p = .286$ (see Table 4.1), and demographic variables (i.e., gender: $\chi^2 = 0.092$, $p = .762$; education: $\chi^2 = 3.46$, $p = .177$; except for age: $\chi^2 = 11.16$, $p = .011$; see Table 4.2). All in all, this suggests that this procedural detail does not severely limit the interpretation of results.

Table 4.1

Means and Standard Deviations for Robot Experience and Perceived Work Characteristics per Condition (Study 3, N = 106)

	Vicarious Experience		Enactive Mastery	
	M	*SD*	*M*	*SD*
Robot Experience	3.60	0.87	3.77	0.69
Work Enrichment	2.91	0.93	2.92	0.81
Work Demands	4.10	0.71	4.06	0.77
Task Identity	4.17	0.69	4.14	0.90

Procedure

Data was collected in individual sessions. Before the start of the actual study, participants were informed that the study focused on the evaluation of an easy-to-program lightweight robot (model LBR iiwa, KUKA AG), and that the study included three parts: (1) a paper-pencil questionnaire, (2) the demonstration of the robot (either via video tutorial only or video tutorial plus operating the robot); and (3) the evaluation of the robot with a second paper-pencil questionnaire. Furthermore, they were informed that their participation was voluntary, and that the data was anonymized right after the completion of the questionnaire (about 170 words). After the participants provided consent, they completed the first questionnaire measuring *robot experience*.

Then, the experimental manipulation of intervention type followed: In the *vicarious experience* condition, participants watched a video tutorial showing the functioning and programming of the lightweight robot for screwdriving on a laptop (duration 5:19 min). The video tutorial briefly introduced the robot and showed how easily the robot could be programmed for screwing two screws: Via a touch interface, a new program had to be initiated. Then, three steps had to be followed to create a program (i.e., screwdriving, testing and releasing). In the video, a male, about 20-year old person executed the programming. In the *enactive mastery* condition, participants watched the same video tutorial, but additionally performed the robot programming by direct hands-on training. To do so, the tutorial was shown in six sections. After each section, the participant performed the respective step shown.

Afterwards, the second questionnaire informed participants that the robot could be used for other applications (e.g., handling, gluing) and included items on *technology enthusiasm*, *resistance to change*, *technology-based job insecurity*, *robot-specific self-efficacy* and sociodemographic variables. Finally, participants were thanked for their participation. Other variables measured in the questionnaires that were unrelated to the present research question (i.e., general job insecurity, perceived usefulness, perceived ease of use, intention to use) can be found in Appendix K.

Table 4.2

Absolute Frequency of Collected Demographic Variables per Condition (Study 3, N = 106).

	Gender		Age				Education		
	Male	Female	18-25	26-35	36-50	50+	Low	Me-dium	High
Vicarious	61 (59%)	4 (4%)	2 (2%)	15 (14%)	28 (26%)	22 (21%)	21 (20%)	38 (37%)	5 (5%)
Enactive	36 (35%)	3 (3%)	8 (8%)	12 (11%)	11 (10%)	8 (8%)	8 (8%)	24 (23%)	7 (7%)

Note: Percentages are given in brackets. Education was coded as low = no or lower secondary school diploma, medium = secondary school diploma, high = technical college certificate, general qualification for university entrance or university degree.

Measures

All items were rated on a 1 (does not apply at all) to 5 (applies completely) point scale. To make sure that participants understood the items linguistically, they were worded in easy language (with an online engine called *languagetool*, accessed on www.languagetool.org/de/leichte-sprache). Internal consistency coefficient ω was computed based on McDonald (1999), which has been argued to superior to Cronbach's α (e.g., Dunn et al., 2014).

Robot Experience as control was assessed with five items adapted from the Computer Attitude Scale (CAS; Loyd & Gressard, 1986; Subscale *Computer Confidence*; e.g., "I am sure I could do work with robots.", $\alpha = .81$; $\omega = .84$).

Robot-Specific Self-Efficacy. To assess our mediator, we adapted four items from the Computer Attitude Scale (CAS; Loyd & Gressard, 1986; Subscale *Computer Confidence*; e.g., "I am sure I could do work with the lightweight robot.", $\alpha = .90$; $\omega = .90$).

Technology Enthusiasm as indicator for internal motivation was assessed with six self-generated items adopted from previous research (Elias et al., 2012; Fleming & Artis, 2010; Venkatesh & Bala, 2008; e.g., "The introduction of these robots in production makes my work much more interesting."; $\alpha = .89$; $\omega = .90$).

Resistance to Change. We used two self-developed items based on Kim and Kankanhalli for this first exploratory outcome (2009; e.g., "If these robots are introduced in production, I prefer to continue my usual activity without the robot."; $r = .33, p < .01$).

Technology-Based Job Insecurity as second exploratory outcome was assessed with seven items adapted from previous job insecurity research (Elias et al., 2012; Vander Elst et al., 2014; e.g., "These robots might replace me as a worker."; α = .90; ω = .90). All items on the outcomes are presented in Appendix L (Table A7).

Additional Measures of Perceived Work Characteristics. We assessed three work characteristics (i.e., *work enrichment*, *work demands*, and *task identity*) based on previous research in blue-collar work (Hampel et al., 2021) at the beginning of the study to add details to the sample description (see above). To measure *work enrichment*, one item each on work scheduling autonomy, decision making autonomy, work methods autonomy, task variety, skill variety, and opportunities to learn was used (e.g., "My job allows me to decide on the order in which things are done on the job."; α = .79, ω = .79; adapted from the Work Design Questionnaire, Morgeson & Humphrey, 2006; and the Questionnaire on Experience and Evaluation of Work, Van Veldhoven & Meijman, 1994). *Work demands* were measured with one item each on physical demands, time pressure, and workload (e.g., "My job requires a lot of physical effort."; α = .67; ω = .67; adapted from Morgeson & Humphrey, 2006; and the Quantitative Workload Inventory, Spector & Jex, 1998). To assess *task identity*, one item each on task identity, feedback from the job, and task significance was used (e.g., "My job is arranged so that I can do an entire piece of work from beginning to end."; α = .62, ω = .63; again adapted from Morgeson & Humphrey, 2006).

Results

All statistical analyses were carried out with SPSS (version 25, SPSS Inc., 2003). Descriptive statistics and bivariate correlations between measures are presented in Table 4.3.

Hypothesis Testing

We predicted that participants in the enactive mastery condition will report higher technology enthusiasm as compared to participants in the vicarious experience condition, and that this effect is mediated by robot-specific self-efficacy. To test this main hypothesis, we planned and pre-registered a mediation analysis (Hayes, 2018; Model 4) including technology enthusiasm (outcome), intervention type (predictor), robot-specific self-efficacy (mediator), and robot experience (control variable).

As predicted, the total effect of intervention type on technology enthusiasm was significant, B = 0.35, SE = 0.17, p = .040, d = 0.45. In addition, we found the predicted indirect effect of intervention type on technology enthusiasm through robot-specific self-efficacy, *B* = .20, *SE*= .099, $CI_{95\%}$ [.0380; .4214]. In the enactive mastery condition, robot-specific self-efficacy was higher than in the vicarious experience condition, *B* = .34, *SE* = .14, *p* = .019, *d* = 0.55 (see Table 4.4). The relation between robot-specific self-efficacy and technology enthusiasm was significant, *B* = .60, *SE* = .10, *p* < .001, *d* = 1.43. (see Figure 4.1).

Table 4.3

Descriptive Statistics and Intercorrelations for Main Variables (Study 3, N = 106)

	Mean	*SD*	1	2	3	4
1. Robot Experience	3.66	0.81				
2. Robot-Specific Self-Efficacy	4.07	0.76	.35***			
3. Technology Enthusiasm	3.82	0.85	.17	.54***		
4. Resistance to Change	2.44	1.01	.04	-.25**	-.55***	
5. Technology-Based Job Insecurity	2.83	1.04	-.20*	-.22*	-.35***	.25*

Note: **p*<.05; ***p*<.01; ****p*<.001.

Exploratory Analysis

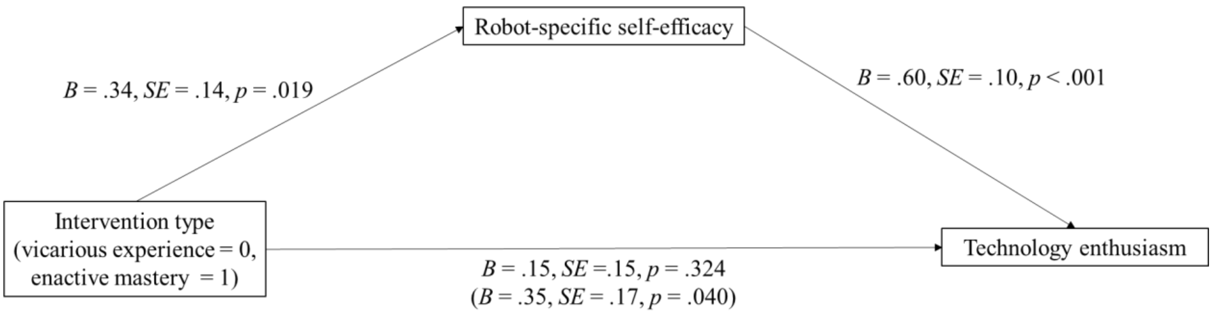
To explore the effects on resistance to change and technology-based job insecurity, we computed the same mediation analysis (Hayes, 2018; Model 4) for these two exploratory outcomes. For *resistance to change*, we found a total effect of intervention type, *B* = -.46, *SE* = .20, *p* = .026, *d* = 0.43, indicating that resistance to change was lower in the enactive mastery than in the vicarious experience condition (see Table 4.4). Furthermore, there was an indirect effect of intervention type on resistance to change through robot-specific self-efficacy, *B* = -.12, *SE*= .074, $CI_{95\%}$ [-.2960; -.0127]. The relation between robot-specific self-efficacy and resistance to change was significant, *B* = -.36, *SE* = .14, *p* = .010, *d* = 0.52 (see Figure 4.1).

Finally, *technology-based job insecurity* was lower in the enactive mastery than in the vicarious experience condition, *B* = -.11, *SE* = .21, *p* = 0.045, *d* = 0.17 (see Table 4.4), but there was no indirect effect via robot-specific self-efficacy, *B* = -.07, *SE*= .065, $CI_{95\%}$ [-.2146; .0372].

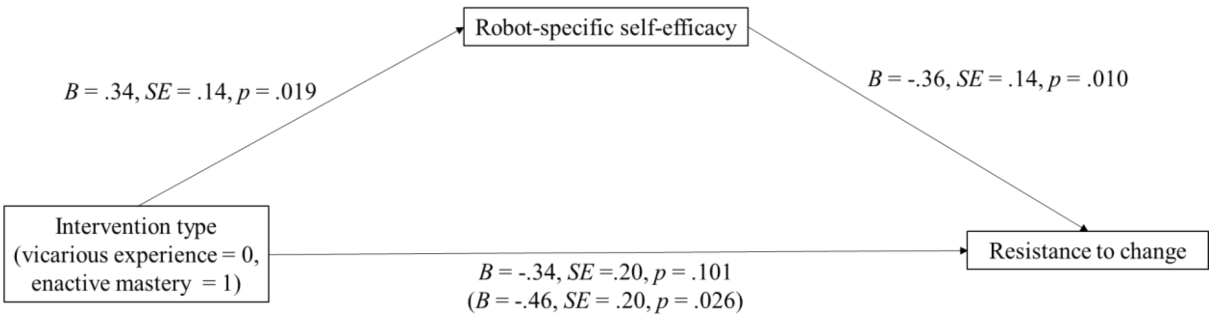
Figure 4.1

Path Diagram (with Regression Coefficients From Multiple Regression Analysis by PROCESS) of the Mediating Role of Robot-Specific Self-Efficacy Regarding the Impact of Intervention Type on (a) Technology Enthusiasm, (b) Resistance to Change, and (c) Technology-Based Job Insecurity and Robot Experience as Control Variable (Study 3, N = 106)

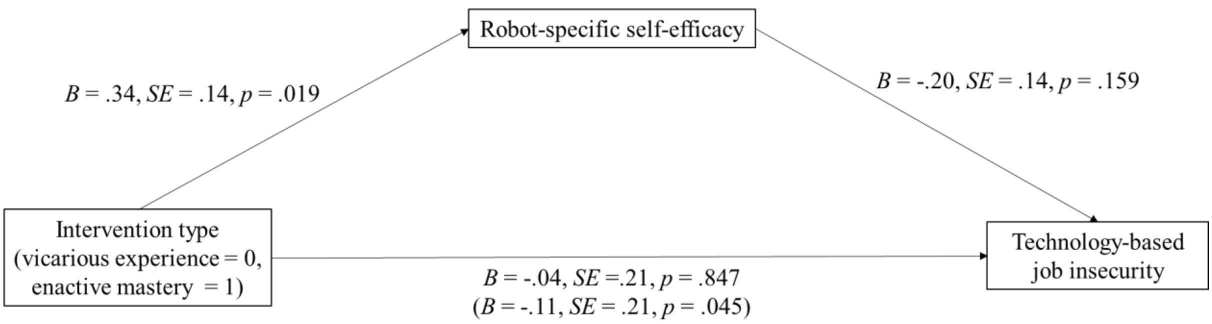
(a)



(b)



(c)



Note: The impact of intervention type on the outcomes without including robot-specific self-efficacy into the regression is given in brackets. Robot experience has been included as control variable into all analysis.

Table 4.4

Means and Standard Deviations of Robot-Specific Self-Efficacy, Technology Enthusiasm, Resistance to Change and Technology-Based Job Insecurity per Condition (Study 3, N = 106)

	Vicarious Experience		Enactive Mastery	
	M	*SD*	*M*	*SD*
Robot-Specific Self-Efficacy	3.93	0.79	4.33	0.62
Technology Enthusiasm	3.68	0.86	4.05	0.78
Resistance to Change	2.60	1.04	2.17	0.92
Technology-Based Job Insecurity	2.89	1.14	2.71	0.84

Discussion of Chapter 4

The current research compared the effectiveness of two types of intervention (implementation modes) of a new technology in an organization—namely, enactive mastery experience and vicarious experience—in improving attitudes. Supporting our pre-registered hypothesis, we found that enactive mastery experience led to higher *technology enthusiasm* (i.e., internal motivation to use it) than vicarious experience; this effect was mediated by higher (robot-specific) self-efficacy. Furthermore, we found that enactive mastery experience also decreased *resistance to change* through the same mechanism; and, it resulted in a lower *technology-based job insecurity* as compared to vicarious experience (not explained by robot-specific self-efficacy). The results demonstrate the effectiveness of this 'simple' intervention to introduce new technology in organizations and highlight the significance of self-efficacy in such change processes.

Specifically, the finding supporting our main hypothesis demonstrates that providing employees with a *real* experience with a new technology can make them realize that their personal resources are sufficient to master the technology. In more abstract terms, enactive mastery made employees recognize the *internally motivating value* (i.e., enthusiasm) associated with new technology and, thus, shifted the locus of causality to internal factors (for a similar argument see Venkatesh, 1999). By contrast, vicarious experience might have primarily highlighted the *extrinsic* value of the new technology (e.g., what a technology can do), with a locus of causality being rather external, thus not resulting in increased enthusiasm. This is particularly relevant in the blue-collar context, who may typically not feel capable of using the technology. In the short term, this enthusiasm can make employees more willing to actually use the new technology, and offers the potential for increased engagement and job satisfaction in the long term (Elias et al., 2012).

Importantly, our findings also suggest that enactive mastery reduces *resistance to change* by increasing self-efficacy. This suggests that when employees come to *recognize* that they are capable and have the necessary personal resources of using technology through hands-on experience, they will be less resistant towards it. One explanation for this is that the increase in self-efficacy might reduce the perception of a technology as a threat to one's position, which likely promotes attitudes towards embracing upcoming changes. As resistance to change has been supposed to be one of the most crucial factors for later project success (Markus, 2004), our results are highly informative—suggesting that enactive mastery can reduce such resistance and, thereby, likely contributes to successful implementation. This finding is valuable for blue-collar work, where resistance to technological change may be particularly high (Rivard & Lapointe, 2012; Salvini et al., 2010).

Furthermore, the finding that enactive mastery had a direct effect on *technology-based job insecurity* indicates that an enactive mastery experience can also reduce the fear of losing one's job because of the new technology. However, the effect of enactive mastery on technology-based job insecurity was not mediated by robot-specific self-efficacy. One reason for this could be that when employees get to know a technology with enactive mastery, they re-evaluate the characteristics and abilities of the *object*. More abstractly speaking, employees might rely less on the mere social representation of the technology (e.g., their prejudices and biases assumptions of robots taking over the current tasks or their jobs)—but they may rather adjust their expectations and realize that the robot will *not* be capable of replacing them. Indeed, a study indicated that introducing care robots only hypothetically made it difficult for care workers to assess the characteristics and capabilities of the robot (Fuji et al., 2011); this may be more effective, as our findings suggest, when introducing new technology via hands-on experience. Nevertheless, as technology-based job insecurity is lower with enactive mastery, the results suggest that enactive mastery can help reducing this fear.

Contribution to Existing Research

The question of how technology can successfully be implemented is important for organizations. Prior research, thus, called for the evaluation of different implementation methods (e.g., Venkatesh & Bala, 2008). The current research followed this call by examining the effect of two relatively simple interventions. In doing so, the present work goes beyond existing research in three ways.

First, previous studies indicated that enactive mastery helps improving the evaluation of technology presented for *voluntary* use (Luse et al., 2013; Savela et al., 2018). Going beyond this, we here focused on technology being introduced top-down in organizations. As such, the present research is, to the best of our knowledge, the first study investigating the effect of enactive mastery on attitudes in the context of blue-collar work. As the present study shows that this intervention improves attitudes even in this (more restrictive) context, it demonstrates that enactive mastery is also helpful in introducing technologies in work contexts where technology use is not voluntary, and employees likely have strong reasons to reject it.

Second, the present work contributes to an understanding of the underlying psychological *mechanism* of enactive mastery: Although assumed by social cognitive theory (Bandura, 1977), there is a lack of research testing for this mediating process (for an exception see Reubsaet et al., 2003), especially within the context of attitudes towards a new technology. The present work contributes useful insights about this by testing for a mediating role of self-efficacy, thereby showing that an increase in self-efficacy accounts for the positive effect of enactive mastery on attitudes towards new technology (i.e., technology enthusiasm and resistance to change). This provides an important starting point for potential other interventions targeting the acceptance of other measures of organizational change.

Finally, as explicitly called for in previous research (Luse et al., 2013), the current research covered a broader conceptualization of attitudes towards a new technology, thereby bringing together different approaches on attitudes towards technology and targeting outcomes (attitudes) that are known to directly link to subsequent behavior (Ajzen, 2012). As these attitudes constitute important aspects for the introduction of new technologies, these findings give valuable insights on the adoption of technology.

Strengths, Limitations, and Future Avenues

A strength of the present study is that was conducted within the relevant work context, investigating blue-collar workers and a real robotic technology introduced in the organization. Hence, the research is of high practical relevance and external validity. Furthermore, we implemented an experimental design, which allowed us to draw causal conclusions. Finally, the study was pre-registered before any data was collected and analyzed.

On the limitations side, one could argue that these aspects resulted in the fact that random allocation to the experimental conditions was only realized in one out of two halls. Still, as blue-collar workers are a sample difficult to reach and the technology studied is quite costly, we believe that the findings of the current work are valuable as they shed light into the knowledge about a population that has not been studied much in previous research. Furthermore, based on collected work characteristics and demographic variables, participants in both conditions were comparable; this suggests that procedural details do not limit the interpretation of results. Nevertheless, in order to rule out final doubts, further studies should opt to replicate our findings in blue-collar work (at best with a larger sample size). Additionally, in order to ensure generalizability, future research should investigate enactive mastery for technology implementation in other contexts and with other technologies.

Moreover, the current research investigated two types of experience (i.e., enactive mastery and vicarious experience) aiming to increase self-efficacy beliefs based on Social Cognitive Theory (Bandura, 1977). However, there are other types of experience that might influence these attitudes as well and that future work may target (e.g., interventions related to physiological state or verbal persuasion; Bandura, 1977).

Another approach to design enactive mastery interventions for the implementation of new technologies (or potentially other changes, such as adapted work procedures) might be to use virtual reality software. Further research could test if this rather indirect way of hands-on experience also has the potential to enhance attitudes towards new technology through enhanced self-efficacy. As prior studies on virtual reality software found that it can enhance self-efficacy beliefs in other contexts (e.g., education; Nissim & Weissblueth, 2017; medicine; Jung et al., 2012), this could resemble a promising approach especially for the pre-implementation phase in which the technology to be introduced is not (yet) available.

Implications for Practice

The current work also has implications for organizations, management, and practitioners. As introducing new technology is often difficult, it is decisive to know how to introduce them properly. Following this idea, our results provide practical strategies that can guide the implementation of new technology. Specifically, as robots in blue-collar work are adopted at rapid speed (e.g., Breitkopf, 2020), providing decision-makers with effective strategies for technology implementation is essential for the successful usage of the technology.

First, the current findings suggest that enactive mastery represents a powerful tool for introducing new technology (i.e., create change) in blue-collar work. Thus, practitioners may want to organize situations (e.g., workshops) in which the employee can experience the technology itself – rather than just showing a video about the new technology. This is especially interesting in the pre-implementation phase of technology introduction, where prejudices and biasing assumptions about the new technology are often present.

Second, our findings highlight the importance of technology-related self-efficacy in shaping attitudes towards new technology. Hence, activities that aim at enhancing self-efficacy beliefs in employees are crucial when introducing changes. This might be especially important in blue-collar work, as employees here may not have the necessary qualifications to operate robots and thus do not feel competent to do so. Consequently, one approach to foster successful technology implementation (especially in the context of blue-collar work) is to take concrete activities that aim at strengthening self-efficacy beliefs related to the introduced technology (e.g., providing detailed information about the technology and further training opportunities, or, if adequate, putting emphasis on the intuitiveness of the technology).

Conclusion

In times of digital change, interventions that help to ensure that employees have a positive attitude towards a new technology are crucial for organizational success. The current study demonstrates that using *enactive mastery* for the introduction of robots in blue-collar work can improve attitudes (i.e., more enthusiasm, less resistance to change, and less job insecurity), the former two by enhancing self-efficacy. Thereby, the present work contributes to our knowledge about how simple, easy-to-be implemented strategies (especially in blue-collar work) can contribute to the acceptance of new technologies and sheds light into the underlining psychological mechanism. Doing so, the results presented here can help both researchers and practitioners to better understand technology implementation in blue-collar work, and it offers a starting point for future research on this topic.

Chapter 5: General Discussion

The current dissertation investigated the research question how digital technology can be successfully implemented in blue-collar work. More specifically, the dissertation sought to improve attitudes towards new technology in blue-collar work, thereby considering three important indicators of attitudes within this context—technology enthusiasm, resistance to change, and technology-based job insecurity. To examine this question, the current dissertation (1) investigated how (actual and desired) work characteristics relate to blue-collar workers' attitudes towards new (robotic) technology and (2) tested the effectiveness of interventions (i.e., implementation strategies) that aimed to improve those attitudes. Thereby, the current work focused on the pre-implementation phase (that is, *before* the actual start of the implementation of technology)—in contrast to most prior research focusing on attitudes towards technology during or after the implementation phase (see Venkatesh & Bala, 2008 for a summary; and Hornbæk & Hertzum, 2017 for an exception).

The first empirical part, *Chapter 2*, examined (actual and desired) work characteristics as antecedents of blue-collar workers' attitudes towards new technology. The results of the study reported in this chapter demonstrated that work characteristics, indeed, correlate with blue-collar workers' attitudes towards new technology. First, desired work demands predicted greater technology enthusiasm. In other words, the more willing employees were to accept higher work demands (especially a higher workload) compared to their current work situation, the more enthused they were about new technologies. Second, a lack of perceived work enrichment was associated with greater technology-based job insecurity. Put differently, the lower employees current level of work enrichment (especially the level of autonomy), the greater was their fear of losing their job due to a new technology. Work characteristics did not predict resistance to change. In sum, the findings of this chapter illustrate the importance of considering employees' evaluation of their current work situation, as well as their (dis)satisfaction with it, as determinants of their attitude towards new technology at work.

The second empirical part, *Chapter 3*, investigated the effect of a needs-oriented communication (i.e., a communication strategy that conveyed how a digital technology can satisfy a recipient's needs) on blue-collar workers' attitudes towards new technology. The findings of the study reported in this chapter demonstrated that the effectiveness of needs-oriented communication depended on workers' perceived work characteristics. More specifically, needs-oriented communication did not improve attitudes towards a new technology among all employees. However, needs-oriented communication resulted in higher technology enthusiasm among workers experiencing low actual work demands (and who thus felt capable of using the technology), but not among those experiencing high work demands. Furthermore, needs-oriented communication led to higher technology-based job insecurity among employees perceiving high task identity, but not among those perceiving low task identity. In sum, the findings of Chapter 3 suggest that needs-oriented communication is an effective technology implementation strategy for employees with low perceived job demands and who hence feel to have the capacity to adopt a new technology and benefit from it.

The third empirical part, *Chapter 4*, compared two interventions, namely an enactive mastery versus a vicarious experience. The former (in which individuals actively engaged with the new technology) aimed to improve blue-collar workers' self-efficacy beliefs and, thereby, their attitudes towards a new technology. The findings reported in this chapter demonstrated that enactive mastery experience resulted in higher technology enthusiasm as compared to vicarious experience, explained by an increase in self-efficacy. Additional analyses revealed that enactive mastery experience also resulted in lower resistance to change and technology-based job insecurity (as compared to vicarious experience) through the same psychological mechanism for the former, but not for the latter. In sum, this chapter highlights the effectiveness of enactive mastery experience to implement new technology successfully and to motivate employees to use it. It also contributes to the knowledge about the underlying mechanism of enactive mastery (i.e., self-efficacy) in determining attitudes towards new technology.

In sum, the current dissertation emphasizes the central role of *motivational factors* (i.e., employees' work-related needs) as well as the significance of individuals' *self-efficacy beliefs* in the introduction of new technologies. Furthermore, the dissertation illustrates that applying "simple", yet effective interventions can contribute to successful technology adoption in the important, yet under-researched context of blue-collar work. In the following, implications of the current research for further technology adoption research, particularly regarding the central role of (1) *motivational factors* and (2) *self-efficacy beliefs* in determining attitudes towards new technology will be discussed. Afterwards, strengths and limitations of the empirical parts, as well as implications for practice will be outlined. Thereby, the first empirical study reported in Chapter 2 will be referred to as *Study 1*, the second empirical study reported in Chapter 3 as *Study 2*, and the third empirical study reported in Chapter 4 as *Study 3*.

Implications for Theory and Future Research Directions

Considering Motivational Factors in Technology Adoption Research

Linking Technology Adoption and Work Motivation Research

The current dissertation contributes to technology adoption research by focusing on aspects related to *work motivation*, an approach that has been widely neglected in prior research (Parker & Grote, 2020). First, Study 1 examined blue-collar workers' *needs* at work (i.e., *work characteristics*) as antecedents of their attitudes towards new technology. Thereby, Study 1 adds to an understanding of how blue-collar workers' perceptions and expectations about their work translate into their attitudes. Second, in Study 2, the motivating work characteristics identified in Study 1 provided the basis for the design of a needs-oriented communication, thereby illustrating the technology's benefits—and improving blue-collar workers' attitudes towards new technology. Thus, Study 2 goes beyond existing research by revealing that an implementation strategy focusing on employees' needs can contribute to successful technology implementation. In sum, both studies provide evidence for the importance of considering motivational aspects in technology adoption research. Linking work motivation and technology adoption research, thus, can contribute to a better understanding of why the adoption of digital technology succeeds or fails; and can provide a basis for further technology adoption research.

Specifically, the motivational approach applied in the current dissertation focused on individuals' preferences related to the *content* of motivation—their central motives, needs, and interests—in other words, the "*what*" that motivates a person. This approach allowed to assess and specifically address the dominant needs among the group of employees in focus. However, this approach does not give insights into the "*how"* of motivation; for instance, how motivation arises, how individuals decide to take specific actions in certain situations, how they pursue specific motivational goals, or how the results achieved in the process are evaluated—in other words, the *dynamics* of motivation (e.g., Nerdinger, 2014).

For this reason, an important avenue for future research is to take an alternative motivational approach to technology adoption by focusing on such dynamics and processes. A basis for this can provide Expectancy Theory (Vroom, 1964). It postulates that individuals might exhibit a certain behavior depending on (a) the *valence* of a potential outcome, (b) the *instrumentality* of performance for a particular (favorable or unfavorable) outcome, and (c) the *expectancy* that effort will lead to performance. Following the theory's rationale, employees should be motivated to use a new technology if they (a) think a high work performance is important (*valence*), (b) believe that using a new technology leads to increased work performance (*instrumentality*), and (c) are confident to have the capability to use the new technology (*expectancy*). Expectancy Theory has been mainly used to study technology adoption in white-collar contexts, with technologies other than robots, and regarding dependent variables other than those used in the present work (e.g., Behringer & Sassenberg, 2015; Hertel et al., 2003; Li, 2011; Snead & Harrell, 1994); however, research in the blue-collar context is scarce. In this vein, applying Expectancy Theory to technology adoption in blue-collar work could be a fruitful step for future research.

Notably, however, self-efficacy represents a component of (c) expectancy. In other words, if an individual thinks that he/she is capable of performing a behavior (e.g., using a technology), this will lead to an increased expectancy that effort will lead to performance (e.g., Locke et al., 1986). As the findings of the current dissertation show that self-efficacy is crucial in determining blue-collar workers' attitudes towards new technology, it provides support for the important role of *expectancy* in determining the evaluation of a new technology. Thus, future research may examine how other components of expectancy (such as having the required support and information to use the technology) or the two other components of Expectancy Theory (i.e., valence and instrumentality) contribute to technology adoption in blue-collar work. This could be done, for instance, by assessing these aspects as antecedents of blue-collar workers' attitudes examined in the current dissertation (i.e., technology enthusiasm, resistance to change, and technology-based job insecurity) or by addressing them in interventions, such as communication strategies.

Another motivational perspective is to examine how self-regulation strategies (i.e., means and mental operations applied to fulfill a need or reach a goal; Sassenberg & Vliek, 2019) and regulatory fit (i.e., the fit between self-regulation strategy and environmental circumstances; Higgins, 2000) contribute to technology adoption in blue-collar work. For example, regulatory focus theory (Higgins, 1998) suggests two motivational systems of self-regulation: Individuals in a *promotion focus* are motivated by growth needs and "ideal" states (i.e., hopes and aspirations), pursue their goals with eagerness, and are sensitive to gains and non-gains (i.e., the (non-) existence of positive outcomes). In contrast, individuals in *prevention focus* are motivated by safety needs and "ought" states (i.e., duties and obligations), pursue their goals with vigilance, and are sensitive to losses and non-losses (i.e., the (non-) existence of negative outcomes). These foci vary chronically (e.g., Higgins, 2000), but can also be activated situationally (e.g., by situational cues or the framing in terms of gains or losses; Lisjak et al., 2012)—and have been found to be important determinants of individuals' cognition, emotions and behavior in many fields of application (e.g., Sassenberg & Vliek, 2019).

Thus, research could examine how blue-collar workers' (chronic or situationally induced) regulatory focus relates to their attitudes towards new technology. For example, prior research has shown that a promotion focus is related to higher openness to change in general, whereas a prevention focus is related to a preference for stability (e.g., Grant & Higgins, 2003; Liberman et al., 1999). Accordingly, it is likely that blue-collar workers in a promotion focus (and who, thus, focus on growth and development) are more enthused about new technologies as compared to those in a prevention focus. On the other hand, blue-collar workers in a prevention focus (and who, thus, focus on safety and stability) might exhibit higher levels of resistance to change and technology-based job insecurity, which might be tested in future research.

Furthermore, considering regulatory focus may contribute to a better understanding of the relation between work characteristics and attitudes towards new technology identified in Study 1. Notably, regulatory focus has been found to moderate the relation between work characteristics and the evaluation of organizational change generally (Petrou & Demerouti, 2010). Thus, it is reasonable that incorporating regulatory focus as a moderator between work characteristics and attitudes towards new technology gives valuable insights into how technology implementation in blue-collar work can be facilitated, which remains to be investigated in future research.

Importantly, the fit between individuals' self-regulation strategy and the strategy they have to apply in a certain situation has been found to result in more positive experiences and outcomes, such as a higher effort or more positive attitudes (as compared to a non-fit; Higgins, 2000; Idson et al., 2004; Lee et al., 2010). Thus, introducing a new technology in a way that fits workers' regulatory focus can help to implement new technology successfully. For example, a communication framing technology usage as an effective way to learn new things and develop new skills will likely activate a promotion focus—and thus may lead to more positive attitudes among individuals with a chronic promotion focus; whereas a communication framing technology usage as an effective way to prevent job loss may activate a prevention focus—and thus will likely lead to more positive attitudes among individuals with a chronic prevention focus. Accordingly, considering the fit between employees' regulatory focus and the way a new technology is introduced may help to improve attitudes towards new technology and, thus, represents a fruitful approach for the design of interventions in further research.

Finally, a third motivational approach to technology adoption in blue-collar work is to consider reactance theory (Brehm, 1966; Brehm & Brehm, 1981). Reactance theory states that reactance occurs when individuals perceive a threat to their freedom, which puts them in “a motivational state directed toward the re-establishment of the threatened or eliminated freedom” (Brehm, 1966, p. 15f). As introducing a new technology is likely to be perceived as a threat to freedom especially in blue-collar work, it might lead to high levels of reactance within this context. Thus, future studies might test interventions that have been found to reduce or prevent reactance in other contexts. For instance, taking the perspective of the threating person (here, the technology implementer; Steindl & Jonas, 2012) or informing individuals early about a potential threat to their freedom (Richards & Banas, 2015) reduced reactance—strategies that future research may apply to and test within the context of technology adoption in blue-collar work.

Taken together, the current dissertation underlines the importance of taking a *motivational* perspective on technology adoption to maximize a new technology’s benefits. Therefore, further research might consider other motivational theories to better understand and design interventions to facilitate technology adoption in blue-collar work.

Addressing Needs in Technology Implementation Strategies

Although both the studies 1 and 2 provide support for the importance of considering motivational factors, there are also unexpected findings that can provide a basis for future studies. Particularly, the intervention *needs-oriented communication* investigated in Study 2 stressed that a new technology serves employees’ needs related to work enrichment. This manipulation was based on the findings obtained as part of Study 1, indicating that work characteristics associated with work enrichment (i.e., autonomy, task variety, skill variety, and opportunities to learn) were most predictive for intrinsic work motivation and work identification in blue-collar work. Building upon this, it was expected that addressing work enrichment would result in improved attitudes towards new technology (i.e., increased technology enthusiasm and decreased resistance to change and technology-based job insecurity). However, the findings of Study 2 revealed that needs-oriented communication did not improve attitudes among all workers, but only increased technology enthusiasm among those perceiving low job demands; indicating that the resources available to learn how to use the new technology determine the effectiveness of needs-oriented communication. Nevertheless, other plausible explanations referring to the manipulation of needs-oriented communication may account for these unexpected findings, and can provide a basis for further research.

First, needs-oriented communication aimed at tailoring the communication to workers' needs. However, it is possible that workers in Study 1 and 2 had different needs. Consequently, only communicating the satisfaction of work enrichment may not have addressed the workers' needs in Study 2. More precisely, if the individuals participated in Study 2 had no need for high work enrichment, communicating this particular need failed to help them understand the technology's benefits; and consequently, did not lead to increased technology enthusiasm overall. To overcome this issue, future research might jointly assess and address the workers' needs within one (longitudinal) study and thus with one sample. Furthermore, work enrichment was not associated with technology enthusiasm in neither of the two studies; but was related to other work characteristics (i.e., desired work demands). Thus, future research could adapt the communication to other needs and test whether this makes the intervention more generally effective.

Second, the needs statements might not have been understood correctly. In this regard, it is possible that the workers generally did not understand the items used in the study. Furthermore, it is reasonable that employees could not relate the needs statements used in Study 2 to their actual needs, as the wording of these needs statements did not exactly correspond to the wording of the items used to assess the employees' needs in Study 1. Therefore, future research should investigate needs-oriented communication using other needs statements; or align the wording of the needs statements with the items used in Study 1—making it unmistakably clear that the technology actually satisfies the (previously assessed) needs.

In summary, addressing employees' needs in technology implementation strategies (e.g., communication) represents a promising approach to improve their attitudes towards new technology. Nevertheless, future research should examine whether other manipulations of needs-oriented communication can make such implementation strategies more generally effective.

Considering Self-Efficacy in Technology Adoption Research

The empirical evidence obtained in the three studies also emphasize the importance of *self-efficacy* in the introduction of new technology. Specifically, Study 1 demonstrated that the level of employees' desired work demands determined how enthused they were about new technology; with a higher desire for high demands predicting a greater enthusiasm. Moreover, a lack of work enrichment predicted higher technology-based job insecurity. Likewise, Study 2 indicated that needs-oriented communication increased technology enthusiasm only among individuals with low perceived job demands. Thus, in combination, these results indicate that employees' perceived *capacity* to use new technology (determined by the level of current and desired work demands) influences their attitude towards a new technology. Furthermore, Study 3 showed that increasing individuals' self-efficacy beliefs through an enactive mastery experience improved attitudes towards new technology. Thus, if employees realize that they have the capacity use a new technology, they respond more positively to it. Notably, the robotic technology used in the studies was designed to be intuitive—thus, the employees should actually have had the ability to use it. However, for a positive attitude towards the new technology, it was decisive whether employees *perceived* themselves as capable of using it. Taken together, the sum of findings stress that workers' perceived capacity (i.e., *self-efficacy*) to use a technology (rather than their actual ability) is a decisive factor for successful technology adoption.

These findings fit into prior technology adoption research considering variables related to self-efficacy as important predictors in many prominent models on technology acceptance and usage (TAM: perceived ease of use, Davis, 1985; UTAUT: effort expectancy, Venkatesh et al., 2003); and indicating that self-efficacy is crucial in determining positive attitudes towards new technology (e.g., Venkatesh, 2000; Zhao et al., 2008). Nevertheless, as previous research mainly focused on voluntary use contexts and white-collar work, the current dissertation goes beyond by revealing that self-efficacy also has a major impact on attitudes towards new technology in the blue-collar context.

Additionally, Study 3 revealed that enactive mastery experience is an effective strategy to improve blue-collar workers' attitudes towards new technology through an increase in self-efficacy. These findings are in line with prior research demonstrating that enactive mastery is an effective means to increase self-efficacy beliefs (e.g., Beatson et al., 2018; Kim, 2005; Reubsaet et al., 2003) and the evaluation of technology (e.g., Luse et al., 2013). However, as prior studies focused on technology for voluntary usage and white-collar contexts (e.g., in the health, social or educational sector), the current work goes beyond by demonstrating that this intervention is also useful to introduce new technology in *mandatory* use contexts, in which workers have profound reasons to reject it.

In this regard, the current findings also contribute to research on organizational change. For example, Streich (1997) suggests that the emotional reactions to organizational change depend on individuals' perceived *ability* (i.e., self-efficacy) to deal with the changes and that actively engaging with the new approach *during* the actual implementation of the change is critical to increase self-efficacy beliefs. Hence, in accordance with the findings of Study 3, the model stresses the importance of hands-on experience with the new approach to increase self-efficacy and, in turn, the acceptance of change. Notably, however, Study 3 focused on the pre-implementation phase of technology adoption—and, hence, on the initiation phase of the technological change process—which suggests that engaging with the new approach in earlier stages of the change process can be valuable to improve individuals' evaluation of change. Thus, a fruitful step for future studies is to test the effectiveness of interventions targeting an enactive mastery experience in other (organizational) change contexts.

Furthermore, as the current findings stress the importance of self-efficacy in technology implementation, future technology adoption research may test other interventions targeting self-efficacy. For example, further studies could put more emphasize on self-efficacy in the design of communication to introduce new technology. This could be implemented in two ways: First, in case of intuitive technology, stressing the technology's intuitiveness and ease of use can help individuals understand that using the technology does not require high technological skills and consequently, that they are able to use it. Second—and probably more effective—communication strategies could aim at strengthening individuals' beliefs about their technological skills. This can be done, for instance, by making them think about situations in which they successfully used technology, by stressing the importance of self-efficacy, or by providing information about ways to increase self-efficacy (as these strategies have been found to be effective to increase self-efficacy in other contexts; e.g., Luszczynska et al., 2007). Thus, further research might examine if communication targeting these self-efficacy-related aspects can improve attitudes towards new technology.

Moreover, future studies could test whether interventions targeting self-control (a concept closely related to self-efficacy; Bandura, 1991), can improve attitudes towards new technology. Self-control training is an approach to promote self-directive skill development (Zimmerman, 2002) and has been found to be an effective tool to increase self-efficacy and to manage change in other contexts (e.g., educational or health context; Schnoll & Zimmerman, 2001; Paris & Paris, 2001; for an overview see Nerdinger, 2001). Self-control trainings includes, for example, objective self-assessment, goal setting, self-monitoring, self-affirmation, as well as maintenance or generalization of self-control to the work routine (Nerdinger, 2001). By that, individuals should learn to control their own behavior consciously and to motivate themselves;

which is why self-control training represents a promising approach to support technology implementation and, thus, remains a next step for future research.

In sum, the current dissertation underlines the importance of self-efficacy in the introduction of new technologies. Therefore, future technology adoption research should consider self-efficacy in the design of implementation strategies.

Further Dependent Variables

The current dissertation investigated three important indicators of attitudes towards new technology that are crucial in determining technology adoption in blue-collar work—namely, technology enthusiasm, resistance to change, and technology-based job insecurity. Doing so, the current dissertation combines research from (1) technology acceptance, (2) resistance to change, and (3) job insecurity literature. Thereby, technology enthusiasm represents a more proximal, positive attitude similar to constructs assessed in technology acceptance research (e.g., perceived usefulness, perceived ease of use); whereas resistance to change and technology-related job insecurity are two more distal attitudes that both represent possible obstacles in the implementation process. By that, the current dissertation adds to prior technology adoption research (that has mainly focused on proximal outcomes related to technology acceptance) by covering a broad range of attitudes that may be particularly relevant in mandatory use contexts, in which technology is implemented top-down.

Nevertheless, especially in other (voluntary) technology use contexts, it may be valuable to consider other dependent variables. For example, regarding the evaluation of a technology with longer and more comprehensive usage experience, future research could investigate the interventions examined in Study 2 and 3 by applying a more sophisticated model that includes outcomes from technology acceptance literature (e.g., perceived ease of use and perceived usefulness from the Technology Acceptance Model; Venkatesh & Davis, 1996). Furthermore, in voluntary use contexts, the behavioural intention to use a new technology might serve as a valuable outcome for further studies.

Additionally, future studies should choose their outcomes depending on the technology in focus. For instance, studies focusing on social technologies (such as social robots) or technologies that are based on artificial intelligence or machine learning might consider the more socially oriented variable trust as outcome. Trust in technology represents the willingness to depend on a technology in a situation with possibly negative consequences (McKnight et al., 2009)—and accordingly, might be especially relevant when individuals do not have full control or transparency over a technology (as it is the case with intelligent systems; e.g., Santoni de Sio & Van den Hoven, 2018; Schmidt et al., 2020).

Finally, as the outcomes (i.e., attitudes) investigated in the current dissertation represent rather cognitive or evaluative judgements about a new technology, future research might consider the emotional reactions towards it (i.e., how a user feels about or when using a new technology). Specifically, research has shown that individuals' negative emotions (e.g., fear or anger) as well as their positive emotions (e.g., happiness or excitement) are important determinants of information technology usage (e.g., Beaudry & Pinsonneault, 2010; Zheng & Montargot, 2021). Additionally, social emotions (e.g., pride, gratitude, shame, or envy) have been suggested to play a role in determining technology adoption behavior (Bagozzi, 2007). To this end, it may be valuable to examine the role of such emotions in determining technology adoption in blue-collar work, as well as the effect of the examined interventions on these affective outcomes.

Taken together, by focusing on outcomes that fit the context and the technology in focus, future research may get a more differentiated understanding of the effectiveness of the interventions investigated in the current dissertation. This can help to determine in which settings and under which circumstances the interventions have the designated effects.

Strengths and Limitations

A strength of the current research is that it links so far mostly unrelated lines of research. First, the current work combines technology adoption research and work motivation research, an approach that has been widely neglected in prior research (Parker & Grote, 2020). Doing so, the current dissertation revealed that work characteristics predict individuals' attitudes towards new technology (Study 1), and that addressing these work characteristics in communication can improve those attitudes (Study 2). Thus, in line with the Sociotechnical Systems Theory (Rice, 1958), the current research combines both the *technological* and the *individuals'* perspective on technology adoption—underlining that the joint optimalization of those perspectives is crucial to ensure successful adoption (e.g., Clegg, 2000; Waterson et al., 2015). Nonetheless, as the Sociotechnical Systems Theory also stresses the importance of considering organizational aspects in the implementation of new technology, an important step for future research is to identify and test moderators referring to such organizational aspects, such as the organization's culture (e.g., Syed-Ikhsan & Rowland, 2004). For instance, technology implementation strategies have been found to be differently effective depending on the organization's culture (e.g., Harper & Utley, 2001), which might be also true for the interventions examined in the present research.

Second, the current work extends approaches on technology adoption (i.e., research on technology acceptance, resistance to change, and job insecurity). As prior technology adoption research mostly focused on positive and proximal outcomes (e.g., perceived usefulness), by combining these approaches—and thereby considering possible obstacles in the implementation process—the current work contributes to a more holistic understanding of technology adoption in blue-collar work.

Another major strength of the current work is that all empirical studies were conducted in field within an organization, with the target sample in focus (i.e., blue-collar workers), and a to-be-implemented robotic technology for this context. Thus, the studies are of high external validity and practical relevance. As blue-collar workers are a sample difficult to reach, the current work provides important knowledge about how to introduce technology successfully among this group of employees. Furthermore, Study 2 and 3 implemented an experimental design, which allowed drawing causal conclusions. Nevertheless, further research should opt to replicate the current findings in more controlled settings (e.g., the lab), focusing less on external validity (as it was the goal of the current work). Furthermore, to ensure generalizability, an important step for future studies is to replicate the present results in other contexts (e.g., white-collar work, other organizations, or voluntary use contexts) and with other technologies.

As another strength of the current dissertation, it developed and tested interventions that targeted the specific underlying *psychological processes* based on established theorizing, and thus goes beyond mere information-based training (Walton, 2014). As Study 3 identified self-efficacy as the mediating mechanism of enactive mastery, it contributes to the understanding of the process why this intervention improved attitudes towards new technology. Since knowledge about effective interventions to implement new technology is limited (Venkatesh, 1999; Venkatesh & Bala, 2008), especially in the blue-collar context (Molino et al., 2020), the present research gives important insights into intervention design within this field and provides an important starting point for further intervention research.

On the limitation side, one could argue that the data obtained in Study 1, as well as the dependent variables assessed in the three studies were based on self-report measures. Self-report measures might lead to biased responses due to social desirability (e.g., Van de Mortel, 2008). This might be particularly relevant in organizational contexts, in which employees might try to answer in line with the organization’s norms and expectations. However, mean ratings of the examined work characteristics in Study 1 and 2 contradict this concern: Mean scores (with ratings on a 1 to 5 point scale) for the rather negative work characteristic perceived work demands were relatively high (*M* = 3.64 in Study 1; *M* = 3.64 in Study 2), comparable to the positive work characteristic task identity (*M* = 3.72 in Study 1; *M* = 4.03 in Study 2), and even higher than work enrichment (*M* = 2.35 in Study 1; *M* = 3.03 in Study 2). Similarly, means for the rather negative attitude component technology-based job insecurity were relatively high in all three studies (*M* = 3.54 in Study 1; *M* = 3.11 in Study 2; *M* = 2.83 in Study 3). These results strengthen confidence in the findings and suggest that these methodological details do not limit the interpretation of the findings.

Furthermore, using single source measures in Study 1 might have caused common-method bias. To address this issue, several considerations in the design of the questionnaire were made (following the propositions of Chang et al., 2010). These involved the order of items, which allowed for separate assessment of independent and dependent variables, and including intervening variables unrelated to the research questions. Moreover, participants were informed about their anonymity, that there were no right or wrong answers, and they were asked to answer as honestly as possible.

However, to rule out final doubts, future research should try to replicate the current findings using measures other than self-reports, such as behavioral measures. Using measures from multiple sources would also help to prevent possible common-method bias in Study 1 (Podsakoff & Organ, 1986). For example, instead of assessing self-reports on resistance to change, future research might use behavioral measures of resistance, such as sabotage (Day, 2000; Moreno, 1999) or destructive behavior (Ferneley & Sobreperez, 2006). Regarding technology enthusiasm, it would be interesting to measure the time of voluntary usage, for instance, in the employees' work breaks. Moreover, another approach would be to assess facial reactions during technology usage to draw conclusions about individuals' emotions and attitudes towards the technology (which, however, might be difficult to implement in field settings).

Finally, the three empirical studies focused on employees' initial and immediate reactions towards a to-be-introduced technology in the *pre-implementation* phase—that is, before the actual implementation of the new technology. This focus was chosen as prior research mainly focused on the acceptance of technology during or after the implementation phase (for a summary see Venkatesh & Bala, 2008; and Hornbæk & Hertzum, 2017 for an exception). Thus, the current research adds to the knowledge about reactions to new technologies in this under-researched phase by focusing on attitudes that capture initial responses towards the new technology. However, this does not allow drawing conclusions about the reactions during and after the implementation process. Notably, however, attitudes are known to be good predictors of actual behavior (e.g., Ajzen, 2012); also, technology enthusiasm and resistance to change have been found to predict the intention to use technology (e.g., Balog & Pribeanu, 2010; Mahmud et al., 2017; Venkatesh et al., 2012).

Nevertheless, future research should test how the interventions examined in Study 2 and 3 influence reactions during and after technology implementation, thereby including outcomes that are relevant at these stages. For example, an initial enthusiastic attitude towards a new technology might result in increased overall job satisfaction and work engagement in the long term (Elias et al., 2012). Similarly, an initial resisting attitude might lead to higher intentions to commit sabotage (e.g., Day, 2000). Furthermore, future research should investigate how these initial attitudes relate to (technology-related) work performance and productivity. Ideally, to assess changes in reactions over time, these aspects should be investigated within a longitudinal study covering all three implementation stages (i.e., pre-, during, and post-implementation).

Practical Implications

Put together, the findings of the current dissertation have implications for practitioners, organizations, and management. As new technologies are being implemented at a rapid speed in the context of Industry 4.0 (e.g., Brougham & Haar, 2018), understanding how to introduce them successfully is decisive for organizational success. Following this idea, the current work provides technology implementers with practical strategies that can guide technology introduction and help to realize the potential of new technologies.

Applying Human-Centered Interventions to Introduce New Technologies

The current dissertation showed that applying simple, easy-to-be implemented strategies (i.e., *interventions*) can improve attitudes towards new technologies. Thus, rather than just focusing on technological aspects in technology adoption, practitioners should aim to design and deploy adequate interventions that consider the employees' perspective. Specifically, organizations often consider "upskilling" their employees with time- and money-intense training as the most effective way to improve employees' attitudes towards new technologies. However, the current findings indicate that comparatively small and cost-effective interventions (that do not directly address employees' actual skills, but rather their motivation and experienced capability) can have a major impact (see also Walton, 2014). This might be especially relevant regarding new intuitive technologies that do not need intense training: Rather than completely refraining from implementation activities that meet the employees' needs, applying such easy-to-be implemented interventions might substantially contribute to a successful adoption.

The current findings have several implications for the design of such interventions. First, the development and design of interventions should be based on employees' characteristics and needs. More abstractly speaking, to design effective interventions, practitioners should create a fit between employees' needs and the technology implementation strategy. This can be done, for example, by considering employees' actual and desired work characteristics, their experience with technology, or their evaluation of own competency (i.e., self-efficacy). Based on this evaluation, the implementation strategy can be tailored in accordance with these needs.

In this regard, the question arises whether the assessment of employees' needs can also be carried out by their supervisors. To examine this question, supervisors of a sub-sample of employees participated in Study 1 (N = 19; based on a targeted ratio of 1 supervisor to 5-10 employees) rated their employees' actual and desired work characteristics. These ratings were correlated with the respective employee ratings, revealing that the evaluations were not at all to moderately correlated and non-significant ($-.12 < r < .41$; all ps > .05); and, in one case even significantly negatively correlated (actual task identity; $r = -.50$, $p < .05$). Thus, the results indicate that discrepancies exist between employees' and supervisors' perceptions of employees' currently perceived and desired work-related needs. Accordingly, in case perceived and desired work-related needs will be used to make decisions about blue-collar workers' work situation, the needs should be assessed among the employees rather than estimated by their supervisors. More details on the research idea, methods and results of this study can be found in Appendix D.

Second, interventions should be based on the technology's implications for employees' work. In other words, technology implementers need to understand how a new technology and the related changes (positively and negatively) affect the employees' tasks and the general design of work. As the impact of technologies on work design is non-deterministic, technologies may have different implications depending on the context in which they are implemented—likely resulting in different performance and motivational consequences (Parker & Grote, 2020). For example, a technology may contribute to increased skill variety if it replaces currently monotonous and repetitive tasks (thereby increasing motivation); but may decrease skill variety if it standardizes currently diversified tasks (thereby decreasing motivation). Thus, the more practitioners know how and why technology alters the employees' work, the more they can gain knowledge about how to address these technological changes in implementation strategies. Consequently, practitioners' understanding of the design of employees' work is crucial to ensure successful technology adoption—which is why another key implication is that technology implementers and managers should be educated in work design and related topics (e.g., work motivation). Based on this, practitioners can actively make choices about the way technology is implemented, and thus on important motivation-related outcomes.

Technology Implementation in the Specific Context of Blue-Collar Work

The current dissertation emphasizes that blue-collar workers are a group of employees with specific characteristics, work conditions, and needs (that differ from those of white-collar workers). Consequently, these aspects should be considered in the implementation of new technologies. First, a central aspect to effective technology implementation in blue-collar work is workers' *self-efficacy*. Blue-collar work entails mainly physical labor with monotonous, repetitive, and simple tasks (as compared to white-collar work; e.g., Schreurs et al., 2011; Nielsen & Abildgaard, 2012), often requiring lower qualifications and education (e.g., Karasek & Theorell, 1990). Accordingly and in line with the current findings, blue-collar workers might more likely question their own self-efficacy to use a new technology—which should therefore be targeted in implementation strategies within this context. In other words, when implementing new technologies in blue-collar work, rather than only improving workers' actual abilities with functional training, it is particularly important to strengthen workers' *beliefs* about their capability to use a new technology.

To this end, practitioners should provide situations (e.g., workshops, hands-on sessions) in which workers can actively engage with the new technology (rather than, for instance, just showing a video tutorial)—thereby creating an enactive mastery experience to increase self-efficacy beliefs. Furthermore, technology implementers may provide information about further training and education opportunities, as well as the functioning of the new technology, or, if relevant, about its easy usage and intuitiveness. Notably, this may be especially valuable before the actual implementation of technology (i.e., in the pre-implementation period), when prejudices and biasing suppositions may be present. Finally, self-efficacy can already be considered in the development and design of technology for blue-collar work by creating user-friendly and intuitive technology. Such human-centered design should include, for instance, appropriate (tailored) feedback that supports increasing workers' actual, but also their perceived abilities.

A second implication is that technology implementers should consider blue-collar workers' fear to lose their work due to new technology in implementation strategies. The fact that the means for technology-based job insecurity were relatively high in the three empirical studies (M = 3.54 in Study 1; M = 3.11 in Study 2; M = 2.83 in Study 3; rated on a 1 to 5 point scale) illustrates that this fear represents a relevant obstacle to successful technology implementation in the blue-collar context. Notably, managers and technology implementers may be aware about the fact that new technologies might replace tasks, but not employees' occupation as a whole (Brynjolfsson et al., 2018). Nevertheless and more importantly, blue-collar workers' subjective concerns about losing their work might still be present based on mental representations, biasing assumption, and expectations about new technologies, as well as their own ability to keep up with the changes. As the current dissertation revealed that applying adequate interventions to introduce technology (i.e., enactive mastery experience) can decrease technology-based job insecurity, practitioners should aim to address this concern in implementation strategies. Another approach to this might be to actively communicate that job loss is not to be expected, or to list future development and educational possibilities.

Taken together, the current dissertation sheds light into potential challenges that technology implementers might face; and provides them with a set of suggestions that can help to guide the design of effective technology implementation strategies, and thus, to maximize a new technology's positive consequences.

Conclusion

As part of Industry 4.0, new digital technologies are being introduced at a rapid speed. However, implementing digital technologies successfully represents a major challenge for organizations, as employees often have a rather negative attitude towards them (e.g., Gnambs & Appel, 2019). Thus, organizations need to have effective implementation strategies that help to improve workers' attitudes towards new technologies and, thus, to optimize a new technology's benefits.

The current dissertation contributes to this knowledge by shedding light into the motivational factors contributing to the formation of attitudes towards new technology in blue-collar work, and by demonstrating that interventions that target employees' (work-related) *needs* or their *self-efficacy* beliefs can improve these attitudes. Thereby, the current dissertation helps to better understand technology implementation in blue-collar work and adds to the knowledge about how easy-to-be implemented strategies can support successful technology adoption in this context. In sum, the current work provides a deeper insight into how considering the employees' perspective can support successful technology adoption. The current findings offer a starting point for future research on this topic and can help practitioners to guide effective technology implementation.

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Appendix

Appendix A

Additional Variables Assessed in the Questionnaire in Study 1

Work Motivation. Work motivation was assessed with the German version of the Multidimensional Work Motivation Scale (MWMS; Gagné et al., 2015) using the subscales *external regulation*, *introjected regulation*, *identified regulation*, *identified regulation*, and *intrinsic motivation*.

Responsibility for Work. We used three items each to assess actual and desired responsibility for work (e.g., actual: “I feel personally responsible for my work.”; desired: “I want to feel personally responsible for my work.”) adopted from Hackman and Oldham (1975).

Identification with Work. We applied the social identification questionnaire developed by Johnson et al. (2012) to the group of production workers.

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Appendix B

Details on Assessed Work Characteristics in Study 1

Table A1

Assessed Work Characteristics, Number of Items, Examples for Actual and Desired WC and Reliability for Actual and Desired WC (ω/r)

Work Characteristic	Number of items	Example Actual WC	*ω/r*	Example Desired WC	*ω/r*
Work Scheduling Autonomy	3	My job allows me to plan how I do my work.	.79	I wish my job allowed me to plan how I do my work.	.82
Decision Making Autonomy	3	My job allows me to make a lot of decisions on my own.	.84	I wish my job allowed me to make a lot of decisions on my own.	.80
Work Methods Autonomy	3	My job allows me to decide on my own how to go about doing my work.	.88	I wish my job allowed me to decide on my own how to go about doing my work.	.86
Task Variety	4	My job involves a great deal of task variety.	.88	I wish my job involved a great deal of task variety.	.89
Task Significance	3	My job has a large on the quality of the products of [name of the company].	.74	I wish my job had a large impact on the quality of [name of the company].	.85
Task Identity	4	My job allows me to complete work I start.	.82	I wish my job allowed me to complete work I start.	.79
Feedback From the Job	3	My job itself provides feedback on my performance.	.80	I wish my job itself provided feedback on my performance.	.76
Skill Variety	4	My job requires a variety of skills.	.96	I wish my job required a variety of skills.	.90
Opportunities to Learn	4	In my job I learn new things.	.90	I wish I learned new things in my job.	.89
Physical Demands	3	My job requires a lot of physical effort.	.85	I wish my job required a lot of physical effort.	.83
Time Pressure	2	My job requires me to work very fast.	.60***	I wish my job required me to work very fast.	.50***
Workload	2	In my job there is a great deal to be done.	.54***	I wish in my job was a great deal to be done.	.54***

Note: Number of items refer to the number of actual and desired WC each. *r* was computed instead of *ω* for scales “time pressure” and “workload“ due to the number of items. *p<.05; **p<.01; ***p<.001.

Table A2

Factor Loadings of Actual WC (With Varimax Rotation)

WC	Work Enrichment	Work Demands	Task Identity
Work Scheduling Autonomy	**.75**	-.31	-.23
Decision Making Autonomy	**.82**	-.25	.02
Work Methods Autonomy	**.81**	-.29	-.06
Task Variety	**.75**	.03	.40
Task Significance	-.01	.04	**.79**
Task Identity	.04	-.17	**.74**
Feedback From the Job	.38	.01	**.67**
Skill Variety	**.77**	.16	.35
Opportunities to Learn	**.86**	-.08	.27
Physical Demands	-.09	**.83**	-.04
Time Pressure	-.36	**.73**	-.07
Workload	-.01	**.88**	-.03
Eigenvalue	4.07	2.31	2.03
% of Variance	33.90	19.21	16.93

Note: The bold values indicate the factor on which the WC loaded most strongly; actual and desired WC factors were formed based on these.

Appendix C

Details on Assessed Attitudes Towards New Technology in Study 1

Table A3

List of All Items Used to Assess Attitudes Towards New Technology

Item
1. *I consider new technologies for my work as an opportunity and not as a risk.
2. *New technologies make my work more difficult than easier.
3. *When a new technology is introduced into production, I would rather continue my usual activity without technology.
4. *When a new technology is introduced into production, I want to use it for my work.
5. *When a new technology is introduced into production, I am excited about technical progress.
6. *If new technologies are introduced into production, they could take over my tasks.
7. *The introduction of new technologies in production makes my work much more interesting.
8. *I enjoy getting to know new technologies for my work.
9. *I enjoy learning how to use new technologies for my work.
10. When a new technology is introduced into production, I question its advantages.

Note: Items marked with an asterisk are included in the final version of the questionnaire.

Table A4

Final Factor Structure and Component Loadings of the Items on Attitudes Towards New Technology

Item No.	Technology Enthusiasm	User Resistance to Change	Technology-Based Job Insecurity
1. I consider new technologies for my work as an opportunity and not as a risk.	**.70**	.09	.36
2. New technologies make my work more difficult than easier.	.02	**.86**	-.20
3. When a new technology is introduced into production, I would rather continue my usual activity without technology.	.38	**.68**	.26
4. When a new technology is introduced into production, I want to use it for my work.	**.64**	.33	.23
5. When a new technology is introduced into production, I am excited about technical progress.	**.60**	.22	.20
6. If new technologies are introduced into production, they could take over my tasks.	.04	-.05	**.92**
7. The introduction of new technologies in production makes my work much more interesting.	**.73**	.09	-.01
8. I enjoy getting to know new technologies for my work.	**.88**	.06	-.02
9. I enjoy learning how to use new technologies for my work.	**.77**	.11	-.10
Eigenvalue	3.30	1.39	1.18
% of variance	36.67	15.40	13.07

Note: The bold values indicate the factor on which the WC loaded most strongly; the three attitudes were formed based on these.

Appendix D

Supervisor vs. Employee Ratings: Are Supervisors Able to Anticipate Employees' Needs?

Idea

Study 1 examined blue-collar workers' actual and desired work characteristics as antecedents of their attitudes towards new technology. Thereby, workers rated their actual and desired work characteristics themselves. The results of Study 1 demonstrate that assessing employees' work-related needs serves as valuable information to better understand technology implementation and to design effective implementation strategies. However, especially in practical settings (e.g., organizational contexts), letting employees rate their needs themselves is time-consuming and costly. Therefore, to make such needs assessments more time- and cost-effective, the question arises whether the evaluation of employees' needs can also be carried out by their supervisors.

Prior research comparing employee and supervisor ratings has mainly focused on performance-related outcomes, indicating that supervisor and employee ratings are only modestly correlated and, thus, differ substantially (e.g., Harris & Schaubroeck; Netemeyer & Maxham, 2007). However, research comparing supervisor and employee ratings of their work-related *needs* is scarce (for exceptions see Bennett, Frain, Brady, Rosenberg, & Surinak, 2009; Ilardi, Leone, Kasser, & Ryan, 1993), but provides first evidence for major discrepancies between employee and supervisor ratings of work-related needs. To this end, we collected additional data in Study 1 to investigate the relation between employee ratings of actual and desired work characteristics and the respective supervisor ratings. To examine this question, supervisors of a sub-sample of employees participated in Study 1 rated their employees' actual and desired work characteristics. These ratings were then correlated with the respective employee ratings.

Methods

Participants

Data was collected as part of Study 1. Based on a targeted ratio of 1 supervisor to 5-10 employees and a total sample of N = 127 in Study 1, nineteen blue-collar workers (2 female, 17 male) and their respective supervisors (all male) from four different sites of a multinational industrial corporation in Germany voluntarily participated in the study during their working time in the workers' break room. Regarding the employee sample, 32% of the participants were 18 to 25 years old, 21% were between 26 and 35 years old, 32% were between 36 and 50 years old and 16% were 51 years and older. 32% had a lower secondary school diploma, 47% had a secondary school diploma, 16% had an either advanced technical college certificate or a general qualification for university entrance, and 5% indicated having a bachelor's degree. Regarding the supervisor sample, 5% of the participants were 18 to 25 years old, 47% were between 26 and 35 years old, and 47% were between 36 and 50 years old. 32% had a lower secondary school diploma, 52% had a secondary school diploma, 16% had an either advanced technical college certificate or a general qualification for university entrance. 47% of the supervisors indicated supervising 1-10 employees, 37% indicated supervising 11-20 employees, and 16% more than 20 employees.

Procedure

Participants were approached individually. Employees and supervisors filled in a paper-pencil questionnaire in separate sessions, whereas employees participated first and supervisors second. The procedure was equal for employees and supervisors: They first read an introductory text informing them that the study focused on employees' perception of their work, that their participation was voluntary, and that the data was anonymized after completing the questionnaire (about 150 words). Additionally, employees were asked to provide informed consent that supervisors evaluate their work-related needs. Afterwards, the actual study started. The questionnaires included items regarding the employees' perceived actual and desired *work characteristics*, and ended up with the assessment of *sociodemographic variables*. Finally, all participants were thanked for their participation.

Measures

All items were in German, worded in easy language, and rated on a 1 (does not apply at all) to 5 (applies completely) point scale. Overall, both supervisors and employees evaluated 12 different work characteristics presented on five pages. *Work scheduling autonomy*, *decision making autonomy*, *work methods autonomy*, *task variety*, *task significance* (adapted to context), *task identity*, *feedback from the job*, *skill variety*, and *physical demands* were assessed with the Work Design Questionnaire (WDQ, Morgeson & Humphrey, 2006). The *opportunities to learn* items were adopted from the Questionnaire on the Experience and Evaluation of Work (QEEW, Van Veldhoven & Meijman, 1994), and the *time pressure* and *workload* items from the Quantitative Workload Inventory (QWI, Spector & Jex, 1998).

For each work characteristic, supervisors and employees completed an actual-target comparison item. In the employee version of the questionnaire, employees were asked to indicate how they *actually* perceive their work at the moment (actual work characteristic; actual WC; e.g., “My job allows me to plan how I do my work.”) and then to indicate how they *would like it* to be (desired work characteristic; desired WC; e.g., “I wish my job allowed me to plan how I do my work.”; for a similar procedure, see Cable & Edwards, 2004). In the supervisor version, supervisors were asked to assess how their employee *actually* perceives his/her work at the moment (actual work characteristic; actual WC; e.g., “My employee can plan his/her work how he/she wants to.”) and then how their employee *would like it* to be (desired work characteristic; desired WC; e.g., “My employee wishes to be able to plan his/her work how he/she wants to.”).

Sample items and the number of items per scale can be found in Appendix B (Table A1). Responses were averaged across items for each actual and desired work characteristic. Based on the factor analysis conducted in Study 1, the employees’ and supervisors’ ratings on actual and desired work characteristics were summarized into three work characteristics indices, namely work enrichment (i.e., actual, $\alpha_{supervisor}$ = .90; desired, $\alpha_{supervisor}$ = .80), work demands (i.e., actual, $\alpha_{supervisor}$ = .93; desired, $\alpha_{supervisor}$ = .75), and actual and desired task identity (i.e., actual, $\alpha_{supervisor}$ = .83; desired, $\alpha_{supervisor}$ = .77). More details on the factor formation and internal consistencies of employee ratings for the total sample in Study 1 can be found in Chapter 2. An overview about which specific work characteristics were included in each of the three factors is presented in Appendix B (Table A2).

Results and Discussion

To examine the relation between employee and supervisor ratings of employees’ actual and desired work characteristics, bivariate correlations between employee and supervisor ratings of actual and desired work characteristics were computed. Descriptive statistics and bivariate correlations between employee and supervisor ratings for actual work characteristics are presented in Table A5, and for desired work characteristics in Table A6.[8]

Regarding actual work characteristics, supervisor and employee ratings of actual work enrichment and actual work demands were only moderately correlated and non-significant (actual work enrichment: $r = .41$, $p = .080$; actual work demands: $r = .32$, $p = .176$). For actual

[8] Regarding desired work characteristics, the number of participants differs due to missing values for one worker. The respective supervisor data on desired work characteristics was excluded. Due to the small sample size in the study, the ratings of actual work characteristics were included.

task identity, the correlation was significantly negative, $r = -.50$, $p < .05$ (see Table A5). This suggests that employee and supervisor ratings of employees' actual work characteristics only correspond to a relatively small degree or even go in opposite directions. Regarding desired work characteristics, supervisor and employee ratings were not correlated (desired work enrichment: $r = .09$, $p = .737$; desired work demands: $r = -.12$, $p = .645$; desired task identity: $r = .10$, $p = .681$; see Table A6). This suggests that supervisor and employee ratings of desired work characteristics do only correspond to a small degree.

Table A5

Descriptive Statistics and Bivariate Correlations for Employee and Supervisor Ratings of Actual Work Characteristics (N = 19)

	Mean	*SD*	1	2	3	4	5
Employee Ratings							
1. Actual Work Enrichment	2.11	0.92					
2. Actual Work Demands	3.62	0.77	-.30				
3. Actual Task Identity	3.87	0.51	.21	.07			
Supervisor Ratings							
4. Actual Work Enrichment	2.47	0.61	.41	.07	-.28		
5. Actual Work Demands	2.96	1.01	.10	.32	.38	.11	
6. Actual Task Identity	3.98	0.66	-.01	-.36	-.50*	.46*	-.15

*Note: *p<.05; **p<.01; ***p<.001.*

Table A6

Descriptive Statistics and Correlations for Employee and Supervisor Ratings of Desired Work Characteristics (N = 18)

	Mean	*SD*	1	2	3	4	5
Employee Ratings							
1. Desired Work Enrichment	4.05	0.64					
2. Desired Work Demands	2.31	0.63	-.01				
3. Desired Task Identity	4.33	0.65	.46	.31			
Supervisor Ratings							
4. Desired Work Enrichment	3.62	0.47	.09	-.32	.10		
5. Desired Work Demands	1.82	0.51	.22	-.12	.15	-.02	
6. Desired Task Identity	4.21	0.51	.00	-.13	.10	.49*	.06

*Note: *p<.05; **p<.01; ***p<.001.*

In sum, the results indicate that discrepancies exist between employees' and supervisors' perceptions of employees' currently perceived and desired work-related needs. In case perceived and desired work-related needs will be used to make decisions about the work situation of blue-collar workers, the needs should be assessed among the workers rather than estimated by the supervisors.

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Appendix E

Questionnaire Study 1 (Employee Version)

Befragung zur Wahrnehmung der Arbeit in der Produktion

Liebe/r Befragungsteilnehmer/in,

vielen Dank für Ihre Teilnahme an dieser Befragung.

In dieser Befragung wollen wir Ihre **Meinung zu Ihrer Arbeit** erfahren. Auf den folgenden Seiten finden Sie daher verschiedene **Fragen zu Ihrer Arbeit**.

Die Untersuchung verläuft **anonym**; individuelle Daten werden zu Mittelwerten zusammengefasst und keinen bestimmten Personen zugeordnet. Wir wollen keine individuellen Profile erstellen, uns interessieren vielmehr Gesetzmäßigkeiten, die über eine große Zahl von Personen hinweg Gültigkeit haben.

Ihre Antworten werden absolut **vertraulich** behandelt. Bitte beantworten Sie jede Frage so ehrlich und offen wie möglich. Es gibt keine richtigen oder falschen Antworten. Bei den Fragen wollen wir Ihre **ehrliche** Einschätzung zu Ihrer Arbeit erhalten.

Bitte beantworten Sie die Fragen **in der Reihenfolge, in der die Seiten zusammengeheftet sind.** Die Bearbeitung des Fragebogens dauert ca. 20 Minuten. Sie können die Studie jederzeit ohne Angabe von Gründen abbrechen.

Wenn Ihnen während der Beantwortung der Fragen etwas unklar ist, fragen Sie bitte jederzeit nach.

Vielen Dank!

Bitte geben Sie jeweils an, wie Sie Ihre Arbeit im Moment wahrnehmen und wie Sie sich Ihre Arbeit wünschen.

Bitte geben Sie Ihre Einschätzung auf der Skala von 1 für *trifft gar nicht* zu bis 5 für *trifft voll und ganz zu* an.

	trifft gar nicht zu				trifft voll und ganz zu
Ich **kann** meine Arbeit zeitlich frei einteilen.	①	②	③	④	⑤
Ich **will** meine Arbeit zeitlich frei einteilen.	①	②	③	④	⑤
Ich **kann** selbst entscheiden, in welcher Reihenfolge ich meine Arbeit mache.	①	②	③	④	⑤
Ich **will** selbst entscheiden, in welcher Reihenfolge ich meine Arbeit mache.	①	②	③	④	⑤
Ich **kann** meine Arbeit so planen, wie ich es möchte.	①	②	③	④	⑤
Ich **will** meine Arbeit so planen, wie ich es möchte.	①	②	③	④	⑤
Ich **kann** selbst entscheiden, wie ich meine Arbeit ausführe.	①	②	③	④	⑤
Ich **will** selbst entscheiden, wie ich meine Arbeit ausführe.	①	②	③	④	⑤
Ich **kann** bei meiner Arbeit viele Entscheidungen selbstständig treffen.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit viele Entscheidungen selbstständig treffen.	①	②	③	④	⑤
Bei meiner Arbeit **habe** ich einen großen Entscheidungsspielraum.	①	②	③	④	⑤
Bei meiner Arbeit **wünsche** ich mir einen großen Entscheidungsspielraum.	①	②	③	④	⑤
Ich **kann** selbst entscheiden, mit welchen Methoden ich meine Arbeit erledige.	①	②	③	④	⑤
Ich **will** selbst entscheiden, mit welchen Methoden ich meine Arbeit erledige.	①	②	③	④	⑤
Ich **kann** frei entscheiden, auf welche Art und Weise ich meine Arbeit mache.	①	②	③	④	⑤
Ich **will** frei entscheiden, auf welche Art und Weise ich meine Arbeit mache.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
Ich **kann** selbst entscheiden, wie ich meine Arbeit angehe.	①	②	③	④	⑤
Ich **will** selbst entscheiden, wie ich meine Arbeit angehe.	①	②	③	④	⑤
Bei meiner Arbeit **gibt** es viel Abwechslung.	①	②	③	④	⑤
Bei meiner Arbeit **wünsche** ich mir viel Abwechslung.	①	②	③	④	⑤
Bei meiner Arbeit **tue** ich viele unterschiedliche Dinge.	①	②	③	④	⑤
Bei meiner Arbeit **will** ich viele unterschiedliche Dinge tun.	①	②	③	④	⑤
Bei meiner Arbeit **muss** ich viele verschiedene Aufgaben bearbeiten.	①	②	③	④	⑤
Bei meiner Arbeit **will** ich viele verschiedene Aufgaben bearbeiten.	①	②	③	④	⑤
Meine Arbeit **beinhaltet** eine Vielzahl von Aufgaben.	①	②	③	④	⑤
Ich **will**, dass meine Arbeit eine Vielzahl von Aufgaben beinhaltet.	①	②	③	④	⑤
Meine Arbeitsergebnisse **beeinflussen** die Qualität der Produkte der Daimler AG.	①	②	③	④	⑤
Ich **wünsche** mir, dass meine Arbeitsergebnisse die Qualität der Produkte der Daimler AG beeinflussen.	①	②	③	④	⑤
Insgesamt betrachtet **ist** meine Arbeit sehr wichtig.	①	②	③	④	⑤
Ich **wünsche** mir, dass meine Arbeit insgesamt betrachtet sehr wichtig ist.	①	②	③	④	⑤
Meine Arbeit **hat** einen großen Einfluss auf die Qualität der Produkte der Daimler AG.	①	②	③	④	⑤
Ich **will**, dass meine Arbeit einen großen Einfluss auf die Qualität der Produkte der Daimler AG hat.	①	②	③	④	⑤
Meine Arbeit **beinhaltet** Aufgaben mit erkennbarem Anfang und Ende.	①	②	③	④	⑤
Ich **wünsche** mir, dass meine Arbeit Aufgaben mit erkennbarem Anfang und Ende beinhaltet.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
Ich **kann** bei meiner Arbeit vollständige Aufgaben von Anfang bis Ende bearbeiten.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit vollständige Aufgaben von Anfang bis Ende bearbeiten.	①	②	③	④	⑤
Bei meiner Arbeit **kann** ich angefangene Aufgaben auch zu Ende führen.	①	②	③	④	⑤
Bei meiner Arbeit **will** ich angefangene Aufgaben auch zu Ende führen.	①	②	③	④	⑤
Bei meiner Arbeit **kann** ich angefangene Aufgaben auch abschließen.	①	②	③	④	⑤
Bei meiner Arbeit **will** ich angefangene Aufgaben auch abschließen.	①	②	③	④	⑤
Meine Arbeitstätigkeiten selbst (nicht Vorgesetzte oder Kollegen) **geben** mir deutliche Hinweise darauf, wie gut ich arbeite.	①	②	③	④	⑤
Ich **wünsche** mir, dass mir meine Arbeitstätigkeiten selbst deutliche Hinweise darauf geben, wie gut ich arbeite.	①	②	③	④	⑤
Meine Arbeit selbst **gibt** mir Rückmeldung zu meiner Arbeitsleistung.	①	②	③	④	⑤
Ich **wünsche** mir, dass mir meine Arbeit selbst Rückmeldung zu meiner Arbeitsleistung gibt.	①	②	③	④	⑤
Bei der Ausführung meiner Tätigkeit **kann** ich leicht feststellen, wie gut ich arbeite.	①	②	③	④	⑤
Bei der Ausführung meiner Tätigkeit **will** ich leicht feststellen können, wie gut ich arbeite.	①	②	③	④	⑤
Meine Arbeit **erfordert** viele Fähigkeiten.	①	②	③	④	⑤
Ich **will**, dass meine Arbeit viele Fähigkeiten erfordert.	①	②	③	④	⑤
Ich **muss** viele verschiedene Fähigkeiten einsetzen, um meine Arbeit zu erledigen.	①	②	③	④	⑤
Ich **will** viele verschiedene Fähigkeiten einsetzen, um meine Arbeit zu erledigen.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
Bei meiner Arbeit **benötige** ich komplexe Fähigkeiten.	①	②	③	④	⑤
Ich **wünsche** mir, dass ich bei meiner Arbeit komplexe Fähigkeiten benötige.	①	②	③	④	⑤
Meine Arbeit **erfordert** den Einsatz einer Reihe von Fähigkeiten.	①	②	③	④	⑤
Ich **wünsche** mir, dass meine Arbeit den Einsatz einer Reihe von Fähigkeiten erfordert.	①	②	③	④	⑤
Bei meiner Arbeit **lerne** ich neue Dinge.	①	②	③	④	⑤
Bei meiner Arbeit **will** ich neue Dinge lernen.	①	②	③	④	⑤
Bei meiner Arbeit **kann** ich mich persönlich entwickeln.	①	②	③	④	⑤
Bei meiner Arbeit **will** ich mich persönlich entwickeln.	①	②	③	④	⑤
Meine Arbeit **gibt** mir das Gefühl, dass ich etwas erreichen kann.	①	②	③	④	⑤
Ich **will**, dass mir meine Arbeit das Gefühl gibt, dass ich etwas erreichen kann.	①	②	③	④	⑤
Bei meiner Arbeit **kann** ich selbstständig denken und handeln.	①	②	③	④	⑤
Bei meiner Arbeit **will** ich selbstständig denken und handeln.	①	②	③	④	⑤
Meine Arbeit **erfordert** eine hohe körperliche Ausdauer.	①	②	③	④	⑤
Ich **will**, dass meine Arbeit eine hohe körperliche Ausdauer erfordert.	①	②	③	④	⑤
Meine Arbeit **erfordert** viel Muskelkraft.	①	②	③	④	⑤
Ich **will**, dass meine Arbeit viel Muskelkraft erfordert.	①	②	③	④	⑤
Meine Arbeit **ist** körperlich anstrengend.	①	②	③	④	⑤
Ich **will**, dass meine Arbeit körperlich anstrengend ist.	①	②	③	④	⑤
Ich **muss** bei meiner Arbeit sehr schnell arbeiten.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit sehr schnell arbeiten.	①	②	③	④	⑤
Ich **habe** für meine Arbeitsaufgaben wenig Zeit.	①	②	③	④	⑤
Ich **will** für meine Arbeitsaufgaben wenig Zeit haben.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
Ich **muss** bei meiner Arbeit sehr hart arbeiten.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit sehr hart arbeiten.	①	②	③	④	⑤
Ich **habe** bei meiner Arbeit sehr viel zu tun.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit sehr viel zu tun haben.	①	②	③	④	⑤
Ich **fühle** mich für meine Arbeit persönlich verantwortlich.	①	②	③	④	⑤
Ich **will** mich für meine Arbeit persönlich verantwortlich fühlen.	①	②	③	④	⑤
Ich alleine **erhalte** Lob oder Kritik für meine Arbeit.	①	②	③	④	⑤
Ich alleine **will** Lob oder Kritik für meine Arbeit erhalten.	①	②	③	④	⑤
Ich **bin** allein dafür verantwortlich, ob ich meine Arbeit gut mache oder nicht.	①	②	③	④	⑤
Ich **will** allein dafür verantwortlich sein, ob ich meine Arbeit gut mache oder nicht.	①	②	③	④	⑤

Bitte geben Sie an, wie Sie sich in Bezug auf Ihre Arbeit fühlen.

	trifft gar nicht zu				trifft voll und ganz zu
Ich bin froh, Mitarbeiter der Produktion zu sein.	①	②	③	④	⑤
Ich bin stolz, Mitarbeiter der Produktion zu sein.	①	②	③	④	⑤
Es ist ein gutes Gefühl, Mitarbeiter der Produktion zu sein.	①	②	③	④	⑤
Wenn ich meine Arbeit in der Produktion aufgeben müsste, wäre ich sehr enttäuscht.	①	②	③	④	⑤
Ich bezeichne mich oft als Mitarbeiter der Produktion.	①	②	③	④	⑤
Meine Arbeit in der Produktion ist sehr wichtig für mein Verständnis dafür, wer ich bin.	①	②	③	④	⑤
Mein Selbstwertgefühl hängt auch von meiner Arbeit in der Produktion ab.	①	②	③	④	⑤
Wenn jemand schlecht über die Arbeit in der Produktion redet, fühle ich mich selbst angegriffen.	①	②	③	④	⑤

Es gibt verschiedene Gründe dafür, sich bei der Arbeit anzustrengen.
Warum strengen Sie sich bei Ihrer Arbeit an? Bitte kreuzen Sie für jeden der Gründe an, wie sehr die jeweilige Aussage auf Sie zutrifft.

Ich strenge mich bei der Arbeit an, …

	trifft gar nicht zu				trifft voll und ganz zu
… um von anderen Anerkennung zu erhalten (z.B. von Vorgesetzten, Kollegen, Familie, Kunden).	①	②	③	④	⑤
… weil andere mich dann stärker respektieren (z.B. Vorgesetzte, Kollegen, Familie, Kunden).	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
… um zu vermeiden, dass ich von anderen kritisiert werde (z.B. von Vorgesetzten, Kollegen, Familie, Kunden).	①	②	③	④	⑤
… weil andere mich finanziell belohnen, wenn ich mich anstrenge (z.B. Arbeitgeber, Vorgesetzte).	①	②	③	④	⑤
… weil andere mir größere Job-Sicherheit bieten, wenn ich mich genug anstrenge (z.B. Arbeitgeber, Vorgesetzte).	①	②	③	④	⑤
… weil ich meine Arbeit verlieren kann, wenn ich mich nicht genug anstrenge.	①	②	③	④	⑤
… weil ich mir beweisen muss, dass ich es kann.	①	②	③	④	⑤
… weil ich dann stolz auf mich bin.	①	②	③	④	⑤
… weil ich mich sonst dafür schämen würde.	①	②	③	④	⑤
… weil ich mich sonst schlecht fühlen würde.	①	②	③	④	⑤
… weil ich es persönlich wichtig finde, mich bei dieser Arbeit anzustrengen.	①	②	③	④	⑤
… weil es meinen Werten entspricht, mich bei dieser Arbeit anzustrengen.	①	②	③	④	⑤
… weil es mir persönlich etwas bedeutet, mich bei dieser Arbeit anzustrengen.	①	②	③	④	⑤
… weil ich Spaß an meiner Arbeit habe.	①	②	③	④	⑤
… weil meine Arbeit spannend ist.	①	②	③	④	⑤
… weil meine Arbeit interessant ist.	①	②	③	④	⑤

In der Produktion werden immer mehr Technologien zur Effizienzsteigerung eingesetzt (z.B. Roboter).

Bitte denken Sie an bisherige Situationen, in denen neue Technologien in die Produktion eingeführt wurden. Wie schätzen Sie diese Veränderungen ein?

	trifft gar nicht zu				trifft voll und ganz zu
Ich sehe neue Technologien für meine Arbeit als Chance und nicht als Risiko.	①	②	③	④	⑤
Durch neue Technologien wird meine Arbeit eher erschwert als erleichtert.	①	②	③	④	⑤
Wenn eine neue Technologie in der Produktion eingeführt wird, möchte ich lieber meine gewohnte Tätigkeit ohne Technologie fortsetzen.	①	②	③	④	⑤
Wenn eine neue Technologie in der Produktion eingeführt wird, möchte ich sie für meine Arbeit nutzen.	①	②	③	④	⑤
Wenn eine neue Technologie in der Produktion eingeführt wird, hinterfrage ich ihre Vorteile.	①	②	③	④	⑤
Wenn eine neue Technologie in der Produktion eingeführt wird, bin ich begeistert über den technischen Fortschritt.	①	②	③	④	⑤
Wenn neue Technologien in der Produktion eingeführt werden, könnten diese meine Aufgaben übernehmen.	①	②	③	④	⑤
Die Einführung neuer Technologien in der Produktion macht meine Arbeit viel interessanter.	①	②	③	④	⑤
Es macht mir Spaß, neue Technologien für meine Arbeit kennenzulernen.	①	②	③	④	⑤
Ich erlerne gerne den Umgang mit neuen Technologien für meine Arbeit.	①	②	③	④	⑤

Abschließend möchten wir Sie noch um einige Angaben zu Ihrer Person bitten.

Wie alt sind Sie?

- ○ bis 25 Jahre
- ○ 26 bis 35 Jahre
- ○ 36 bis 50 Jahre
- ○ 51 Jahre und älter

Welches Geschlecht haben Sie?

- ○ weiblich
- ○ männlich

Sprechen Sie fließend deutsch?

- ○ ja
- ○ nein

Welchen Bildungsabschluss haben Sie?

- ○ Schule beendet ohne Abschluss
- ○ Volks-, Hauptschulabschluss
- ○ Mittlere Reife, Realschul- oder gleichwertiger Abschluss
- ○ Fachabitur, Fachhochschulreife
- ○ Abitur, Hochschulreife
- ○ Anderer Abschluss, und zwar: ______________________________

Welchen beruflichen Bildungsabschluss haben Sie?

- ○ keinen beruflichen Ausbildungsabschluss
- ○ abgeschlossene Berufsausbildung
- ○ abgeschlossene weiterführende Berufsausbildung (Meister-, Techniker- oder gleichwertiger Fachschulabschluss)
- ○ Anderer Abschluss, und zwar: ______________________________

Wie lange sind Sie schon im Unternehmen (ggf. mit Ausbildungszeit)?

○ unter 3 Jahre

○ 3 bis 5 Jahre

○ 6 bis 10 Jahre

○ 11 bis 25 Jahre

○ 26 Jahre und länger

Wie schätzen Sie Ihre Erfahrung mit Robotern ein?

① ② ③ ④ ⑤

gar keine Erfahrung — sehr viel Erfahrung

Wie viele Roboterschulungen haben Sie absolviert?

○ keine

○ eine

○ zwei oder mehr

Haben Sie Anregungen oder Anmerkungen zu dieser Befragung? (optional)

____

____

____

____

Sie sind am Ende der Befragung angekommen. Vielen Dank für Ihre Teilnahme!

Sie können sich nun an die Befragungsleiterin wenden.

Appendix F

Questionnaire Study 1 (Supervisor Version)

Befragung zur Wahrnehmung der Arbeit in der Produktion

Liebe/r Befragungsteilnehmer/in,

vielen Dank für Ihre Teilnahme an dieser Befragung.

In dieser Befragung wollen wir **Ihre Einschätzung** dazu erhalten, **wie Ihre Mitarbeiter**[9] **ihre Arbeit wahrnehmen**.

Auf den folgenden Seiten finden Sie verschiedene Fragen zur **Arbeit einer Ihrer Mitarbeiter,** der sein Einverständnis zur Beantwortung der Fragen durch Sie gegeben hat. Bitte halten Sie sich bei der Beantwortung der Fragen **diesen Mitarbeiter** vor Augen und beantworten Sie die Fragen in Bezug auf seine Arbeit.

Die Untersuchung verläuft **anonym**; individuelle Daten werden zu Mittelwerten zusammengefasst und keinen bestimmten Personen zugeordnet. Wir wollen keine individuellen Profile erstellen, uns interessieren vielmehr Gesetzmäßigkeiten, die über eine große Zahl von Personen hinweg Gültigkeit haben.

Ihre Antworten werden absolut **vertraulich** behandelt. Bitte beantworten Sie jede Frage so ehrlich und offen wie möglich. Es gibt keine richtigen oder falschen Antworten. Bei den Fragen wollen wir Ihre **ehrliche** Einschätzung zur Arbeit Ihres Mitarbeiters erhalten.

Bitte beantworten Sie die Fragen **in der Reihenfolge, in der die Seiten zusammengeheftet sind.** Die Bearbeitung des Fragebogens dauert ca. 15 Minuten. Sie können die Studie jederzeit ohne Angabe von Gründen abbrechen.

Wenn Ihnen während der Beantwortung der Fragen etwas unklar ist, fragen Sie bitte jederzeit nach.
Vielen Dank!

[9] Aus Gründen der besseren Lesbarkeit wird im Folgenden für „Mitarbeiter“ nur die männliche Form verwendet. Es sind aber stets Personen männlichen und weiblichen Geschlechts gleichermaßen gemeint.

Bitte geben Sie eine Einschätzung ab, wie Ihre Mitarbeiter ihre Arbeit im Moment wahrnehmen und wie sie sich ihre Arbeit wünschen.

Bitte geben Sie Ihre Einschätzung auf der Skala von 1 für *trifft gar nicht* zu bis 5 für *trifft voll und ganz zu* an.

	trifft gar nicht zu				trifft voll und ganz zu
Mein Mitarbeiter **kann** seine Arbeit zeitlich frei einteilen.	①	②	③	④	⑤
Mein Mitarbeiter **will** seine Arbeit zeitlich frei einteilen.	①	②	③	④	⑤
Mein Mitarbeiter **kann** selbst entscheiden, in welcher Reihenfolge er seine Arbeit macht.	①	②	③	④	⑤
Mein Mitarbeiter **will** selbst entscheiden, in welcher Reihenfolge er seine Arbeit macht.	①	②	③	④	⑤
Mein Mitarbeiter **kann** seine Arbeit so planen, wie er es möchte.	①	②	③	④	⑤
Mein Mitarbeiter **will** seine Arbeit so planen, wie er es möchte.	①	②	③	④	⑤
Mein Mitarbeiter **kann** selbst entscheiden, wie er seine Arbeit ausführt.	①	②	③	④	⑤
Mein Mitarbeiter **will** selbst entscheiden, wie er seine Arbeit ausführt.	①	②	③	④	⑤
Mein Mitarbeiter **kann** bei seiner Arbeit viele Entscheidungen selbstständig treffen.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei seiner Arbeit viele Entscheidungen selbstständig treffen.	①	②	③	④	⑤
Mein Mitarbeiter **hat** bei seiner Arbeit einen großen Entscheidungsspielraum.	①	②	③	④	⑤
Mein Mitarbeiter **wünscht** sich bei seiner Arbeit einen großen Entscheidungsspielraum.	①	②	③	④	⑤
Mein Mitarbeiter **kann** selbst entscheiden, mit welchen Methoden er seine Arbeit erledigt.	①	②	③	④	⑤
Mein Mitarbeiter **will** selbst entscheiden, mit welchen Methoden er seine Arbeit erledigt.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
Mein Mitarbeiter **kann** frei entscheiden, auf welche Art und Weise er seine Arbeit macht.	①	②	③	④	⑤
Mein Mitarbeiter **will** frei entscheiden, auf welche Art und Weise er seine Arbeit macht.	①	②	③	④	⑤
Mein Mitarbeiter **kann** selbst entscheiden, wie er seine Arbeit angeht.	①	②	③	④	⑤
Mein Mitarbeiter **will** selbst entscheiden, wie er seine Arbeit angeht.	①	②	③	④	⑤
Bei der Arbeit meines Mitarbeiters **gibt** es viel Abwechslung.	①	②	③	④	⑤
Mein Mitarbeiter **wünscht** sich bei seiner Arbeit viel Abwechslung.	①	②	③	④	⑤
Mein Mitarbeiter **tut** bei seiner Arbeit viele unterschiedliche Dinge.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei seiner Arbeit viele unterschiedliche Dinge tun.	①	②	③	④	⑤
Mein Mitarbeiter **muss** bei seiner Arbeit viele verschiedene Aufgaben bearbeiten.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei seiner Arbeit viele verschiedene Aufgaben bearbeiten.	①	②	③	④	⑤
Die Arbeit meines Mitarbeiters **beinhaltet** eine Vielzahl von Aufgaben.	①	②	③	④	⑤
Mein Mitarbeiter **will**, dass seine Arbeit eine Vielzahl von Aufgaben beinhaltet.	①	②	③	④	⑤
Die Arbeitsergebnisse meines Mitarbeiters **beeinflussen** die Qualität der Produkte der Daimler AG.	①	②	③	④	⑤
Mein Mitarbeiter **wünscht** sich, dass seine Arbeitsergebnisse die Qualität der Produkte der Daimler AG beeinflussen.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
Insgesamt betrachtet **ist** die Arbeit meines Mitarbeiters sehr wichtig.	①	②	③	④	⑤
Mein Mitarbeiter **wünscht** sich, dass seine Arbeit insgesamt betrachtet sehr wichtig ist.	①	②	③	④	⑤
Die Arbeit meines Mitarbeiters **hat** einen großen Einfluss auf die Qualität der Produkte der Daimler AG.	①	②	③	④	⑤
Mein Mitarbeiter **will**, dass seine Arbeit einen großen Einfluss auf die Qualität der Produkte der Daimler AG hat.	①	②	③	④	⑤
Die Arbeit meines Mitarbeiters **beinhaltet** Aufgaben mit erkennbarem Anfang und Ende.	①	②	③	④	⑤
Mein Mitarbeiter **wünscht** sich, dass seine Arbeit Aufgaben mit erkennbarem Anfang und Ende beinhaltet.	①	②	③	④	⑤
Mein Mitarbeiter **kann** bei seiner Arbeit vollständige Aufgaben von Anfang bis Ende bearbeiten.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei seiner Arbeit vollständige Aufgaben von Anfang bis Ende bearbeiten.	①	②	③	④	⑤
Mein Mitarbeiter **kann** bei seiner Arbeit angefangene Aufgaben auch zu Ende führen.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei seiner Arbeit angefangene Aufgaben auch zu Ende führen.	①	②	③	④	⑤
Mein Mitarbeiter **kann** bei seiner Arbeit angefangene Aufgaben auch abschließen.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei seiner Arbeit angefangene Aufgaben auch abschließen.	①	②	③	④	⑤
Die Arbeitstätigkeiten meines Mitarbeiters selbst (nicht Vorgesetzte oder Kollegen) **geben** ihm deutliche Hinweise darauf, wie gut er arbeitet.	①	②	③	④	⑤
Mein Mitarbeiter **wünscht** sich, dass ihm seine Arbeitstätigkeiten selbst deutliche Hinweise darauf geben, wie gut er arbeitet.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
Die Arbeit meines Mitarbeiters selbst **gibt** ihm Rückmeldung zu seiner Arbeitsleistung.	①	②	③	④	⑤
Mein Mitarbeiter **wünscht** sich, dass ihm seine Arbeit selbst Rückmeldung zu seiner Arbeitsleistung gibt.	①	②	③	④	⑤
Mein Mitarbeiter **kann** bei der Ausführung seiner Tätigkeit leicht feststellen, wie gut er arbeitet.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei der Ausführung seiner Tätigkeit leicht feststellen können, wie gut er arbeitet.	①	②	③	④	⑤
Die Arbeit meines Mitarbeiters **erfordert** viele Fähigkeiten.	①	②	③	④	⑤
Mein Mitarbeiter **will**, dass seine Arbeit viele Fähigkeiten erfordert.	①	②	③	④	⑤
Mein Mitarbeiter **muss** viele verschiedene Fähigkeiten einsetzen, um seine Arbeit zu erledigen.	①	②	③	④	⑤
Mein Mitarbeiter **will** viele verschiedene Fähigkeiten einsetzen, um seine Arbeit zu erledigen.	①	②	③	④	⑤
Mein Mitarbeiter **benötigt** bei seiner Arbeit komplexe Fähigkeiten.	①	②	③	④	⑤
Mein Mitarbeiter **wünscht** sich, dass er bei seiner Arbeit komplexe Fähigkeiten benötigt.	①	②	③	④	⑤
Die Arbeit meines Mitarbeiters **erfordert** den Einsatz einer Reihe von Fähigkeiten.	①	②	③	④	⑤
Mein Mitarbeiter **wünscht** sich, dass seine Arbeit den Einsatz einer Reihe von Fähigkeiten erfordert.	①	②	③	④	⑤
Mein Mitarbeiter **lernt** bei seiner Arbeit neue Dinge.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei seiner Arbeit neue Dinge lernen.	①	②	③	④	⑤
Mein Mitarbeiter **kann** sich bei seiner Arbeit persönlich entwickeln.	①	②	③	④	⑤
Mein Mitarbeiter **will** sich bei seiner Arbeit persönlich entwickeln.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
Die Arbeit meines Mitarbeiters **gibt** ihm das Gefühl, dass er etwas erreichen kann.	①	②	③	④	⑤
Mein Mitarbeiter **will**, dass ihm seine Arbeit das Gefühl gibt, dass er etwas erreichen kann.	①	②	③	④	⑤
Mein Mitarbeiter **kann** bei seiner Arbeit selbstständig denken und handeln.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei seiner Arbeit selbstständig denken und handeln.	①	②	③	④	⑤
Die Arbeit meines Mitarbeiters **erfordert** eine hohe körperliche Ausdauer.	①	②	③	④	⑤
Mein Mitarbeiter **will**, dass seine Arbeit eine hohe körperliche Ausdauer erfordert.	①	②	③	④	⑤
Die Arbeit meines Mitarbeiters **erfordert** viel Muskelkraft.	①	②	③	④	⑤
Mein Mitarbeiter **will**, dass seine Arbeit viel Muskelkraft erfordert.	①	②	③	④	⑤
Die Arbeit meines Mitarbeiters **ist** körperlich anstrengend.	①	②	③	④	⑤
Mein Mitarbeiter **will**, dass seine Arbeit körperlich anstrengend ist.	①	②	③	④	⑤
Mein Mitarbeiter **muss** bei seiner Arbeit sehr schnell arbeiten.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei seiner Arbeit sehr schnell arbeiten.	①	②	③	④	⑤
Mein Mitarbeiter **hat** für seine Arbeitsaufgaben wenig Zeit.	①	②	③	④	⑤
Mein Mitarbeiter **will** für seine Arbeitsaufgaben wenig Zeit haben.	①	②	③	④	⑤
Mein Mitarbeiter **muss** bei seiner Arbeit sehr hart arbeiten.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei seiner Arbeit sehr hart arbeiten.	①	②	③	④	⑤
Mein Mitarbeiter **hat** bei seiner Arbeit sehr viel zu tun.	①	②	③	④	⑤
Mein Mitarbeiter **will** bei seiner Arbeit sehr viel zu tun haben.	①	②	③	④	⑤

Vielen Dank. Sie sind am Ende der Fragen angekommen.

Abschließend möchten wir Sie noch um einige Angaben zu Ihrer Person bitten.

Wie alt sind Sie?

- ◯ bis 25 Jahre
- ◯ 26 bis 35 Jahre
- ◯ 36 bis 50 Jahre
- ◯ 51 Jahre und älter

Welches Geschlecht haben Sie?

- ◯ weiblich
- ◯ männlich

Sprechen Sie fließend deutsch?

- ◯ ja
- ◯ nein

Wie lange sind Sie schon im Unternehmen (ggf. mit Ausbildungszeit)?

- ◯ unter 3 Jahre
- ◯ 3 bis 5 Jahre
- ◯ 6 bis 10 Jahre
- ◯ 11 bis 25 Jahre
- ◯ 26 Jahre und länger

Welchen Bildungsabschluss haben Sie?

- ◯ Schule beendet ohne Abschluss
- ◯ Volks-, Hauptschulabschluss
- ◯ Mittlere Reife, Realschul- oder gleichwertiger Abschluss
- ◯ Fachabitur, Fachhochschulreife
- ◯ Abitur, Hochschulreife
- ◯ Anderer Abschluss, und zwar: ______________________________

Welchen beruflichen Bildungsabschluss haben Sie?

○ keinen beruflichen Ausbildungsabschluss

○ abgeschlossene Berufsausbildung

○ abgeschlossene weiterführende Berufsausbildung (Meister-, Techniker- oder gleichwertiger Fachschulabschluss)

○ Anderer Abschluss, und zwar: ____________________________

Für wie viele Mitarbeiter sind Sie verantwortlich?

○ 1 – 10 Mitarbeiter

○ 11 – 20 Mitarbeiter

○ > 20 Mitarbeiter

Wie schwierig war die Beantwortung der Fragen für Sie?

①	②	③	④	⑤
sehr einfach				sehr schwierig

Falls Sie die Beantwortung der Fragen schwierig fanden, warum?

____

____

____

Haben Sie Anregungen oder Anmerkungen zu dieser Befragung? (optional)

____

____

____

Sie sind am Ende der Befragung angekommen. Vielen Dank für Ihre Teilnahme!

Sie können sich nun an die Befragungsleiterin wenden.

Appendix G

Additional Variables Assessed in the Questionnaire in Study 2

Desired Work Characteristics. Desired work enrichment, desired work demands and desired task identity were assessed with the same items as for actual work characteristics (for details see section *7.3. measures*), and participants indicated how they *would like it* to be (desired work enrichment: e.g., “I want to decide for myself in what order I do my work.”, α = .86; desired work demands: e.g., “I want my job required a lot of physical effort.“, α = .72; desired task identity: e.g., “I want to work on complete tasks from beginning to end.“; α = .87).

Technology Self-Efficacy. Technology self-efficacy was assessed with five items based on Compeau and Higgins (1995), e.g., "I could complete my tasks using the robot if someone helped me at the beginning." as well as three self-developed items (e.g., “I believe that I can do my job with the LBR.”; α = .64)

Perceived Usefulness. Perceived usefulness was measured with three items based on Davis (1989) and Park (2009); e.g., "Using the robot would improve my performance at work." (α = .79).

Intention to Use. Intention to use the robot was assessed using two items based on Venkatesh and Davis (2000); e.g. "If I had access to the robot, I would use it for my work." (r = .77, p < .001).

Global Attitude Towards Technology. We used three items based on Park (2009), e.g. "It's a good idea to use the robot." (α = .87).

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Appendix H

Introductory Communication Texts Used in Study 2

<u>Version: Needs-Oriented Communication</u>

In diesem Video lernst du den Leichtbauroboter, kurz „LBR“ zu bedienen. Um ihn einzulernen, kannst du ihm Bewegungen ganz einfach vormachen. Dadurch kannst du ihn für verschiedene Bauteile anlernen. Das hat für dich den Vorteil, dass du flexibel bist, welches Bauteil du wann bearbeiten möchtest.

Wir möchten dir in diesem Video zeigen, wie du dem LBR das Schrauben beibringen kannst. Was du beim LBR alles einstellen kannst und wie du Fehler beheben kannst, wird in weiteren Videos genauer erklärt. Hier möchten wir dir erst einmal einen Überblick über den Anlernvorgang geben. Wir zeigen dir nun, wie du dem LBR das Verschrauben von zwei Schrauben beibringen kannst.

1. Um den LBR einzulernen, benutzt du ein Tablet. Die einfache Bedienung bietet jedem die Gelegenheit, den LBR auch ohne Programmierkenntnisse für den Einsatz zu trainieren. Du als Produktionsmitarbeiter bekommst die Chance, das Anlernen des LBR selbst zu übernehmen und dein Aufgabenfeld zu erweitern. Das Einlernen läuft folgendermaßen ab: Zu Beginn befindest du dich im Hauptmenü. Um den LBR für ein Bauteil anzulernen, erstellst du zuerst ein neues Programm. Klicke dazu „Neues Programm“ an. Dann kannst du mit dem Tablet ein Bild von deinem Bauteil machen. Dadurch kannst du das Programm im Menü leicht wiederfinden. Dann gibst du dem Programm einen Namen. Hier nennen wir das Programm „Test“. Dann klickst du auf „OK“. Nachdem das Programm erstellt wurde, gelangst du in den sogenannten „Einrichtbetrieb“.

2. Wähle zum Einlernen im Menü auf der linken Seite „Schrauben“ aus. In der unteren Leiste befinden sich Videos, die die Funktionen des LBR erklären. Sie können dir später einmal als Hilfe dienen. Im Moment kannst du sie aber ignorieren. Im Folgenden machst du dem LBR die Bewegung vor, indem du selbst verschraubst. Das merkt sich der LBR und macht es nach. Das Vorgehen ist wie beim Einlernen eines neuen Mitarbeiters. Um ihm die Bewegung zu zeigen, berührst du ihn zum Start, damit er weich wird. Führe ihn dann möglichst senkrecht auf die Schraube. Dann kannst du ihn wie einen Akkuschrauber bedienen: Du hältst den Knopf unten am Schraubarm gedrückt und schraubst die Schraube fest. Wenn die Schraube festsitzt, drückst du einmal kurz den grünen Knopf vorne am LBR. Dadurch speicherst du den eben eingelernten Schraubpunkt.

   Nun kannst du den LBR zur nächsten Schraube führen. Hier gehst du genauso vor. Du führst den Arm senkrecht auf die Schraube. Dann drückst du den Knopf unten am Schraubarm und schraubst die Schraube fest. Dann speicherst du den zweiten Punkt wieder durch einen Druck auf den grünen Knopf. Wenn du mit dem Einlernen fertig bist, bringst du den LBR wieder in eine freie Position. Dann hältst du den grünen Knopf gedrückt, bis das Licht des LBR rot leuchtet.

Auf dem Bildschirm kannst du die Bahnen und Schraubpunkte sehen. Die Punkte kannst du an die Stelle schieben, wo sich die Schrauben befinden. So kannst du den Ablauf des Programms gut nachvollziehen.

3. Nun kannst du testen, ob der LBR die richtige Bewegung ausführt. Auf dem Tablet wählst du im linken Menü „Testen“ aus. Hier gibt es zwei Möglichkeiten, die Bewegungen zu testen. Entweder kannst du über einen Klick auf „Bahnen“ nur die Bewegung ohne Schrauben abfahren. Oder du kannst über „Bahnen und Fähigkeiten“ die Bewegungen und das Schrauben testen. Hier wollen wir beides testen, deshalb klickst du auf “Bahnen und Fähigkeiten“. Nun musst du den LBR wieder berühren. Dann startet der Testlauf. Der LBR prüft nun alle Arbeitsschritte, die du ihm gezeigt hast, in langsamer Geschwindigkeit.

   Parallel zum Testlauf kannst du auf dem Bildschirm alle Bewegungen sehen. So kannst du den Ablauf gut überprüfen. Du hast stets im Blick, was der LBR tut. Du kannst beobachten, wie die Bahnen und Schraubpunkte grün leuchten, wenn alles richtig abläuft. Sollten Probleme auftreten, kannst du sie selbst beheben. Du kannst zum Beispiel auf die Hilfsvideos zurückgreifen oder die Bewegung des LBR direkt während des Testlaufs ausbessern. Du bekommst dadurch die Chance, eigenständiger zu handeln und bist unabhängiger von Experten.

4. Wenn der Test abgeschlossen ist, kannst du das von dir erstellte Programm für den Automatikbetrieb freigeben. Dazu drückst du im linken Menü auf „Freigabe“ und dann auf „Programm freigeben“. Dann berührst du den LBR wieder zum Starten. Nun führt er das eben gelernte Programm einmal in voller Geschwindigkeit aus. War die Freigabe erfolgreich, wird das Programm automatisch gespeichert.

Du hast den Anlernvorgang gemeistert. Ab jetzt führt der LBR genau die Bewegung aus, die du ihm gezeigt hast. Das bedeutet für dich, dass du zum Einlernen des LBR deine technischen Fähigkeiten einsetzen kannst und deine Arbeit anspruchsvoller wird.

Der gesamte Vorgang des Einlernens ermöglicht es dir, etwas zu tun, das vorher nur Experten tun konnten. Du bekommst die Möglichkeit, dich weiterzubilden und dein technisches Wissen zu vertiefen. Da die Erfahrung mit Robotern immer wichtiger wird, machen dich die neuen LBR-Kenntnisse fit für die Zukunft.

Version: Information-Focused Communcation

Dieses Video handelt von dem Leichtbauroboter, kurz „LBR“. Um den LBR einzulernen, kann man ihm Bewegungen ganz einfach vormachen. Dadurch kann man ihn für verschiedene Bauteile anlernen.

Wir möchten in diesem Video zeigen, wie man dem LBR das Schrauben beibringen kann. Was man beim LBR alles einstellen kann und wie man Fehler beheben kann, wird in weiteren Videos genauer erklärt. Hier möchten wir erstmal einen Überblick über den Anlernvorgang geben. Wir zeigen nun, wie man dem LBR das Verschrauben von zwei Schrauben beibringen kann.

1. Um den LBR einzulernen, benutzt man ein Tablet. Die einfache Bedienung bedeutet für jeden, dass er den LBR auch ohne Programmierkenntnisse für den Einsatz trainieren kann. Das Einlernen läuft folgendermaßen ab: Zu Beginn befindet man sich im Hauptmenü. Um den LBR für ein Bauteil anzulernen, erstellt man zuerst ein neues Programm. Dazu klickt man „Neues Programm“ an. Dann kann man direkt mit dem Tablet ein Bild von seinem Bauteil machen. Dadurch findet man das Programm im Menü leicht wieder. Dann gibt man dem Programm einen Namen. Hier nennen wir das Programm „Test“. Dann klickt man auf „OK“. Nachdem das Programm erstellt wurde, gelangt man in den sogenannten „Einrichtbetrieb“.

2. Man wählt im Menü auf der linken Seite „Schrauben“ aus. In der unteren Leiste befinden sich Videos, die die Funktionen des LBR erklären. Sie können später einmal als Hilfe dienen. Im Moment kann man sie aber ignorieren. Im Folgenden zeigt man dem LBR die Bewegung, indem man selbst verschraubt. Das merkt sich der LBR und macht es nach. Um ihm die Bewegung zu zeigen, berührt man ihn zum Start, damit er weich wird. Dann führt man ihn möglichst senkrecht auf die Schraube. Dann kann man ihn wie einen Akkuschrauber bedienen: Man hält den Knopf unten am Schraubarm gedrückt und schraubt die Schraube fest. Wenn die Schraube festsitzt, drückt man einmal kurz den grünen Knopf vorne am LBR. Dadurch speichert man den eben eingelernten Schraubpunkt.

   Nun kann man den LBR zur nächsten Schraube führen. Hier geht man genauso vor. Man führt den Arm senkrecht auf die Schraube. Dann drückt man den Knopf unten am Schraubarm und schraubt die Schraube fest. Dann speichert man den zweiten Punkt wieder durch einen Druck auf den grünen Knopf. Wenn man mit dem Einlernen fertig ist, bringt man den LBR wieder in eine freie Position. Dann hält man den grünen Knopf gedrückt, bis das Licht des LBR rot leuchtet.

   Auf dem Bildschirm kann man die Bahnen und Schraubpunkte sehen. Diese kann man an die Stelle schieben, wo sich die Schrauben befinden. So kann man den Ablauf des Programms gut nachvollziehen.

3. Nun kann man testen, ob der LBR die richtige Bewegung ausführt. Auf dem Tablet wählt man im linken Menü „Testen“ aus. Hier gibt es zwei Möglichkeiten, die Bewegungen zu testen. Entweder kann man über einen Klick auf „Bahnen“ nur die Bewegungen ohne Schrauben abfahren. Oder man kann über „Bahnen und Fähigkeiten“ die Bewegungen und das Schrauben testen. Hier wollen wir beides testen, deshalb klickt

man auf “Bahnen und Fähigkeiten“. Nun muss man den LBR wieder berühren. Dann startet der Testlauf. Der LBR prüft nun alle Arbeitsschritte, die ihm gezeigt wurden, in langsamer Geschwindigkeit.

Parallel zum Testlauf kann man auf dem Bildschirm alle Bewegungen sehen. So kann man den Ablauf gut überprüfen. Man hat stets im Blick, was der LBR tut. Man kann beobachten, wie die Bahnen und Schraubpunkte grün leuchten, wenn alles richtig abläuft. Sollten Probleme auftreten, kann man sie selbst beheben. Man kann zum Beispiel auf die Hilfsvideos zurückgreifen oder die Bewegung des LBR direkt während des Testlaufs ausbessern.

4. Wenn der Test abgeschlossen ist, kann man das selbst erstellte Programm für den Automatikbetrieb freigeben. Dafür drückt man im linken Menü auf „Freigabe“ und dann auf „Programm freigeben“. Dann berührt man den LBR wieder zum Starten. Nun führt er das eben gelernte Programm einmal in voller Geschwindigkeit aus. War die Freigabe erfolgreich, wird das Programm automatisch gespeichert.

Der Anlernvorgang ist beendet. Ab jetzt führt der LBR genau die Bewegung aus, die ihm gezeigt wurde.

Appendix I

First Questionnaire Study 2

Studie zum Einsatz von Leichtbaurobotern in der Produktion

Liebe/r Teilnehmer/in,

in dieser Studie wollen wir Ihre Einschätzung zum Einsatz von **Leichtbaurobotern (LBR) in der Produktion** erfahren. Dazu bitten wir Sie, zuerst den folgenden Fragebogen auszufüllen. Anschließend zeigen wir Ihnen ein Video, in dem der LBR vorgestellt wird. Zuletzt folgt eine Nachbefragung. Die Studie dauert insgesamt ca. 30 Minuten.

Die Untersuchung verläuft **anonym**; individuelle Daten werden zu Mittelwerten zusammengefasst und keinen bestimmten Personen zugeordnet. Wir wollen keine individuellen Profile erstellen, uns interessieren vielmehr Gesetzmäßigkeiten, die über eine große Zahl von Personen hinweg Gültigkeit haben.

Ihre Antworten werden absolut **vertraulich** behandelt. Bitte beantworten Sie jede Frage so ehrlich und offen wie möglich. Es gibt keine richtigen oder falschen Antworten. Bei den Fragen wollen wir Ihre **ehrliche** Einschätzung zu Ihrer Arbeit erhalten.

Die Teilnahme an dieser Studie ist **freiwillig**. Sie können die Studie jederzeit ohne Angabe von Gründen abbrechen.

Wenn Ihnen während der Beantwortung der Fragen etwas unklar ist, fragen Sie bitte jederzeit nach.

Vielen Dank!

Bitte geben Sie im Folgenden an, wie Sie Ihre Arbeit heute wahrnehmen und wie Sie sich Ihre Arbeit wünschen würden.

Bitte geben Sie Ihre Einschätzung auf der Skala von 1 für *trifft gar nicht* zu bis 5 für *trifft voll und ganz zu* an.

	trifft gar nicht zu				trifft voll und ganz zu
Ich **kann** selbst entscheiden, in welcher Reihenfolge ich meine Arbeit mache.	①	②	③	④	⑤
Ich **will** selbst entscheiden, in welcher Reihenfolge ich meine Arbeit mache.	①	②	③	④	⑤
Ich **kann** bei meiner Arbeit viele Entscheidungen selbstständig treffen.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit viele Entscheidungen selbstständig treffen.	①	②	③	④	⑤
Ich **kann** frei entscheiden, auf welche Art und Weise ich meine Arbeit mache.	①	②	③	④	⑤
Ich **will** frei entscheiden, auf welche Art und Weise ich meine Arbeit mache.	①	②	③	④	⑤
Bei meiner Arbeit **tue** ich viele unterschiedliche Dinge.	①	②	③	④	⑤
Bei meiner Arbeit **will** ich viele unterschiedliche Dinge tun.	①	②	③	④	⑤
Meine Arbeit **hat** einen großen Einfluss auf die Qualität der Produkte der Daimler AG.	①	②	③	④	⑤
Ich **will**, dass meine Arbeit einen großen Einfluss auf die Qualität der Produkte der Daimler AG hat.	①	②	③	④	⑤
Ich **kann** bei meiner Arbeit vollständige Aufgaben von Anfang bis Ende bearbeiten.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit vollständige Aufgaben von Anfang bis Ende bearbeiten.	①	②	③	④	⑤
Bei der Ausführung meiner Tätigkeit **kann** ich leicht feststellen, wie gut ich arbeite.	①	②	③	④	⑤
Bei der Ausführung meiner Tätigkeit **will** ich leicht feststellen können, wie gut ich arbeite.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
Ich **muss** viele verschiedene Fähigkeiten einsetzen, um meine Arbeit zu erledigen.	①	②	③	④	⑤
Ich **will** viele verschiedene Fähigkeiten einsetzen, um meine Arbeit zu erledigen.	①	②	③	④	⑤
Bei meiner Arbeit **lerne** ich neue Dinge.	①	②	③	④	⑤
Bei meiner Arbeit **will** ich neue Dinge lernen.	①	②	③	④	⑤
Meine Arbeit **ist** körperlich anstrengend.	①	②	③	④	⑤
Ich **will**, dass meine Arbeit körperlich anstrengend ist.	①	②	③	④	⑤
Ich **muss** bei meiner Arbeit sehr schnell arbeiten.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit sehr schnell arbeiten.	①	②	③	④	⑤
Ich **habe** bei meiner Arbeit sehr viel zu tun.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit sehr viel zu tun haben.	①	②	③	④	⑤
Ich **fühle** mich für meine Arbeit persönlich verantwortlich.	①	②	③	④	⑤
Ich **will** mich für meine Arbeit persönlich verantwortlich fühlen.	①	②	③	④	⑤

Sie sind am Ende der Vorbefragung angekommen. Vielen Dank für Ihre Antworten!

Sie können sich nun an die Studienleiterin wenden

Appendix J

Second Questionnaire Study 2

Sie haben soeben ein Video über den Leichtbauroboter (LBR) gesehen. Nun wollen wir Ihre **Einschätzung zu dem LBR** erfahren. Auf den folgenden Seiten finden Sie daher verschiedene **Fragen zu dem LBR**. Bitte geben Sie Ihre Einschätzung auf der Skala von 1 für *trifft gar nicht* zu bis 5 für *trifft voll und ganz zu* an.

Wie bewerten Sie den LBR für Ihre Arbeit?

	trifft gar nicht zu				trifft voll und ganz zu
Ich sehe den LBR für meine Arbeit als Chance und nicht als Risiko.	①	②	③	④	⑤
Durch den LBR wird meine Arbeit eher erschwert als erleichtert.	①	②	③	④	⑤
Wenn der LBR in der Produktion eingeführt wird, möchte ich lieber meine gewohnte Tätigkeit ohne den LBR fortsetzen.	①	②	③	④	⑤
Wenn der LBR in der Produktion eingeführt wird, möchte ich ihn für meine Arbeit nutzen.	①	②	③	④	⑤
Durch die Einführung des LBR könnte mein jetziger Arbeitsplatz überflüssig werden.	①	②	③	④	⑤
Wenn der LBR in der Produktion eingeführt wird, bin ich begeistert über den technischen Fortschritt.	①	②	③	④	⑤
Wenn der LBR in der Produktion eingeführt wird, könnte er meine Aufgaben übernehmen.	①	②	③	④	⑤
Die Einführung des LBR in der Produktion macht meine Arbeit viel interessanter.	①	②	③	④	⑤
Der LBR könnte mich als Arbeitskraft ersetzen.	①	②	③	④	⑤
Es macht mir Spaß, den LBR kennenzulernen.	①	②	③	④	⑤

Ich erlerne gerne den Umgang mit dem LBR für meine Arbeit.	①	②	③	④	⑤

Stellen Sie sich vor, dass Sie den LBR zukünftig auf der Arbeit benutzen. Wie schätzen Sie sich selbst dabei ein?

Ich könnte meine Aufgaben mithilfe des LBR erledigen …

	trifft gar nicht zu				trifft voll und ganz zu
… wenn ich bei Problemen jemanden zur Hilfe holen könnte.	①	②	③	④	⑤
… wenn mir zu Beginn jemand helfen würde.	①	②	③	④	⑤
… wenn ich keine genaue Anleitung dafür habe.	①	②	③	④	⑤
… wenn mir vorher jemand gezeigt hätte, wie es geht.	①	②	③	④	⑤
… wenn ich vorher noch nie mit dem LBR gearbeitet habe.	①	②	③	④	⑤

Inwiefern stimmen Sie den folgenden Aussagen zu?

Ich glaube daran, dass ich den LBR bedienen kann.	①	②	③	④	⑤
Ich glaube, dass ich mit dem LBR meine Aufgaben erledigen kann.	①	②	③	④	⑤
Ich bin mir sicher, dass ich auch schwierige Aufgaben mit dem LBR bearbeiten kann.	①	②	③	④	⑤

Denken Sie nun weiterhin an die Arbeit mit dem LBR. Wie schätzen Sie die Nutzung ein?

Den LBR zu benutzen, würde …

	trifft gar nicht zu				trifft voll und ganz zu
… meine Leistung bei der Arbeit verbessern.	①	②	③	④	⑤
… mir helfen, mit weniger Aufwand mehr Ergebnisse zu erzielen.	①	②	③	④	⑤
… es mir einfacher machen, meine Arbeit zu erledigen.	①	②	③	④	⑤

Inwiefern stimmen Sie den folgenden Aussagen zu?

	trifft gar nicht zu				trifft voll und ganz zu
Wenn ich Zugang zum LBR hätte, würde ich ihn für meine Arbeit benutzen.	①	②	③	④	⑤
Wenn ich die Möglichkeit habe, den LBR für meine Arbeit zu benutzen, würde ich es tun.	①	②	③	④	⑤
Es ist eine gute Idee, den LBR zu benutzen.	①	②	③	④	⑤
Ich bin dem LBR gegenüber positiv eingestellt.	①	②	③	④	⑤
Es ist eine kluge Idee, den LBR zu benutzen.	①	②	③	④	⑤

Abschließend möchten wir Sie noch um einige Angaben zu Ihrer Person bitten.

Wie alt sind Sie?

☐ bis 25 Jahre

☐ 26 bis 35 Jahre

☐ 36 bis 50 Jahre

☐ 51 Jahre und älter

Welches Geschlecht haben Sie?

☐ weiblich

☐ männlich

☐ divers

Sprechen Sie fließend deutsch?

☐ ja

☐ nein

Welchen Bildungsabschluss haben Sie?

☐ Schule beendet ohne Abschluss

☐ Volks-, Hauptschulabschluss

☐ Mittlere Reife, Realschul- oder gleichwertiger Abschluss

☐ Fachabitur, Fachhochschulreife

☐ Abitur, Hochschulreife

☐ Anderer Abschluss, und zwar: ________________________________

Welchen beruflichen Bildungsabschluss haben Sie?

☐ keinen beruflichen Ausbildungsabschluss

☐ abgeschlossene Berufsausbildung

☐ abgeschlossene weiterführende Berufsausbildung (Meister-, Techniker- oder gleichwertiger Fachschulabschluss)

☐ anderer Abschluss, und zwar: _________________________________

Wie schätzen Sie Ihre Erfahrung mit Robotern ein?

① ② ③ ④ ⑤

gar keine Erfahrung — sehr viel Erfahrung

Wie viele Roboterschulungen haben Sie absolviert?

☐ keine

☐ eine

☐ zwei oder mehr

Welche Funktion haben Sie bei Ihrer Arbeit?

☐ Montagemitarbeiter

☐ Linienführer

☐ Systemführer

☐ Prüffeld

☐ Nacharbeit

☐ Sonstiges: ____

Haben Sie Anregungen oder Anmerkungen zu dieser Befragung? (optional)

____

____

____

____

Sie sind am Ende der Befragung angekommen. Vielen Dank für Ihre Teilnahme!

Sie können sich nun an die Studienleiterin wenden.

Appendix K

Additional Variables Assessed in the Questionnaire in Study 3

General Job Insecurity was assessed with the four items of the Job Insecurity Scale (Vander Elst, De Witte & De Cuyper, 2014; e.g., "I feel insecure about the future of my job."; α = .81, ω = .82)

Perceived Usefulness was assessed with two items adapted from Venkatesh & Davis (2000, e.g., g., I would find the lightweight robot useful for screwing at work."; $r = .80$, $p <$ .01).

Perceived Ease of Use with two items from Davis (1989; e.g., I think the lightweight robot is easy to use."; $r = .76$, $p < .01$).

Behavioral Intention to Use. We used two self-developed items based on Venkatesh und Davis (2000; e.g., "If I had to screw at work, I'd like to use the lightweight robot."; $r =$ .86, $p < .01$)

References

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Vander Elst, T., De Witte, H., & De Cuyper, N. (2014). The Job Insecurity Scale: A psychometric evaluation across five European countries. *European Journal of Work and Organizational Psychology*, *23*, 364-380.

Venkatesh, V. & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science, 46*, 186-204.

Appendix L

Details on Assessed Attitudes Towards new Technology in Study 3

Table A7

List of All Items Used to Assess Technology Enthusiasm, Resistance to Change, and Technology-Based Job Insecurity

Dependent Variable	Item
Technology Enthusiasm	I consider these robots for my work as an opportunity and not as a risk.
	If these robots are introduced into production, I want to use them for my work.
	When these robots are introduced into production, I am excited about technical progress.
	The introduction of these robots in production makes my work much more interesting.
	I enjoy getting to know these robots for my work.
	I enjoy learning how to use these robots for my work.
Resistance to Change	If these robots are introduced in production, I prefer to continue my usual activity without the robot.
	These robots make my work more difficult than easier.
Technology-Based Job Insecurity	These robots might replace me as a worker.
	The introduction of these robots could make my current workplace superfluous.
	If these robots are introduced in production, they could take over my tasks.
	Chances are I will soon lose my job because of these robots.
	I am sure I can keep my job if these robots are used. (R)
	I feel insecure about the future of my job because of these robots.
	I think I might lose my job in the near future because of these robots.

Appendix M

First Questionnaire Study 3

[Additional information provided in the enactive mastery experience condition is given in square brackets.]

Studie zur Bewertung eines leicht einlernbaren Roboters

Liebe/r Teilnehmer/in,

in dieser Studie interessiert uns, wie Sie einen leicht einlernbaren **Leichtbauroboter (LBR)** bewerten. Zuerst bitten wir Sie, den folgenden Fragebogen auszufüllen. Dann lernen Sie den LBR kennen: Sie sehen ein **Video über den LBR** [und dürfen ihn **selbst bedienen]**. Zuletzt sollen Sie den LBR mit einem Fragebogen bewerten. Die Studie dauert insgesamt ca. 25 Minuten.

Die Untersuchung verläuft **anonym**; individuelle Daten werden zu Mittelwerten zusammengefasst und keinen bestimmten Personen zugeordnet. Wir wollen keine individuellen Profile erstellen, uns interessieren vielmehr Gesetzmäßigkeiten, die über eine große Zahl von Personen hinweg Gültigkeit haben.

Ihre Antworten werden absolut **vertraulich** behandelt. Bitte beantworten Sie jede Frage so ehrlich und offen wie möglich. Es gibt keine richtigen oder falschen Antworten. Bei den Fragen wollen wir Ihre **ehrliche** Einschätzung zu Ihrer Arbeit erhalten.

Die Teilnahme an dieser Studie ist **freiwillig**. Sie können die Studie jederzeit ohne Angabe von Gründen abbrechen.

Wenn Ihnen während der Beantwortung der Fragen etwas unklar ist, fragen Sie bitte jederzeit nach.

Vielen Dank!

Bitte geben Sie im Folgenden an, wie Sie Ihre Arbeit heute wahrnehmen und wie Sie sich Ihre Arbeit wünschen würden.

Bitte geben Sie Ihre Einschätzung auf der Skala von 1 für *trifft gar nicht* zu bis 5 für *trifft voll und ganz zu* an, indem Sie ein Kreuz machen.

	trifft gar nicht zu				trifft voll und ganz zu
Ich **kann** selbst entscheiden, in welcher Reihenfolge ich meine Arbeit mache.	①	②	③	④	⑤
Ich **will** selbst entscheiden, in welcher Reihenfolge ich meine Arbeit mache.	①	②	③	④	⑤
Ich **kann** bei meiner Arbeit viele Entscheidungen selbstständig treffen.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit viele Entscheidungen selbstständig treffen.	①	②	③	④	⑤
Ich **kann** frei entscheiden, auf welche Art und Weise ich meine Arbeit mache.	①	②	③	④	⑤
Ich **will** frei entscheiden, auf welche Art und Weise ich meine Arbeit mache.	①	②	③	④	⑤
Bei meiner Arbeit **tue** ich viele unterschiedliche Dinge.	①	②	③	④	⑤
Bei meiner Arbeit **will** ich viele unterschiedliche Dinge tun.	①	②	③	④	⑤
Meine Arbeit **hat** einen großen Einfluss auf die Qualität der Produkte der Daimler AG.	①	②	③	④	⑤
Ich **will**, dass meine Arbeit einen großen Einfluss auf die Qualität der Produkte der Daimler AG hat.	①	②	③	④	⑤
Ich **kann** bei meiner Arbeit vollständige Aufgaben von Anfang bis Ende bearbeiten.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit vollständige Aufgaben von Anfang bis Ende bearbeiten.	①	②	③	④	⑤
Bei der Ausführung meiner Tätigkeit **kann** ich leicht feststellen, wie gut ich arbeite.	①	②	③	④	⑤
Bei der Ausführung meiner Tätigkeit **will** ich leicht feststellen können, wie gut ich arbeite.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
Ich **muss** viele verschiedene Fähigkeiten einsetzen, um meine Arbeit zu erledigen.	①	②	③	④	⑤
Ich **will** viele verschiedene Fähigkeiten einsetzen, um meine Arbeit zu erledigen.	①	②	③	④	⑤
Bei meiner Arbeit **lerne** ich neue Dinge.	①	②	③	④	⑤
Bei meiner Arbeit **will** ich neue Dinge lernen.	①	②	③	④	⑤
Meine Arbeit **ist** körperlich anstrengend.	①	②	③	④	⑤
Ich **will**, dass meine Arbeit körperlich anstrengend ist.	①	②	③	④	⑤
Ich **muss** bei meiner Arbeit sehr schnell arbeiten.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit sehr schnell arbeiten.	①	②	③	④	⑤
Ich **habe** bei meiner Arbeit sehr viel zu tun.	①	②	③	④	⑤
Ich **will** bei meiner Arbeit sehr viel zu tun haben.	①	②	③	④	⑤

Wie schätzen Sie Ihre Roboterkenntnisse ein?

	trifft gar nicht zu				trifft voll und ganz zu
Ich kann gut mit Robotern umgehen.	①	②	③	④	⑤
Ich fühle mich in der Lage, eine neue Aufgabe mit einem Roboter auszuprobieren.	①	②	③	④	⑤
Ich glaube, dass ich schwierige Roboterarbeit machen könnte.	①	②	③	④	⑤
Ich bin sicher, dass ich gut mit Robotern arbeiten kann.	①	②	③	④	⑤
Die Nutzung eines Roboters bei der Arbeit wäre sehr schwierig für mich.	①	②	③	④	⑤

Wie denken Sie über die Sicherheit Ihrer Arbeit?

	trifft gar nicht zu				trifft voll und ganz zu
Es ist möglich, dass ich bald meine Arbeit verliere.	①	②	③	④	⑤
Ich bin sicher, dass ich meine Arbeit behalten kann.	①	②	③	④	⑤
Ich bin unsicher über die Zukunft meiner Arbeit.	①	②	③	④	⑤
Ich denke, ich werde meine Arbeit in naher Zukunft verlieren.	①	②	③	④	⑤

Sie sind am Ende der Vorbefragung angekommen. Vielen Dank für Ihre Antworten.

Als Nächstes sehen Sie ein Video über den Leichtbauroboter (LBR) zum Schrauben und dürfen ihn selbst bedienen.
Hinweis: Das Schrauben ist eine beispielhafte Anwendung des LBR. Den LBR kann man auch für viele andere Aufgaben nutzen (z.B. Greifen, Kleben, usw.).
Viel Spaß!

Sie können sich nun an die Studienleiterin wenden.

Appendix N

Second Questionnaire Study 3

Sie haben gerade ein Video über den **Leichtbauroboter (LBR) zum Schrauben** gesehen [und ihn bedient]. Bitte bewerten sie nun diese Roboter. Wichtig ist, dass man den LBR nicht nur für das Schrauben verwenden kann. **Den LBR kann man auch für viele andere Aufgaben nutzen (z.B. Greifen, Kleben, usw.). Uns interessiert Ihre allgemeine Meinung zu solchen leicht bedienbaren Robotern wie dem LBR.**

Bitte beantworten Sie die Fragen auf der Skala von 1 für *„trifft gar nicht zu"* bis 5 für *„trifft voll und ganz zu"* an, indem Sie ein Kreuz machen.

Wie bewerten Sie diese Roboter für Ihre Arbeit?

	trifft gar nicht zu				trifft voll und ganz zu
Ich sehe diese Roboter für meine Arbeit als Chance und nicht als Risiko.	①	②	③	④	⑤
Diese Roboter würden meine Arbeit eher erschweren als erleichtern.	①	②	③	④	⑤
Wenn diese Roboter in der Produktion eingeführt würden, möchte ich lieber meine gewohnte Tätigkeit ohne Roboter fortsetzen.	①	②	③	④	⑤
Wenn diese Roboter in der Produktion eingeführt würden, möchte ich gerne damit arbeiten.	①	②	③	④	⑤
Durch die Einführung dieser Roboter könnte mein jetziger Arbeitsplatz überflüssig werden.	①	②	③	④	⑤
Wenn diese Roboter in der Produktion eingeführt würden, bin ich begeistert über den technischen Fortschritt.	①	②	③	④	⑤
Wenn diese Roboter in der Produktion eingeführt würden, könnten sie meine Aufgaben übernehmen.	①	②	③	④	⑤

Die Einführung dieser Roboter in der Produktion macht meine Arbeit viel interessanter.	①	②	③	④	⑤
Diese Roboter könnten mich als Arbeitskraft ersetzen.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
Es macht mir Spaß, diese Roboter kennenzulernen.	①	②	③	④	⑤
Ich erlerne gerne den Umgang mit diesen Robotern für meine Arbeit.	①	②	③	④	⑤
Ich könnte meine Arbeit durch diese Roboter bald verlieren.	①	②	③	④	⑤
Ich bin sicher, ich kann meine Arbeit behalten, auch wenn diese Roboter eingesetzt werden.	①	②	③	④	⑤
Wegen dieser Roboter bin ich unsicher über die Zukunft meiner Arbeit.	①	②	③	④	⑤
Ich denke, ich werde meine Arbeit in naher Zukunft durch diese Roboter verlieren.	①	②	③	④	⑤

Was denken Sie: Wie gut können Sie mit dem LBR umgehen?

	trifft gar nicht zu				trifft voll und ganz zu
Ich denke, ich kann gut mit dem LBR arbeiten.	①	②	③	④	⑤
Ich fühle mich in der Lage, eine neue Aufgabe mit dem LBR auszuprobieren.	①	②	③	④	⑤
Ich bin mir sicher, dass ich auch schwierige Aufgaben mit dem LBR bearbeiten kann.	①	②	③	④	⑤
Ich bin sicher, dass ich in der Bedienung des LBR gut bin.	①	②	③	④	⑤

Bitte bewerten Sie den LBR für die Arbeit des Schraubens.

	trifft gar nicht zu				trifft voll und ganz zu
Ich finde den LBR für die Arbeit des Schraubens nützlich.	①	②	③	④	⑤
Den LBR zu verwenden, würde das Schrauben effektiver machen.	①	②	③	④	⑤
Ich denke es ist einfach, die Benutzung des LBR zu lernen.	①	②	③	④	⑤
Ich denke, dass der LBR einfach zu benutzen ist.	①	②	③	④	⑤
Wenn ich bei der Arbeit schrauben müsste, würde ich den LBR gerne nutzen.	①	②	③	④	⑤
Wenn ich eine Aufgabe mit Schrauben machen müsste, würde ich den LBR nutzen wollen.	①	②	③	④	⑤

Stellen Sie sich vor, Sie würden bei der Arbeit eine Aufgabe mit einem LBR bekommen. Wie schätzen Sie die folgenden Aussagen ein?

Ich denke, dass ich bei der Benutzung eines LBR…

	trifft gar nicht zu				trifft voll und ganz zu
…die Arbeit zeitlich frei einteilen kann.	①	②	③	④	⑤
…viele Entscheidungen selbstständig treffen kann.	①	②	③	④	⑤
...frei entscheiden kann, auf welche Art und Weise ich die Arbeit mache.	①	②	③	④	⑤
…viele unterschiedliche Dinge tun kann.	①	②	③	④	⑤
…eine vollständige Aufgabe von Anfang bis Ende bearbeiten kann.	①	②	③	④	⑤

	trifft gar nicht zu				trifft voll und ganz zu
…leicht feststellen kann, wie gut ich arbeite.	①	②	③	④	⑤
…viele verschiedene Fähigkeiten einsetzen kann.	①	②	③	④	⑤
…neue Dinge lerne.	①	②	③	④	⑤
…körperlich angestrengt bin.	①	②	③	④	⑤
…sehr schnell arbeiten muss.	①	②	③	④	⑤
…sehr viel zu tun habe.	①	②	③	④	⑤

Wie schätzen Sie Ihre Erfahrung mit Robotern ein?

①	②	③	④	⑤
gar keine Erfahrung				sehr viel Erfahrung

Abschließend möchten wir Sie noch um einige Angaben zu Ihrer Person bitten.

Wie alt sind Sie?

☐ bis 25 Jahre

☐ 26 bis 35 Jahre

☐ 36 bis 50 Jahre

☐ 51 Jahre und älter

Welches Geschlecht haben Sie?

☐ weiblich

☐ männlich

☐ divers

Welchen Bildungsabschluss haben Sie?

☐ kein Abschluss oder Hauptschule

☐ Mittlere Reife, Realschul- oder gleichwertiger Abschluss

☐ Fachabitur oder höher

Welche Funktion haben Sie bei Ihrer Arbeit?

☐ Montagemitarbeiter

☐ Linienführer oder Systemführer

☐ Qualitätsprüfung

☐ Sonstiges: ____

Haben Sie Anregungen oder Anmerkungen zu dieser Befragung? (optional)

____

____

____

Sie sind am Ende der Befragung angekommen. Vielen Dank für Ihre Teilnahme!

Sie können sich nun an die Studienleiterin wenden.

Appendix O

Pre-Registration of Study 3

ASPREDICTED

Wharton CREDIBILITY LAB UNIVERSITY of PENNSYLVANIA

CONFIDENTIAL - FOR PEER-REVIEW ONLY

The effect of training type on the evaluation of a new technology. (#27619)

Created: 09/09/2019 07:28 AM (PT)
Shared: 03/13/2021 07:51 AM (PT)

1) Have any data been collected for this study already?
No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?
We will compare two training types, that is vicarious experience (i.e. watching a video tutorial about a new technology only) and enactive mastery (i.e. watching a video tutorial about a new technology plus direct hands-on training with the technology), regarding the evaluation of the technology.
We expect that participants in the enactive mastery condition will report higher technology enthusiasm as compared to participants in the vicarious experience condition. We expect that this effect is mediated by target related technology self-efficacy.

3) Describe the key dependent variable(s) specifying how they will be measured.
Participants will rate technology enthusiasm (assessed with 6 items), and target related technology self-efficacy (assessed with 4 items) after the training intervention.
All dependent measures will be rated on 5-point scales (1 = strongly disagree; 5 = strongly agree) and will be assessed in German.

4) How many and which conditions will participants be assigned to?
Training type: two conditions: enactive mastery vs. vicarious experience (between-participants).
In the vicarious experience condition, participants will watch a video tutorial about a new technology (robot) and its functionality.
In the enactive mastery condition, participants will watch the same video tutorial and will practice the use of the robot by direct hands-on training.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
The predicted mediation of the effect of training mode via target related self-efficacy on technology enthusiasm will be tested using model 4 from the process macro (Hayes, 2018). Chronic self-efficacy (assessed with 5 items) will be included in this analysis to control for interindividual differences in robot related self-efficacy.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
Non-native speakers of German and participants with more than 2 missing values in the scales included in the analysis reported under 5 will be excluded from the analyses.

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.
We aim to collect at least 82 observation to achieve 80% power with alpha = .05, d = .65 (medium to large effect), and a 1:1.7 ratio of the cell size (enactive mastery : vicarious experience). Given that data will be collected among blue-collar workers within one company and data collection requires the availability of a robot, the access to participants and the data collection time is very limited. Therefore, it is unclear whether we will be able to collect more observations.

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)
For exploratory purposes, we will include items regarding actual (12 items) and desired (12 items) work characteristics, chronic self-efficacy (5 items), and chronic job insecurity (4 items), technology job insecurity (7 items), user resistance to change (2 items), perceived usefulness (2 items), perceived ease of use (2 items), behavioral intention to use (2 items), work characteristics addressed by the technology (11 items), and experience with robots (1 item).

Summary

As part of the Industry 4.0, digital technologies are introduced in blue-collar work at a rapid speed. Adopting new technologies entails enormous potential for organizations and their employees, for instance, by enriching blue-collar workers' jobs (e.g., Parker & Grote, 2020). Notwithstanding, implementing new technologies successfully represents a major challenge for organizations, as workers often are not motivated to use new technologies or even refuse doing so (e.g., Brynjolfsson & Hitt, 2000; Tiersky, 2017). Thus, it is essential that organizations have adequate implementation strategies (i.e., interventions) to improve workers' attitudes towards new technology (e.g., increase their enthusiasm and reduce their resistance and job insecurity; Venkatesh & Bala, 2008). However, knowledge about successful technology implementation strategies in blue-collar work is limited—as it is a work context difficult to reach. To address this gap, the current dissertation investigates the research question how digital technologies can be successfully implemented in blue-collar work. More precisely, the current research aims to (1) identify *predictors* of blue-collar workers' attitudes towards new (robotic) technologies; and (2) develop and test *interventions* on how to introduce new technologies and improve attitudes towards them; thereby considering three important indicators of attitudes within this work context—namely, *technology enthusiasm*, *resistance to change*, and *technology-based job insecurity*.

The research questions were examined in three empirical field studies. First, a correlational field study among blue-collar workers examined (actually perceived and desired) *work characteristics* as predictors of workers' attitudes towards new technology. The results indicate that work characteristics, indeed, are associated with attitudes towards new technology. Specifically, desired work demands predicted greater technology enthusiasm; whereas a lack of actually perceived work enrichment was related to greater technology-based job insecurity. Work characteristics were not associated with resistance to change.

Second, two experimental field studies in blue-collar work tested interventions to improve attitudes towards new technology. The first intervention, *needs-oriented communication*, conveyed how a new technology can satisfy the workers' needs and, thus, illustrated its benefits. The results demonstrate that needs-oriented communication can improve attitudes towards new technology (i.e., increase technology enthusiasm) among employees currently perceiving low job demands (and thus feel capable of using the technology). However, needs-oriented communication also increased technology-based job insecurity among workers

perceiving high current task identity. In sum, the results indicate that needs-oriented communication is an effective implementation strategy for employees with low perceived job demands.

The second intervention, *enactive mastery experience,* in which workers practiced the use of a new technology by direct hands-on training, aimed at increasing workers' self-efficacy beliefs, and thereby, improving their attitudes. The findings indicate that an enactive mastery experience increases blue-collars workers' technology enthusiasm, and reduces their resistance to change and technology-based job insecurity (as compared to a vicarious experience); and that this effect is explained by increased self-efficacy for the two former, but not for the latter. Thus, enactive mastery represents an effective strategy to implement new technologies in blue-collar work.

In sum, the findings give insights into the motivational factors contributing to successful technology adoption in blue-collar work. Furthermore, they add to our understanding of how easy-to-be implemented interventions can support successful technology implementation in this work context, indicating that implementation strategies that target employees' *needs* or their *self-efficacy beliefs* can improve their attitudes towards new technologies. Thus, the findings provide a starting point for future research on this topic and can help practitioners to guide effective technology implementation.

Deutsche Zusammenfassung

Im Rahmen der Industrie 4.0 werden digitale Technologien in rasantem Tempo in der Produktion eingeführt. Die Einführung neuer Technologien birgt ein enormes Potenzial für Organisationen und ihre Mitarbeitenden, beispielsweise durch die Bereicherung der Tätigkeiten von Produktionsmitarbeitenden (z.B. Parker & Grote, 2020). Nichtsdestotrotz stellt die erfolgreiche Implementierung neuer Technologien eine große Herausforderung für Organisationen dar, da Mitarbeitende oft nicht motiviert sind, neue Technologien zu nutzen oder dies sogar verweigern (z.B. Brynjolfsson & Hitt, 2000; Tiersky, 2017). Daher ist es von entscheidender Bedeutung, dass Unternehmen über geeignete Implementierungsstrategien (d.h. Interventionen) verfügen, um die Einstellung von Mitarbeitenden gegenüber neuen Technologien zu verbessern (z.B. ihre Begeisterung zu erhöhen und ihre Resistenz und Arbeitsplatzunsicherheit zu verringern; Venkatesh & Bala, 2008). Das Wissen über erfolgreiche Technologieimplementierungsstrategien in der Produktion ist jedoch begrenzt, da es sich um einen schwer zugänglichen Arbeitskontext handelt. Um diese Lücke zu schließen, geht die vorliegende Dissertation der Forschungsfrage nach, wie digitale Technologien erfolgreich in der Produktion eingeführt werden können. Genauer gesagt zielt die vorliegende Forschung darauf ab, (1) *Prädiktoren* der Einstellung von Produktionsmitarbeitenden gegenüber neuen (Roboter-) Technologien zu identifizieren; und (2) *Interventionen* zur Technologieeinführung zu entwickeln und zu testen, um die Einstellung zu verbessern. Hierbei werden drei wichtige Indikatoren der Einstellung in diesem Arbeitskontext berücksichtigt—nämlich die *Technologiebegeisterung*, die *Resistenz gegenüber Veränderungen* und die *technologiebasierte Arbeitsplatzunsicherheit*.

Die Forschungsfragen wurden in drei empirischen Feldstudien untersucht. Zunächst wurden in einer korrelationalen Feldstudie mit Produktionsmitarbeitenden (gegenwärtig wahrgenommene und gewünschte) *Tätigkeitsmerkmale* als Prädiktoren der Einstellung gegenüber neuen Technologien untersucht. Die Ergebnisse deuten darauf hin, dass Tätigkeitsmerkmale tatsächlich mit der Einstellung gegenüber neuen Technologien zusammenhängen. So sagten gewünschte Arbeitsanforderungen eine größere Technologiebegeisterung voraus, während ein Mangel an gegenwärtig wahrgenommener Arbeitsbereicherung mit einer größeren technologiebasierten Arbeitsplatzunsicherheit zusammenhing. Die Tätigkeitsmerkmale standen nicht in Zusammenhang mit der Resistenz gegenüber Veränderungen.

Zweitens wurden in zwei experimentellen Feldstudien in der Produktion Interventionen zur Verbesserung der Einstellung gegenüber neuen Technologien getestet. Die erste Intervention, die *bedürfnisadressierte Kommunikation*, vermittelte, wie eine neue Technologie die Bedürfnisse der Mitarbeitenden befriedigen kann und veranschaulichte so ihren Nutzen. Die Ergebnisse zeigen, dass eine bedürfnisadressierte Kommunikation die Einstellung gegenüber neuen Technologien (d.h. die Technologiebegeisterung) von Mitarbeitenden verbessern kann, die derzeit geringe Arbeitsanforderungen wahrnehmen (und sich daher in der Lage fühlen, die Technologie zu nutzen). Allerdings erhöhte die bedürfnisadressierte Kommunikation auch die technologiebasierte Arbeitsplatzunsicherheit bei Mitarbeitenden, die eine hohe gegenwärtige Ganzheitlichkeit der Tätigkeit wahrnahmen. Insgesamt deuten die Ergebnisse darauf hin, dass die bedürfnisadressierte Kommunikation eine wirksame Implementierungsstrategie bei Mitarbeitenden mit geringen wahrgenommenen Arbeitsanforderungen ist.

Die zweite Intervention, die *aktive Erfolgserfahrung*, bei der die Mitarbeitenden den Umgang mit einer neuen Technologie durch direktes praktisches Training übten, zielte darauf ab, die Selbstwirksamkeitsüberzeugungen der Mitarbeitenden zu erhöhen und dadurch ihre Einstellung zu verbessern. Die Ergebnisse deuten darauf hin, dass eine aktive Erfolgserfahrung die Technologiebegeisterung der Mitarbeitenden (im Vergleich zu einer stellvertretenden Erfahrung) erhöht und ihre Resistenz gegenüber Veränderungen sowie ihre technologiebasierte Arbeitsplatzunsicherheit reduziert; und dass dieser Effekt durch eine erhöhte Selbstwirksamkeit bezüglich der beiden erstgenannten, nicht aber bezüglich der letzteren Variable erklärt wird. Somit stellt die aktive Erfolgserfahrung eine wirksame Strategie zur Einführung neuer Technologien in der Produktion dar.

Zusammenfassend geben die Ergebnisse Aufschluss über die motivationalen Faktoren, die zu einer erfolgreichen Technologieeinführung in der Produktion beitragen können. Darüber hinaus verdeutlichen sie, dass Implementierungsstrategien, die auf die *Bedürfnisse* der Mitarbeitenden oder ihre *Selbstwirksamkeitsüberzeugungen* ausgerichtet sind, ihre Einstellung gegenüber neuen Technologien verbessern können und tragen so zu unserem Verständnis bei, wie einfach umzusetzende Interventionen eine erfolgreiche Technologieimplementierung in diesem Arbeitskontext unterstützen können. Damit bieten die Ergebnisse einen Ausgangspunkt für zukünftige Forschung zu diesem Thema und können Praktizierenden helfen, eine effektive Technologieimplementierung zu begleiten.

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