THE EXPERIENCE OF TECHNOLOGY AT WORK: AN EXPERIENTIAL MODEL OF AUTOMATION AND AGENCY IN THE WORKPLACE

A Dissertation
Presented to
The Academic Faculty

by

Gina M. Bufton

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy in the
School of Psychology

Georgia Institute of Technology
August 2019

THE EXPERIENCE OF TECHNOLOGY AT WORK: AN EXPERIENTIAL MODEL OF AUTOMATION AND AGENCY IN THE WORKPLACE

Approved by:

Dr. Howard M. Weiss, Advisor
School of Psychology
Georgia Institute of Technology

Dr. Kimberly A. French
School of Psychology
Georgia Institute of Technology

Dr. Ruth Kanfer
School of Psychology
Georgia Institute of Technology

Dr. Robert Rosenberger
School of Public Policy
Georgia Institute of Technology

Dr. Christopher W. Wiese
School of Psychology
Georgia Institute of Technology

Date Approved: May 9, 2019

ACKNOWLEDGEMENTS

I would like to thank my advisor, Howard, for his guidance and wisdom over the past several years. Howard was the inspiration behind this project and related work. He has greatly improved my thinking on these topics, and my thinking generally, by continually pushing me to think carefully and to pursue unchartered territories – to build walls rather than to add bricks. I would also like to thank the rest of my committee members, Dr. Ruth Kanfer, Dr. Chris Wiese, Dr. Kimberly French, and Dr. Robert Rosenberger, for their advice and support throughout this project. They have made this project better and have helped me to become a better researcher.

I would like to thank my lab mates, Sophie and Kelsey, for the many pep talks, brainstorming sessions, and acts of friendship that they have given me over the years. I would like to thank my cohort-mates – the Bens, Jason, and Gabe – for the many ideas and laughs they have provided along the way. I would like to thank members of my Atlanta crew – all the Bs (the Burri, Branstetters, and Bentons), Wes, my field hockey teammates, friends who have moved away (Margaret, Eli, and Harrison) – for the emotional support and fun that kept me sane and smiling throughout different points of the process. I would like to thank my family – my mom, dad, and sister – for their continual support of my pursuits and belief in my ability to achieve my goals. I would like to thank my Aunt Denise for her encouragement and guidance in my pursuit of a career in psychology.

Finally, I would like to thank the person who has been instrumental to my success, happiness, and purpose – Andrew. Andrew has been my sounding board, my motivational

speaker, and my steadfast companion, not to mention an amazing partner and travel buddy. I can't wait to become Dr. Dopp. We did it!

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

There has been much attention paid to the macroeconomic implications of increased automation in the workforce, yet the psychological impact to affected workers has been largely ignored. To address this research gap, the purpose of this study was to examine the relationship between automation, operationalized as a set of generalizable experiential features, and the experience of agency at work, operationalized as momentary feelings of control within performance episodes. The study also examined trait-level predictors of experiential features of automation and proximal well-being outcomes in relation to experiences of agency. The study sample consisted of 81 full-time workers who used a variety of automated business software (e.g., Salesforce, PeopleSoft, QuickBooks) in their daily work tasks. In line with expectations, I found that experiential features of automation, including perceived ease of use, perceived usefulness, perceived reliability, and experience/skill, were positively related to experiences of agency, although I did not find support for the expected negative relationship between perceived level of automation and agency. However, there was a significant interaction effect between perceived level of automation and task difficulty on agency, such that the relationship between perceived level of automation and agency was positive under high task difficulty and negative under low task difficulty. Although the hypotheses for the trait-level predictors of the experiential features of automation were largely unsupported, I found positive relationships between the experience of agency and feelings of authenticity and work engagement. Taken together, these findings suggest that there are shared experiential features of automated technologies that can impact workers' experiences of control in their jobs, and that

momentary experiences of control (i.e., agency) are related to meaningful well-being outcomes at work. The study's limitations and suggested future research directions are discussed.

CHAPTER 1. INTRODUCTION

The prospect of technology taking over human work has become increasingly salient given the accelerated technological advancements in the 21st century. Technology has always been an integral part of work, but the study of how technology is changing the nature of work has not received much research attention in organizational literature. Research that has been done on technology in Industrial-Organizational (I-O) psychology and Organizational Behavior (OB) literature has largely focused on topics like mobile-based assessment and selection (Brenner, Ortner, & Fay, 2016; Chapman & Webster, 2003; Stone, Deadrick, Lukaszewski, & Johnson, 2015), remote teamwork (Maruping & Agarwal, 2004; Townsend, DeMarie, & Hendrickson, 1998), gamification of learning and assessment (Landers, 2014, 2015) and the role of social media in the workplace (Landers & Schmidt, 2016; McFarland & Ployhart, 2015). However, research on the impact of technology on people's everyday work experience has been lacking. Rather than examining technology as an additional feature amongst traditional I-O and OB topics, the present investigation seeks to explicate the psychological role of automation in the experience of work.

The growing role of technology in the labor market largely reflects the increased presence of automation. Automation is broadly defined as technology's performance of functions that once were (or feasibly could be) performed by humans (R. Parasuraman, Sheridan, & Wickens, 2000), and it is becoming more pervasive across both white- and blue-collar jobs. McKinsey Global Institute estimates that about half of the global work activities could be automated by adapting current technology (Manyika et al., 2017), which

suggests that many of the common tasks that employees now perform could be easily outsourced to technology in the coming years. There is also widespread unease among workers that their jobs are at risk due to 'technological unemployment'. A public opinion study conducted by the Pew Research Center (Wike & Stokes, 2018) revealed that 65% of U.S. respondents believed it was likely in the next 50 years that robots and computers would do much of the work currently done by humans, echoing the fear that people will lose their jobs to technology and that those jobs will not be replaced.

However, Manyika et al. (2017) propose that it is more likely, at least in the near term, that workers will incorporate automation into their work roles and operate alongside technology, rather than being completely displaced. Automation is currently best suited for repetitive, data-based tasks, rather than tasks that are novel or that require creative or social intelligence (Frey & Osborne, 2013). Given the complexity and social nature of many workers' job responsibilities, it is unlikely that many jobs would able to be completely automated into a set of routine tasks. For example, there are many tasks in healthcare that *can* be automated, such as patient check-ins and medical record management, but the strong socioemotional component of caregiving in healthcare has a very low risk of being automated any time soon. Moreover, automation exists on many levels that differ by the degree to which the automation assists a human operator, which implies that automation is not an 'all-or-nothing' phenomenon in the workplace (R. Parasuraman et al., 2000). So, rather than technology completely taking over jobs or humans continuing to use technology merely for assistance on tasks, it appears that the structure of most work roles will become a collaboration of sorts between humans and automation.

There are important implications of the increased presence of automation in the workplace for the psychology of work. A salient example of a dramatic technological shift in work is the creation of the driverless car. One of the most populated jobs among men in the United States is truck driving (Bureau of Labor Statistics, 2017), which is an occupation that could be eliminated entirely by driverless cars within the next few decades. However, while driverless car technology is still in its adoption phase, it is likely that truck drivers will remain employed as 'monitors' to ensure safe travels and deliveries. The shift in responsibilities from driving to automation monitoring undoubtedly has effects on truck drivers' daily experiences of their jobs and their overall attitudes towards their work, although there is no I-O research currently being conducted on this topic in anticipation of these kinds of organizational changes.

In the present investigation, I aimed to explore the experience of working with automation to highlight the psychological impact of automation on the worker. Most discussions about technology and work occur outside of I-O psychology and they focus on the impact of technological disruption on the broader labor market. I instead sought to understand how automated technologies are influencing workers' experiences in their existing jobs. To do so, I examined individuals' experiences working with automation, operationalized as automated business software in the proposed investigation. The primary momentary experiential outcome of interest was agency, which was defined as the momentary feeling of control that arises from a perceived match between one's intentions and outcomes (Bayne & Levy, 2006). The primary goal of the proposed investigation was to define and explore the shared experiential mechanisms by which various automated business influenced the experience of agency in individuals' work. Additionally, select

precursors and exploratory moderators of these relationships were examined to understand the potential facilitating conditions under which automated technologies may be experienced as agency-enhancing or diminishing. Proximal well-being outcomes, including positive affect, authenticity, and work engagement, were examined to determine if there were positive or negative experiential consequences related to working with certain types of automated technologies, as mediated by experiences of agency.

CHAPTER 2. LITERATURE REVIEW

The primary momentary experiential outcome of interest in this study was agency, defined as the momentary feeling of control that arises from the perceived match between one's intentions and outcomes. Agency was of foremost interest in this study because the greater incorporation of automation into the workforce has implications for a kind of 'shared agency' among humans and technology. Agency is also a central component of the activity of working. Weiss (2014) defines the activity of work as an agentic, creative activity often involving the creation of artifact. Fundamental to this person-centric definition of work is the notion of individuals as agentic doers, such that they originate plans for action at work and carry out those actions in relevant work tasks. The experience of work cannot be understood without understanding how and when individuals experience agency within their work activities. Thus, the examination of the impact of automation on agency represents a fundamental starting point to understanding how the use of automation impacts the experience of work. In this section, I further describe how agency is conceptualized in this study and why agency is an important extension to the extant control literature in the organizational sciences, particularly to understand the effects of automation on work experiences.

2.1 **Agency**

The term 'agency' has a variety of meanings across different kinds of literature. One way in which different agency terms can be understood is through the scope of action and/or time that they are positioned to address. For example, one sociological definition of agency is "the individual's belief in his or her ability to influence his or her life course"

(Kristiansen, 2014, p. 15). Bandura (2006) describes agency in the same manner, suggesting that to be a human agent is to "influence intentionally one's functioning and life circumstances" (p. 164). These, and other similar definitions of agency (Alkire, 2005; Cote & Levine, 2002; Little, Snyder, & Wehmeyer, 2006; Martin, Sugarman, Thompson, Thompson, & Thompson, 2003) all broadly describe agency as the human ability to be self-directive. Alternatively, in areas such as philosophy and cognitive psychology, the sense of agency has been defined as the experience of control over one's actions and the outcomes of those actions, in relation to specific sensorimotor acts (Haggard, 2017; Haggard & Tsakiris, 2009). Thus, the extent of human behavior that the term 'agency' has been used to describe has ranged from experiences of discrete actions to one's entire lifespan.

Agency has also been used to describe the way that individuals structure their life narratives. McAdams, Hoffman, and Day (1996) propose a dichotomy between agency and communion themes in people's stories about their lives. Agency, in this context, refers to descriptions of the self in terms of self-protection, self-expansion, and mastery of the environment. In contrast, communion themes are used to describe the individual as a member of a larger community, involving terms such as union, love, and intimacy (McAdams et al., 1996). Thus, 'agency' represents the description of oneself as an independent actor. This definition differs from those mentioned above as it refers to an explanatory style about life experiences, rather than referring to the experiences themselves. However, given the abundance of work incorporating this perspective on agency in personality (Abele & Wojciszke, 2007; Wiggins, 1991), gender (Carlson, 1971; Helgeson, 1994), developmental (Ackerman, Zuroff, & Moskowitz, 2000), and

organizational (van Marrewijk, 2003) psychology research, it is important to acknowledge this line of work before turning to the proposed definition.

2.2 Definition and Mechanism of Agency

For the purposes of this study, agency has been defined as the feeling of control that arises from the perceived match between one's intentions and outcomes. This definition of agency draws most closely from the sense of agency literature. The sense of agency, as it has traditionally been examined, refers to "the experience of being in control both of one's own actions and, through them, of events in the external world" (Haggard & Tsakiris, 2009, p. 242). Cognitive psychologists have mainly focused on when and how the sense of agency arises in relation to individuals' neural activity and sensorimotor actions (Buhrmann & Di Paolo, 2017; Dewey & Knoblich, 2014; Ebert & Wegner, 2010; Engbert, Wohlschlager, & Haggard, 2008; Haggard, 2005; Moore, Wegner, & Haggard, 2009; Sato & Yasuda, 2005), whereas philosophers have theorized about the phenomenology of the sense of agency within normal and abnormal circumstances (i.e., in disorders of volition; Bayne, 2008; Bayne & Levy, 2006; Buhrmann & Di Paolo, 2017; Gallagher, 2000, 2012; Haggard & Tsakiris, 2009; Hohwy, 2007; Pacherie, 2007, 2012). Given the current interest in examining the sense of agency in relation to the experience of work, there are a few key differences between the sense of agency as it has been traditionally examined and the current definition, which I will review here.

First, in my interest, 'intentions and outcomes' as applied to the current definition of agency refer to higher order work activities, rather than discrete actions. Rather than narrowly focusing on individual actions or broadly at the life course, the examination of

agency within work activities allows for a dynamic understanding of individuals' experiences of control that are associated with meaningful work-related goals. For example, a person could feel a strong sense of agency within a particularly effective writing session or a diminished feeling of agency after a frustrating meeting. In both examples, the examination of agency is tied to the extent to which a person's intentions are realized for a particular performance episode. Those intentions could be writing a certain number of words or successfully communicating a point to coworkers. Performance episodes are defined as "naturally segmented, relatively short episodes thematically organized around work-relevant immediate goals or desired end states" (Beal, Weiss, Barros, & MacDermid, 2005, p. 1055), and they provide a meaningful structure with which to understand experiences of agency at work. Performance episodes are not a necessary component of the definition of agency, although they provide insight into the ways in which agency may ebb and flow during the workday.

Second, the perceived match between one's intentions and outcomes within a work activity can be understood as the mechanism of agency, which gives rise to feelings of control, among other experiences. This notion is supported by extant cognitive psychology research that has explored the relationship between neural activity and the conscious experience of agency over action. There is great debate about how and when the sense of agency arises, which has led to two major perspectives: predictive and reductionist arguments (For a review, see Moore, 2016). The predictive, or comparative, argument suggests that agency stems from the match between internal predictions and sensory feedback of actions and action outcomes (Blakemore, Wolpert, & Frith, 2000; David, Newen, & Vogeley, 2008; Frith, 2005), whereas the reductionist argument holds that

individuals are conscious of their intentions to act and of the acts themselves, but that they have no predictive control over those actions (Wegner & Wheatley, 1999). Rather, the reductionist argument claims that the sense of agency is merely illusory and serves as an explanatory mechanism for the results of actions that are controlled by unconscious pathways in the brain (Wegner, 2002; Wegner & Wheatley, 1999). In the reductionist argument, the sense of agency arises from a post-hoc realization of a match between one's intentions and outcomes, rather than from a prediction.

Although it is beyond the scope of this paper to comprehensively review the merits of these two arguments, both approaches converge on the notion that the sense of agency arises from the relationship between intention and action and between action and the effects of action. That is, regardless of *how* or *when* the sense of agency arises, either through intentional control over the motor system or through a top-down explanatory process, both views support the idea that agency arises from the perceived match between intentions and outcomes. Drawing on this shared belief, more recent theoretical work has sought to describe the sense of agency as the product of multiple sources of sensorimotor information (See Moore, Wegner, & Haggard, 2009), with the basic notion that the sense of agency within normal subjects is the result of an experienced match between their intentions and outcomes. Although the discussion of the sense of agency at the sensorimotor level has limited applicability to an investigation of actions within work-relevant experiences, the broader notion of intention-outcome match can be generalized to examine individuals' experiences of agency in their work. That is, agency can arise from a match between individuals' intentions and outcomes of their work within specific performance episodes. Returning to the examples of writing or attending a meeting, I can feel a high or low sense

of agency in those situations, depending upon the extent to which things are going 'as planned'. Afterward, I can reflect upon on the extent to which my experiences conformed to my predictions for those situations. In the next section, I will detail the differences between these two states, the feeling of agency and the judgment of agency, as well as the associated experiential phenomena.

2.3 The Feeling, Judgment, and Experience of Agency

The sense of agency has typically been conceptualized along two dimensions: the feeling of agency (FoA) and the judgment of agency (JoA). The FoA represents the low-level, pre-reflective notion of being in control of one's actions, whereas the JoA is the reflective judgment of control over one's actions, which presumably involves some level of cognition. The FoA has been described as having a 'thin phenomenology' (Hohwy, 2007), which references the fact that the FoA is short-lived and not a salient component of most actions. When individuals are involved in a given activity, they are not usually thinking about how much agency they have over their actions *in the moment*. Yet, they can reflect on their actions afterward and ascribe a JoA for themselves. A JoA is the conscious, cognitive awareness of "I did that", and it accompanies most individuals' experiences of their actions, except in cases of disorders of volition (e.g., schizophrenia; Blakemore, Wolpert, & Frith, 2002; Frith, 2005). The FoA is typically assessed in an experimental setting by measuring individuals' tendencies towards intentional binding, which is an effect of volitional action wherein individuals report a shortened time duration judgment between their agentic actions and the effects of those actions. Intentional binding has been a robust finding in relation to agentic actions across several studies (Moore & Obhi, 2012) and it is related to individuals' explicit judgments of agency, although not perfectly (Dewey &

Knoblich, 2014). Judgments of agency are typically assessed by asking participants to rate their confidence about how much their actions have caused a given effect or event on some Likert-type scale (Dewey & Knoblich, 2014).

Research that has examined both FoA and JoA has involved experiments that manipulate participants' perceptual awareness of their actions to some extent, which allows for an examination of the facilitating conditions for the sense of agency. For example, in the demonstrative "I Spy" study, Wegner and Wheatley (1999) altered the experience of directing a mouse cursor over primed objects in a computerized I-Spy task, so that participants had to report how confident they were that their own direction versus a partner's direction had caused the mouse cursor to move over the appropriate object. When the timing of primed information was manipulated such that individuals heard a certain word (e.g., "cat") only 1-5 seconds before the cursor landed on that image, participants were just as likely to report a sense of agency (i.e., "I intended to make the stop") when the confederate controlled the stop versus when the participant controlled the stop. This finding has been replicated in a similar experimental paradigm with primed information (Aarts, Custers, & Wegner, 2005), suggesting that individuals' feelings of agency can be induced through manipulation of feedback about intentions and actions, despite an actual lack of control.

Examinations of FoA and JoA are useful ways to understand the precise conditions under which the sense of agency may be altered, although they do not make sense for an initial attempt to understand the phenomenon of agency in the workplace. The population of interest in the proposed investigation is healthy, working adults, who are often not going to be confronted with situations in which they are perceptually uncertain of the extent to

which they caused a given effect with their actions. However, there are a variety of cognitive-affective states that are attached to the experience of one's actions that are also related to the sense of agency. In addition to the feeling and judgment of agency, the experience of agency may be examined and provide information as to individuals' agentic states. Several scholars describe the rich phenomenology of agency, including Pacherie who highlighted the following potential features:

"awareness of a goal, awareness of an intention to act, awareness of initiation of action, awareness of movements, sense of activity, sense of mental effort, sense of physical effort, sense of control, experience of authorship, experience of intentionality, experience of purposiveness, experience of freedom, and experience of mental causation." (Pacherie, 2008, p. 180)

These are some examples of the many ways that agency has been described, and there is a robust literature that explores these different aspects of agency experiences (Barlas & Obhi, 2013; Bayne & Levy, 2006; Bayne & Pacherie, 2007; Buhrmann & Di Paolo, 2017; Gallagher, 2012; Haggard & Tsakiris, 2009; Hohwy, 2007). There are various ways in which the experience of agency may be examined, depending on nature of the research question, and the proposed investigation narrows to a focus on the experience of momentary control within the sense of agency for several reasons.

The experience of control, currently defined as the feeling of exerting influence over one's environment, is arguably the most central component of agency. The terms 'control' and 'agency' are used interchangeably across the sense of agency literature, which conveys the theoretical proximity of these two constructs (Barlas & Kopp, 2018; Haggard

& Tsakiris, 2009; Limerick, Coyle, & Moore, 2014; Moore et al., 2009). Haggard and Tsakiris (2009) describe agency as the "experience of control through action" (p. 243), which suggests that agency *is* the feeling of control. Thus, it is reasonable to suggest that the experience of agency is predominantly that of control, although other feelings, such as effort and intentionality, are commonly mentioned in the sense of agency literature as well. However, other components of the agentic experience, such as effort, are often discussed contextually – such that high agency could be associated with high effort in one condition, and low effort in another (See Bayne & Levy, 2006 and Pacherie, 2008). The feeling of control, on the other hand, has an unequivocally positive relationship with agency – higher judgments of agency are related to higher feelings of control. Therefore, to streamline the proposed investigation as an initial step in this research space, I narrow my focus to the experience of control. I use the terms 'feeling' or 'experience of control' and 'experience of agency' interchangeably in this paper.

2.4 **Agency in Work**

The study of agency, as currently defined, represents a novel contribution to organizational research. Although control has remained an important topic in the I-O and OB literatures, the examination of momentary control within agency augments the extant control research in two important ways. First, the construct of agency extends past research on trait-like control constructs, such as locus of control and self-efficacy, to a momentary level. It is well-known that 'control', broadly conceptualized, is an important predictor of well-being and performance at work. An internal locus of control, for example, is related to improvements in physical health, mental well-being, job performance, job motivation, and career success and decreases in levels of job stress and burnout (Meier, Semmer,

Elfering, & Jacobshagen, 2008; Ng, Sorensen, & Eby, 2006; Wang, Bowling, & Eschleman, 2010). However, past research has largely examined 'control' as a stable feature of one's self or one's environment rather than as a dynamic, context-driven experience. Agency represents a momentary, first-person conceptualization of control that is context-independent, and this difference from past control constructs has important theoretical and practical implications.

In terms of theoretical conceptualization, it is important to align the scope of a given construct with the measurement of said construct. ESM research gathers momentary instances of individuals cognitive-affective states, and as such the measurement of those states should occur at the state-, rather than trait-level. Far too often, ESM research is plagued by the arbitrary adaption of stable constructs to momentary measures by changing the wording of the scale items. The current study is no exception due to the absence of more appropriate measures (e.g., momentary work engagement), although this practice should improve given the abundance of ESM in organizational research. If what we really want to know is how much control a person feels in a given moment at work, rather than how much flexibility a job is currently offering (which is likely relatively stable over time, anyway), it makes more sense to examine agency, rather than momentary job autonomy. Although this issue is more of a comment about the current state of organizational ESM research rather than agency itself, it is nonetheless an important advantage of incorporating agency, and agency-like constructs, into work psychology research.

In practice, the transition from a trait-level to a momentary-level conceptualization of control also allows for a more fine-grained examination of how the experience of control ebbs and flows in concert with different contexts and events that arise across time at work. Given the fast-paced demands of the modern workforce, it is increasingly important to understand the drivers and obstacles to workers' well-being and performance in their jobs. A better understanding of workers' momentary experiences of control is one way to address this need. Such research may also provide insight into how stable attributions of control at work, such as job autonomy or work locus of control, are formed and how they might change over time. In this way, experiences of agency represent the 'process' by which the 'outcomes' of stable attributions of control may be formed. For example, a person who accumulates multiple experiences of high agency in their work may report a strong internal work locus of control, whereas a person who continually feels low agency in their jobs would likely endorse an external work locus of control. Future research might approach the study of agency in the workplace as a 'lever' for worker well-being, such that interventions that increase experiences of agency could lead to improvements in worker happiness and performance. For these reasons, the current examination of agency represents an important step towards understanding the first-person experience of control at work in a more precise, temporally-sensitive manner.

The examination of agency also emphasizes the importance of understanding the individual worker. The first-person, person-centric perspective has been largely lacking in extant I-O research, in favor of approaches that operationalize constructs from the perspective of the organization. For example, job autonomy, a work-specific control construct, represents employees' perceptions of the amount of control available within their

work roles, including the extent to which they can determine the schedule of their work and the procedures to complete their work (Thompson & Prottas, 2006). This conceptual approach offers information about the amount of autonomy offered in the job itself, yet it ignores the extent to which a person actually feels a sense of control in day-to-day experiences in the job. Although it is certainly important to understand the conditions that facilitate or inhibit autonomy at work, it is equally important to know how those conditions contribute or detract from the actual experience of control, particularly if those conditions are fluid.

I have made the case that the nature of work is changing due to technology, which I believe also increases the need for research that focuses on the individual worker rather than the organization (Weiss & Rupp, 2011). The first-person, person-centric approach is valuable not only because it is underutilized, but because it provides a useful way to understand the important role of work in people's lives. Research on job loss and unemployment makes clear that work is an important contributor to individuals' sense of well-being and life-purpose. Paul and Moser (2009) conducted a meta-analysis on the relationship between unemployment and several mental health indicators, including depression, anxiety, psychosomatic symptoms, and subjective well-being. Their results suggested that unemployment was not only correlated with poor mental health outcomes but also caused it, such that individuals experienced more distress following job loss, whereas distress was attenuated upon reemployment. To extend these findings, future research must explore the relationship between individuals and work as defined as an activity, rather than work as defined as a job. I argue that this understanding can be derived from the study of the first-person experience of work that takes the individual's personal,

subjective account of working as its primary consideration. Agency is an inherent component of the activity of working and represents an important starting point for this broader research agenda. I now turn to discuss automation, which is an important driver of the change in the experience of work.

2.5 **Automation**

The increasing presence of automation in the workplace leads to at least two changes to the nature of work: some work roles will be replaced by automation, while others will be adapted to incorporate automation. The incorporation of automation changes the kinds of tasks performed by a human worker, as well as the kinds of experiences formed while working. For example, the experience of working as a cashier becomes qualitatively different if self-checkouts are introduced across a cashier's workplace. Without self-checkouts, the cashier is responsible for ringing up items, interacting with customers, and completing sales. With self-checkouts, cashiers simply need to monitor the execution of these processes between the customer and the automated checkout, stepping in to resolve discrepancies when necessary. In this example, some of the cashier's tasks are fundamentally different, whereas other tasks that were once carried out independently become shared with the automation. This shared action is the mechanism by which automation is expected to influence individuals' experiences of agency at work. Specifically, I propose that automated technologies directly influence the intention-outcome match process underlying the judgment of agency, which in turn influences feelings of control. In the next section, I introduce the concept of technologically mediated intentionality as a guiding theoretical framework to explain how and why the use of automation may alter the experience of agency.

2.6 **Technologically Mediated Intentionality**

The postphenomenological notion of 'technologically mediated intentionality', which stems from the philosophy of technology literature, proposes that individuals' experiences of their worlds are shaped by technology (Verbeek, 2005). Postphenomenology is an approach in philosophy of technology that assumes that the relationship between technology and humans can only be understood from the lived-through experience of humans interacting with technologies. Technologically mediated intentionality builds upon Idhe's (1990) concept of 'technological intentionality', which suggests that technologies have a 'certain directionality, an inclination or trajectory that shapes the ways in which they are used" (Verbeek, 2005). This concept implies that technologies have a way of altering human behavior through their use. Verbeek offers an example originally provided by Idhe in referencing the differences in writing styles produced by a fountain pen, typewriter, and word processor. Although each of these writing technologies is neutral in themselves, they each exert a distinct influence on an individual's work activity. An individual using a fountain pen may write slowly and deliberately, whereas the same individual might quickly jot down any idea that comes to mind on a laptop. These two technologies, the fountain pen and the laptop, each have an 'intentionality' that promotes a certain kind of use, like writing slowly or quickly.

Intentionality takes on a further meaning in the term 'technologically mediated intentionality'. In addition to the notion of 'intentionality' referring to the ways in which technology shapes human behavior, intentionality also refers to the fact that the relationship between humans and the world is mediated by technologies, which alters individuals' perceptions of their realities. For example, the writing style produced by different

technologies is accompanied by a different experience on behalf of the writer. Writing with a pen and paper may be more or less enjoyable, more or less effortful, or more or less engaging than typing on a computer. Thus, any experiential phenomenon is necessarily altered when technology is introduced, including experiences of agency. Given that automation alters experiences, and that the experience of agency accompanies all normal experiences of one's actions, it follows that agency experiences are influenced to some extent when one uses an automated technology.

It is not the case, however, that all technologies affect agency in the same manner. Although it is tempting to outline a set of objective characteristics of automation that could indicate whether the automation would be experienced as agency-enhancing or agency-diminishing, technologies cannot be understood in isolation. As noted by Verbeek (2005), "Artifacts (technologies) can only be understood in terms of the relation that human beings have to them…The insight that technologies cannot be separated from their use contexts implies that they have no 'essence'; they are what they are only in their use" (p.117). In other words, technologies do not have objective properties that implicate how they might be experienced in the absence of people using them. The experience of a technology can only become apparent through its use, which may differ across person, time, place, and purpose. Thus, the same technology could be experienced in completely different ways by different people. Therefore, instead of attempting to identify the ways in which material components of automated technologies impact the experience of work in the proposed study, I instead seek to outline universal experiential features of automated technologies that become apparent through their use and that are proposed to affect individuals' experiences of agency. In the next section, I introduce the experiential features of

automation and offer hypotheses regarding their impact on agency to be tested within an investigation of workers' experiences of using automated business software in their jobs.

CHAPTER 3. THE IMPACT OF AUTOMATION ON AGENCY

The experiential features of automation that I will explore in the proposed investigation include the following: perceived level of automation, perceived ease of use, perceived usefulness, and the perceived reliability of the automation, as well as the experience/skill of the human operator. These features have been chosen because they represent salient components of the experience of working with automated technologies. Many of these features have been explored in other literatures, including management, information systems, and human factors, although not for the purpose of examining the impact of technology on the user's experience. Instead, like technology-related I-O psychology research, other literatures' research aims have been to improve humans' usage of technology and to optimize associated performance outcomes. Thus, the proposed investigation involving these experiential features represents a novel attempt to explore how these features might impact workers' daily experiences and well-being.

Thus far, I have asserted that the perceived match between one's intentions and outcomes is the mechanism through which the experience of agency (i.e., control) arises. I suggest that the use of automation impacts this mechanism of agency within activities that are accompanied by automation, thereby influencing the experience of agency. Specifically, I suggest that the use of automated technologies may either enhance or disrupt the intention-outcome match process because of the shared action involved in using an automated technology at work. When actions become shared in any capacity, with a joint computer actor or another person, an individual's experience of agency is necessarily altered to some extent (Obhi & Hall, 2011b, 2011a; Strother, House, & Obhi, 2010;

Wohlschläger, Haggard, Gesierich, & Prinz, 2003). I will describe here a study by Obhi and Hall (2011b) to illustrate how agency may be altered under conditions of shared action with technology to provide a foundation for the hypotheses that follow about the relationship between the experiential features of automation and agency.

Obhi and Hall (2011b) conducted an experiment to examine the emergence of agency within shared action, both implicitly through intentional binding and explicitly through judgments of agency. In the experiment, 11 participants completed a computerized task with either a human co-actor or with a computer co-actor. In some trials of the experiment, participants tapped a touch pad and heard an auditory sound 200 milliseconds (ms) after their actions (although they were made to believe that the interval between their action and sound was random). They were asked to judge both the onset time of their actions and the time of the tone. These timing judgments were used to calculate the extent of their intentional binding. Afterwards, they were given on-screen feedback that informed them as to whether they had caused the tone, or if it had been caused by the other person (a confederate) or the computer agent. Participants were also asked to record their own private beliefs as to who caused the tone (self, other person, or computer) as a manipulation-check, which upon inspection were all in alignment with the feedback that participants had been given.

Obhi and Hall (2011b) found that when participants thought they were operating alongside another human, they displayed intentional binding effects, indicated by a significantly shortened time interval reported between the onset time of the action and the time of the tone. The intentional binding effect occurred even when individuals reported knowing that the action was performed by the other person in the experiment. However,

intentional binding did not occur during the trials in which participants believed they were operating alongside a computer. The manipulation check that asked participants to report whom they believed had caused the tone served as the explicit judgment of agency, which was always in alignment with the information they had received on-screen. Thus, participants' explicit judgments of agency always matched the high-level feedback they were given and were not always in alignment with the implicit measure of agency (i.e., intentional binding). The authors suggested that this finding indicates that the pre-reflective experience of agency can be preserved even when high-level feedback may alter individuals' explicit judgments of agency.

What is more intriguing about these findings, though, is the divergence in the intentional binding effects between the human-human and human-computer conditions. In the trials where participants believed the tone had been caused by the other person, participants demonstrated an intentional binding effect that was identical to the binding that they demonstrated when they believed they themselves had caused the tone. Obhi and Hall suggested that when two people are involved in a task together, they form an agentic 'we' identity that contributes to a sense of pre-reflective agency for both people, regardless of who is actually responsible for the action. In response to similar findings, Wohlschläger and colleagues (2003) proposed that shared human action may activate a "system for understanding biological actions" (i.e., mirror neurons; p. 589). These findings suggest that although explicit agency judgments may accurately reflect the true author of a given action, a sense of pre-reflective agency may be preserved for both individuals who work on the shared task together, regardless of who is the true author of the action. However, this phenomenon does not extend to joint computer actors.

In their explanation regarding the lack of intentional binding within the human-computer condition, Obhi and Hall (2011b) proposed the following: "the basic processes underlying the pre-reflective sense of agency break down, or are overridden and inhibited in such a way that binding does not occur, even for action effects that the participant (explicitly) knows they caused" (p. 668). The authors go on to suggest that it is possible in the human-computer condition that participants subconsciously developed a belief that they had no control in the task because they were unable to represent the computer's task in the same way as their own task and unable to comprehend the computer's 'intentions' as similar to their own intentions for the task. Unlike joint action between humans, in which the authors suggest a 'we' agency is formed from the ability to share the same mental model regarding intention for action, joint action between humans and computers does not preserve individuals' intentionality for actions. The authors suggest, then, that a person's lack of ability to represent the computer's 'intention' for action disrupts the pre-reflective sense of agency, which inhibits the experience of control for the task.

Obhi and Hall's (2011b) findings are an important precursor to the proposed investigation. Although these results are experimental in nature, they provide initial evidence that the mechanism of agency can be negatively impacted when actions are jointly shared between an individual and a computer agent. I hope to extend this line of work in the proposed investigation in several ways. First, I suggest that in addition to disrupting the feeling of agency, automation may enhance the sense of agency under certain conditions. I seek to explore the features of automation that are both negatively and positively related to agency in the sections that follow. Relatedly, I seek to provide additional theorizing around the notion that joint action with computers (or automation) disrupts the "basic

processes underlying the pre-reflective sense of agency". I do so by providing a combination of theoretical and empirical evidence from various literatures to comprehensively address the ways in which different experiential features of automation may both positively and negatively impact the experience of agency. For each of the features to be discussed, I suggest that automation impacts the perceived match between one's intentions and outcomes, which in turn influences the experience of agency. Therefore, I will be positing direct relationships between the features of the automation experience and the experience of agency, as well as the mediation of those relationships by the perceived match between intentions and outcomes. I will now discuss each of the experiential features of automation in turn.

3.1 Perceived Level of Automation

Levels of automation (LoA) reflect the extent to which an automated technology versus a human operator is responsible for carrying out a given function or activity. In higher levels of automation, the technology performs most of the function, with minimal human input or oversight. There are a variety of taxonomies for levels of automation, many of which refer specifically to decision-making types of automation (Endsley, 1987; Sheridan & Verplank, 1978), whereas other taxonomies broadly assign levels of automation across various automated functions (Endsley & Kaber, 1999; R. Parasuraman et al., 2000). Each of these taxonomies coalesces around the notion of total human control versus total automation control at opposite ends of the spectrum. High levels of automation reduce potentials for human errors, but there is also evidence to suggest that high levels of automation may be coupled with diminished human operator performance under certain conditions because of a lack of vigilance (Endsley & Kiris, 1995; Hitchcock et al., 2003;

Mosier, Skitka, Heers, & Burdick, 1998; R. Parasuraman, Molloy, & Singh, 1993). Endsley and Kiris (1995) coined the term 'out-of-the-loop' (OOL) performance problem to refer to the tendency for individuals to become less situationally aware, less vigilant, and more complacent within tasks coupled with high automation.

Berberian, Le Blaye, Maille, and Sarrazin (2012) suggest that these performance decrements may be fundamentally related to individuals' decreased sense of agency in automation-related performance tasks. Berberian and colleagues propose that individuals who use high levels of automation may experience lower agency because they perceive a reduced amount of control available to them in a task that involves a high level of automation. The authors suggest that the perception of reduced control causes disengagement from the task, which then leads to the OOL performance problem. This interpretation relates to Obhi and Hall's (2011b), who proposed that participants in their study may have subconsciously developed a belief that they had no control in the human-computer condition because of the inability to mentally represent the computer's 'intention' for the task. Both interpretations imply that individuals' sense of agency is reduced simply because of the perception of a low amount of control available within a task coupled with automation, but this justification lacks precision.

In tasks coupled with high LoA, individuals have objectively less control over a task and thereby are not initiating most (if any) of the actions. Instead, human operators who work with high LoA are simply authorizing or monitoring the functions that are initiated by the technology. The low task requirements for human operators under high LoA preclude the need for the human operator to form strong intentions for such activities. Accordingly, I suggest that the perception of a high LoA interrupts the extent to which

individuals form intentions for the work activities that they share with high automation. The formation of intentions is crucial to the sense of agency, because the perception of a match between one's intentions and actions can only occur in the presence of an intention. If individuals do not form strong intentions for tasks in which they use automation, the ability to perceive a match between intentions and outcomes is impaired and the experience of agency suffers. Thus, I argue that Obhi and Hall's interpretation is not directly relevant to *all* relationships between humans and computers but is instead reflective of the LoA of the computer agent with which the human is working. In the next several sections, I suggest alternative mechanisms by which other features of automation influence the perceived match between intentions and outcomes.

There have been two experimental studies that have examined the relationship between LoA and the sense of agency. Berberian, Sarrazin, Le Blaye, and Haggard (2012) conducted an experiment in which participants completed an aircraft simulation task that offered differing levels of automated assistance within different trials. Judgments of agency were assessed explicitly by asking participants to verbally report how strongly they felt they had caused a given maneuver in the task on a scale from 0 (*No causal involvement*) to 3 (*Strong causal involvement*). Intentional binding was assessed as an implicit measure of the feeling of agency, which included participants' temporal estimates of the duration between the execution of their maneuvers and feedback about their actions. The researchers found that as levels of automation increased, participants' explicit and implicit levels of agency decreased, suggesting that increased LoA has a negative impact on individuals' sense of agency.

Kumar and Srinivasan (2011) examined the relationship between agency and control in an experimental design in which the amount of control afforded to participants was manipulated across different trials. In this study, the researchers measured participants' levels of intentional binding and self-reports of control in response to the varying amount of objective control offered in an experimental task. Results indicated that participants' levels of self-reported control increased as the objective control offered in the task increased, regardless of whether they were successful in the task trial. The positive relationship between objective task control and subjective feelings of control can be directly applied to the context of automation. When using high levels of automation, a human operator's level of control is necessarily decreased in favor of increased control by automation, which is expected to be related to diminished experiences of agency.

Both Berberian et al. (2012) and Kumar and Srinivasan (2011) provide experimental support for the negative relationship between LoA and agency, and I seek to extend these findings by replicating them in an organizational context. This replication is an important first step in the proposed investigation because it cannot be assumed that the relationship between perceived LoA and experiences of agency will be preserved in the absence of a tightly controlled laboratory setting. LoA is a highly salient feature of the experience of working with automation and high automation is becoming more pervasive across different types of jobs. Participants in this study provide subjective ratings of LoA for the different types of automated business software that they use in their own jobs across a variety of tasks. Moreover, I aim to further delineate the relationship between LoA and agency by exploring the mediating role of perceived intention-outcome match, as I believe that perceived LoA impacts the experience of control by inhibiting the formation or

realization of intentions, which interrupts the perception of a match between one's intentions and outcomes. Therefore, I propose the following:

H1a: Perceived level of automation will be negatively related to experiences of agency.

H1b: The relationship between perceived level of automation and the experiences of agency will be mediated by perceived intention-outcome match.

3.2 Perceived Ease of Use

In addition to the disruption to the formation of intentions, I also contend that automation can impact the perception of intention-outcome match by influencing the ease or difficulty with which the perceived match is attained. When a person is working towards a goal within a performance episode, whether it be finishing a manuscript or persuading coworkers of a viewpoint in a team meeting, that goal can feel easy or hard, or somewhere in between. This perception of goal difficulty depends on a variety of contextual factors, such as the amount of work (task load), task complexity, amount of skill for the task, or individual differences in goal orientation (e.g., avoid or approach orientation; Midgley, Kaplan, & Middleton, 2001). For example, a person may have many confusing revisions to address on a manuscript, which would make the performance episode seem difficult, or it could be on a familiar topic and feel very easy to write. This example assumes that the person is independently working on the task and that the only determinants of performance are person or task-based. However, the technology that a person uses to perform such tasks must also be considered in the modern workforce. For example, individuals' experiences of agency might be negatively affected if their computers crash in the middle of saving

final manuscript changes or if Skype continually cuts out when they are attempting to communicate with teammates. The technology that mediates a person's work activity must be accounted for when examining the ease or difficulty with which a person attains desired performance outcomes.

These examples of 'bad' technology experiences of the crashing computer or the faulty internet connection highlight another concept in postphenomenology: a loss of transparency within an embodiment relation with technology (Rosenberger, 2009). An embodiment relation refers to the kinds of relationships between humans and technologies wherein the technical artifact recedes into the phenomenological background, allowing the human to experience reality *through* the technology. A prime example of an embodied relation with technology is of a person using eyeglasses – the glasses literally allow the person to see the world more clearly. Although a new pair of glasses might take some time to get used to, once a person is accustomed to a pair of eyeglasses, they might be experientially forgotten during normal wear. This 'forgetting' highlights the high degree of transparency within the eyeglasses. When technologies operate as they are supposed to, especially as we are familiar with them, technologies largely maintain a high degree of transparency. However, when technologies break or perhaps if they are difficult to use, the transparency in the technology decreases (Rosenberger, 2009).

Rosenberger (2009) describes the scenario of the crashing computer as one way in which a technology might lose its transparency. This scenario suggests that the computer becomes salient because its typical 'use' disappears and the individual's attention must turn away from the task at hand and towards the tool that was previously facilitating that task. I propose that the extent to which an individual must turn towards the tool, rather than the

task for which the tool is meant to facilitate, is indicative of how much the tool will negatively impact the individual's experience of agency in the activity. For example, when an individual is using a technology to accomplish a task and that technology is difficult to use, the individual must exert effort towards figuring out how to use the technology rather than simply focusing on the task itself. The difficult technology, then, presents on obstacle to one's intended outcome, which hinders the ability to attain a match between one's intentions and outcomes. Embedded in this discussion is the role of effort, which is a topic of debate within the sense of agency literature.

Effort refers to perceived investments of mental and/or physical energy and will-power into actions (Bayne & Levy, 2006). Empirically, there have been mixed results regarding the relationship between effort and agency. Demanet, Muhle-Karbe, Lynn, Blotenberg, and Brass (2013) reported a positive relationship between the sense of agency and effort, whereas Sidarus and Haggard (2016) and Hon, Poh, and Soon (2013) found that increased effort was related to decreased intentional binding and lower judgments of agency, respectively. Pacherie (2008) states that effort can increase the sense of agency if the sense of self is highly salient in the action, because of the 'sharpened sense of self' that occurs through the experience of resistance between oneself and environment. Yet, Pacherie also describes agency as a feeling of 'effortless control', wherein individuals feel a high sense of agency because they achieve their intended outcomes with little to no correction or adjustment to their original intentions or behaviors.

Thus, both the empirical and theoretical literature are conflicted. However, given that the proposed investigation seeks to examine individuals' experiences during normal work tasks, it is not expected that individuals 'sense of self' will be highly salient during

the moments of interest. Rather, only a 'minimal' sense of self is associated with normal momentary actions, such that I am aware that *I* am controlling my own actions, but I am not consciously thinking about the action as it is embedded in the larger scope of my autobiographical narrative (Hohwy, 2007). Therefore, I suggest that it is more likely to expect a negative relationship between the sense of agency and effort, such that agency is increased when feelings of effort are low. Returning to the context of automation, I propose that the effort that a person must expend on operating a difficult-to-use technology detracts from the seamlessness with which one may otherwise accomplish the activity, thereby reducing the perceived intention-outcome match and associated experience of agency. Thus, I suggest that one way that this lack of seamlessness or transparency of a technology can be operationalized is how easy it is to use.

The perceived ease of use of a technology (Venkatesh & Davis, 2000) has been extensively examined in the information technology (IT) literature and has been defined as "the extent to which a person believes that using the [technology] will be free of effort" (Venkatesh & Davis, 2000, p. 187). There is robust evidence that perceived ease of use, (along with perceived usefulness, which will be discussed in the next section), strongly influences individuals' intentions to use technology, as well as their ultimate usage behaviors (King & He, 2006; Lee, Kozar, & Larsen, 2003; Turner, Kitchenham, Brereton, Charters, & Budgen, 2010). In past theoretical work on the topic, the relationship between perceived ease of use and usage behaviors has been unquestioned – of course if a technology is easier to use, people will use it more. However, I suggest that an important explanatory factor in individuals' tendency towards using 'easy' technology is because easy technology maintains or even enhances experiences of agency, whereas technology

that is difficult to use diminishes experiences of agency. An easy-to-use technology enhances the ease with which one can achieve one's outcomes, whereas a difficult-to-use technology presents an obstacle to the achievement of one's outcomes. Thus, I propose the following:

> H2a: The perceived ease of use of an automation will be positively related to experiences of agency.
>
> H2b: The relationship between perceived ease of use and the experiences of agency will be mediated by perceived intention-outcome match.

3.3 Perceived Usefulness

Closely related to the perceived ease of use of a technology is the perception of its usefulness, which is defined as "the extent to which a person believes that using the [technology] will enhance his or her job performance" (Venkatesh & Davis, 2000, p. 187). As mentioned above, perceived usefulness is also a primary determinant of individuals' intentions for use and usage behaviors of technology within the Technology Acceptance Model (TAM; Venkatesh & Davis, 2000). An automated technology used at work may be perceived as useful for several reasons. Perhaps an automated technology allows a person to complete tasks that would otherwise not be possible or to handle a larger workload in a shorter amount of time or to examine data in new ways. Regardless of the reason, the mere fact of a technology's perceived usefulness implies that it is perceived as enabling one's performance at work. Conversely, the extent to which an automation is perceived as not useful highlights the extent to which it may constrain a person's outcomes at work. Specifically, if a person uses an automation at work that slows or complicates his or her

workflow, he or she may feel limited by the automation rather than enabled. This feeling of being limited or constrained implies a perceived difficulty in achieving one's desired outcomes, which I suggest will negatively impact a person's feelings of control.

Within the postphenomenology literature, Kiran (2015) proposes that technologies have a two-sidedness, which means that while technologies can bring certain things to our attention or enable certain actions, they are simultaneously pushing other things outside of our focus. One dimension of technology that Kiran describes as two-sided is the 'enabling-constraining' nature of technologies. Kiran states that technologies are both enabling and constraining, such that while technologies allow us to perform certain actions, they also constrain our actions by shaping *how* we perform them. By shaping *how* we perform actions, technologies constrain the repertoire of all of the possible ways that a certain task could feasibly be completed. Applied to the current context, automated technologies that are perceived as useful can be understood as 'enabling' agentic behaviors, that is, allowing individuals to achieve their desired outcomes in an efficient or desired manner. The perception of a useful technology suggests that the 'enabling' aspects of the technology are important to one's job and are salient to the individual worker. That is, the technology is shaping one's behaviors in a way that is perceived to be efficient and helpful to one's workflow. Alternatively, automated technologies that are perceived as being not useful can be understood as constraining workers' agency, such that they represent an obstacle between one's intentions and desired outcomes. Perhaps the automated technology requires a person to make several unnecessary clicks or is extremely slow or prevents a person from working on tasks that are perceived as more important or interesting. Whatever the exact nature of the perceived 'uselessness', a technology that is perceived as not useful is

proposed to be shaping the person's behavior in such a way that desired outcomes become more difficult to attain.

Like the argument provided for perceived ease of use, I suggest that useful technologies enhance the ease with which desired outcomes can be attained, which makes the perception of a match between one's intentions and outcomes more likely to occur. Whereas easy-to-use technologies enhance perceived intention-outcome match by allowing individuals to stay focused on their tasks (rather than on the technologies), useful technologies do so by enabling behaviors that are productive or important to one's job. Relatedly, to the extent that useful technologies enhance perceptions of a match between intentions and outcomes, it is expected that the experience of control will be increased as well. Thus, I propose the following:

> H3a. The perceived usefulness of an automation will be positively related to the experience of agency.
>
> H3b: The relationship between perceived usefulness and the experiences of agency will be mediated by perceived intention-outcome match.

3.4 **Perceived Reliability**

Perceived reliability refers to the extent to which a person feels that an automated technology is functioning the way it is supposed to (without risk of technical failure or misinformation, for example). Human factors research on this topic has typically focused on the relationship between perceptions of reliability in an automation and resulting trust of the automation (R. Parasuraman & Riley, 1997). Lee and Moray (1994; 1992) were of the first to examine these relationships, and reported that humans' trust in automation

works much of the same way as it does with other humans: the more reliable that the automation tends to be, the greater trust that individuals place in it. Trust in automation has important implications for the ways in which individuals choose to use automated technologies, or if they choose to use the technologies at all (Dixon, Wickens, & McCarley, 2007; Muir & Moray, 1996; R. Parasuraman, Sheridan, & Wickens, 2008). However, the reliability of an automation has important implications for individuals' experiences of agency as well. Reliable technologies give users greater confidence that a given action will produce the expected effect. In other words, reliable technologies are more predictable. Predictability is an important component underlying the sense of agency, and it is the mechanism by which I suggest reliable technologies influence agentic experiences.

The predictability of an action's outcome underlies the emergence of agency because it represents a confirmation of one's belief that he or she has achieved what was originally intended for a given action. In other words, if a person can predict or have a clear notion of what the outcome of a certain action will be, when that outcome does in fact occur, the person feels a strong sense of agency for that action. This notion has been explored at the sensorimotor level, and researchers have suggested that the sense of 'predictability' for action stems from matches between one's intentions and outcomes at a series of sensorimotor levels (Engbert et al., 2008). A proponent of the predictive argument regarding the emergence of the sense of agency, Moore (2016) states that actions begin with intentions that provide a prediction of the desired state of the motor system once the action is complete, and the sense of agency arises if there is a match between the predicted and actual state of the system. Although proponents of the reductionist argument would claim that agency arises from a post-hoc inference rather than a true prediction of one's

actions (Wegner & Wheatley, 1999), it is without question that the *experience* of one's intentions and one's actions is that of prediction, which is the focus of the current proposition.

These notions of reliability and predictability are pertinent to the experience of agency while working with automation. When a person works with an automated technology, that experience is going to be influenced by the extent to which that person can successfully predict what will occur from various actions with that automation. For example, if a technology always functions as it is supposed to, a person can reliably predict what the outcome of one's actions will be and the experience of agency in that task is preserved. For example, if I know that pushing a button on my computer will always cause it to shut down, my sense of agency will be maintained when I push the button and it does, in fact, shut down. Alternatively, if an automated technology often breaks or provides inaccurate guidance, the person's ability to predict the future outcomes of a given action is decreased and the experience of agency following that action suffers. If I push the button on my computer and expect it to shut down – and it does not shut down – I am left confused and have a decreased experience of control following that action than if the button were to have functioned properly. Accordingly, I suggest that reliable technologies enhance the likelihood of attaining a match between one's intentions and outcomes because of increased predictability, which is in turn related to greater experiences of control. Thus, I propose the following:

> H4a. The perceived reliability of an automation will be positively related to the experience of agency.

H4b: The relationship between perceived reliability and the experiences of agency will be mediated by perceived intention-outcome match.

3.5 Experience & Skill

The final property of the experience of automation that I will explore relates to the individual's level of experience and skill with the technology. Like the perceived reliability of an automated technology, I argue that the experience or skill of a human operator with a given automated technology can influence his or her experience of agency through the mechanism of predictability. Beyond the cognitive underpinnings, the phenomenon of predictability within agency is relatable at a behavioral level, for example, with the action of a basketball shot. An experienced basketball player, like Steph Curry, has a much better ability to predict whether a certain shot will go into a basketball hoop than a novice player who is shooting a basketball for the first time. These two players have drastically different experiences of agency for the same activity – the experienced player has a much stronger experience of agency than the novice because of the extent to which he can predict the outcome of his action (i.e., the basketball going into the hoop). The difference in experience and skill levels between these two players is indicative of both 1) the difference in their abilities to predict the outcomes of their basketball shots and 2) the difference in their experiences of control for those basketball shots.

This experience also applies to technologically-mediated actions at work. For example, if a person acquires a new technology in his or her job, the experience might be initially frustrating to one's agency because the person does not know how to operate the system smoothly or quickly. However, as the person becomes more familiar with the

technology over time, the person's experience of agency increases in tandem with increased knowledge and exposure to the various contextual factors and outcomes associated with operating that technology. Both experience and skill are fundamentally related to the person's ability to predict what will occur when using the technology, which enhances the perceived match between one's intentions and outcomes and concomitant experiences of control. Thus, I propose the following:

> H5a. The experience and skill level of the human operator of an automation will be positively related his or her experience of agency with that technology.
>
> H5b: The relationship between experience/skill and the experiences of agency will be mediated by perceived intention-outcome match.

CHAPTER 4. TRAITS AND TASK CHARACTERISTICS

So far, I have explored five major properties of the experience of working with automation that are proposed to impact the experience of agency. Each of these properties is posited to influence some aspect of the perceived match between a person's intentions and outcomes for their work activities, which in turn influences the experiences of control related to those activities. However, it is not suggested that these relationships are invariable across different workers and work contexts. Conversely, I suspect that the relationships between the experiential features of automation and experiences of agency may differ between individuals with different trait-level tendencies, as well between different types of tasks.

In this section, I explore three individual difference factors that may influence workers' perceptions of automated technologies (beyond the actual properties of the technologies themselves): affinity for technology, age, and technology self-efficacy. Although there is simply not as much theoretical or empirical evidence to guide these hypotheses as the previous set of hypotheses, I review the extant support and limitations for each of these proposed relationships. Additionally, I briefly describe exploratory analyses that introduce the moderating role of task characteristics on the relationship between features of the experience with automation and the experience of agency.

4.1 Affinity for Technology

The current investigation is primarily interested in understanding the momentary experiences that people have with automated technologies in their work activities, although

it is recognized that individuals have different generalized orientations towards technology (Edison & Geissler, 2003). Some people consider themselves to be 'tech-savvy', whereas others prefer to avoid new technological advancements at all costs. Affinity for technology is a construct that denotes a positive affect towards different types of technology (Edison & Geissler, 2003), although there has not been much research on this topic. Most research on this topic has focused on people's attitudes towards specific IT technologies under the broader context of IT adoption (Venkatesh & Bala, 2008; Venkatesh & Davis, 2000). Venkatesh (2000) reported that various self-referent beliefs and attitudes regarding computers, including computer self-efficacy and perceived enjoyment, were significant predictors of the perceived ease of use of new computer systems, which was in turn related to participants' perceived usefulness of those systems. Moreover, other research has shown that individuals' generalized attitudes towards the trustworthiness of automation can impact their perceptions of the reliability of specific automated systems (Pop, Shrewsbury, & Durso, 2015). However, these outcomes have not been directly examined in relation to affinity for technology, nor have the other two features of the experience with automation included in the proposed investigation.

It is expected, though, that better liking of technology, generally, will be associated with more favorable perceptions of the technology used in one's job. Affinity for technology can be understood as a prepotent disposition that inclines individuals towards more favorable perceptions of technology, which I suggest will have a positive influence on momentary experiences of technology used in one's work role. I expect that affinity for technology will influence the features of the automation experience that are most closely tied to perceptions of the functionality of the technology, namely perceived ease of use,

usefulness, and reliability. The perception of level of automation reflects a judgment of the labor division between the technology and the self, whereas experience and skill with the technology reflect self-evaluations regarding one's exposure and abilities with the technology. These two features are not expected to be significantly related to affinity for technology, as they do not denote any positive or negative value judgment regarding the technology itself. Thus, I propose the following exploratory hypotheses:

> H6a-c. There will be positive relationships between affinity for technology and (a) perceived ease of use, (b) perceived usefulness, and (c) perceived reliability.

4.2 **Age**

Another individual difference variable that has been examined in relation to technology is age. In general, past research has indicated that individuals' attitudes and usage of technology decline as they get older (Czaja et al., 2006; Czaja & Sharit, 1998; Morris & Venkatesh, 2000; Niehaves & Plattfaut, 2014). Older adults have been shown to have lower computer self-efficacy (Czaja et al., 2006; Czaja & Sharit, 1998; Niehaves & Plattfaut, 2014), higher computer anxiety (Czaja et al., 2006), and lower usage behaviors of different technologies (Czaja et al., 2006; Morris & Venkatesh, 2000) than younger adults. Age is an important factor in the workplace because baby boomers represent approximately one-third of the current workforce (Fry, 2018). Individuals are living longer and, therefore, working longer, and there is still much that is not understood about the aging workforce (Hedge, Borman, & Lammlein, 2006). However, there has not been any empirical or theoretical research to inform formal hypotheses regarding the relationship between age and features of the automation experience posited here.

That being said, given that past trends have indicated that older adults are more reluctant to embrace new technologies (Hanson, 2010; Morris & Venkatesh, 2000), it is suggested here that 'automated' technologies as examined in the proposed study would be no different. Specifically, for those features of the experience with automation that reflect positive or negative perceptions of the functionality of the technology – including perceived ease of use, usefulness, and reliability – it is expected that older adults will report more negative perceptions, on average, than younger adults. It is not expected that age will have a significant relationship to the perceived level of automation nor experience and skill, for the same reasons mentioned above for affinity for technology. Thus, I seek to test the following propositions in an exploratory fashion:

> H7a-c. There will be negative relationships between age and (a) perceived ease of use, (b) perceived usefulness, and (c) perceived reliability.

4.3 **Technology Self-Efficacy**

Self-efficacy refers to the degree to which individuals believe in their ability to successfully execute certain behaviors to produce desired outcomes (Bandura, 1977). Bandura proposed that self-efficacy is likely domain-specific, such that an individual who has high self-efficacy in math does not necessarily have high self-efficacy in reading. Accordingly, it is possible that individuals may have high or low self-efficacy in technologically-mediated activities. Computer self-efficacy has been examined as a pre-determinant to the TAM and was found to be a significant predictor of perceived ease of use and indirectly related to perceived usefulness through perceived ease of use (Venkatesh, 2000; Venkatesh & Davis, 1996). A meta-analysis by Karsten, Mitra, and

Schmidt (2012) also reported positive relationships between computer self-efficacy and perceived ease of use and usefulness, as well as computer skill.

Given these findings, it is expected that technology self-efficacy will be positively related to perceived ease of use and usefulness in the proposed investigation. I do not expect that technology self-efficacy will be related to perceived level of automation or one's subjective level of experience, for similar reasons as provided for the prior two sets of hypotheses. However, as self-efficacy is directly relevant to a person's belief in his or her own abilities, it is expected that there will be a positive relationship between technology self-efficacy and subjective skill. In other words, the belief in one's ability to do something well should be highly correlated with the endorsement of one's subjective ability for that activity. Thus, I propose the following:

> H8a-c. There will be positive relationships between technology self-efficacy and (a) perceived ease of use, (b) perceived usefulness, and (c) subjective skill.

4.4 Task Characteristics

The proposed investigation will also include exploratory analyses involving task characteristics. There are a wide variety of tasks within any person's job, that range on how enjoyable, engaging, and interesting they are, and those task characteristics may influence the nature of the relationship between automation and agency, beyond any of the features of automation themselves. A research question of the proposed investigation is whether the context of task type within a performance episode significantly moderates the relationships between the features of automation and the experience of agency. Although there are no formal hypotheses that guide this research question, the role of various task characteristics,

including task difficulty, task enjoyment, task importance, and task intrinsic interest, will be explored in the proposed research design. It is possible that these task characteristics may serve as meaningful control variables given the exploratory nature of proposed investigation, so they will be included to allow for a comprehensive examination of the nature of experiences with automation within naturally occurring tasks in people's workdays. These task characteristics will be described in greater detail in the Methods section.

CHAPTER 5. WELL-BEING OUTCOMES

In addition to examining the antecedents and moderators of the relationship between automation and agency, I am also interested in examining well-being outcomes that may be partially determined by individuals' experiences of agency in their work. The indicators of well-being that will be examined in the proposed study include positive affect, authenticity, and job engagement. It is possible that the features of automated technologies also influence these outcomes, mediated partially or fully by experiences of agency, although there has not been sufficient research in relevant domains to warrant evidence-based propositions along these lines. Therefore, only the direct relationships between experiences of agency and the well-being outcomes will be formally hypothesized. The relationships between the experiential features of automation and well-being outcomes will be examined in an exploratory manner, including tests of mediation by agency experiences. I will discuss each of the proposed outcomes in turn.

5.1 Positive Affect

Despite the clear tie between action and emotion experiences, there has not been much research on the relationship between the sense of agency and affective states (Gentsch & Synofzik, 2014). However, the small body of work that has been done in this area generally indicates that the sense of agency is related to more positive affective outcomes (Barlas, Hockley, & Obhi, 2017; Gentsch & Synofzik, 2014; Gentsch, Weiss, Spengler, Synofzik, & Schütz-Bosbach, 2015; Yoshie & Haggard, 2013, 2017). Most of this work has focused on how the valence of an action's outcomes, either positive or negative, affects the actor's sense of agency. Findings have shown that individuals' sense

of agency is increased following positively-valenced outcomes and decreased following negatively-valenced outcomes. Gentsch and Synofzik (2014) have suggested that these results may reflect a self-serving bias, in which individuals are more likely to attribute positive outcomes to their own actions and negative outcomes to factors outside their control. By attributing positive outcomes to oneself, individuals are acting to protect their self-esteem and to reduce experiences of cognitive dissonance (Harmon-Jones, Amodio, & Harmon-Jones, 2009). These studies provide some support for similar findings in the current study, although there are important differences to note. Specifically, the studies referenced here all examined the relationship between the sense of agency and the positive or negative valence of the *outcome* of one's actions, rather than individuals' affective states.

However, it would be consistent that positive outcomes would be associated with positive affective states (and the same for negative outcomes), suggesting that positive affective states would be associated with a greater experience of agency. Moreover, given that people typically intend for positive (rather than negative) outcomes for their work activities, it should follow that individuals who perceive a high match between their intentions and outcomes for a given work activity would also experience more positive affect in those situations. The findings noted thus far about the sense of agency and affect have all been experimental in nature, although there has been considerable research that has examined the relationships between more stable control constructs and well-being in the workplace. These studies have shown that people generally report higher levels of well-being, both at work and generally, when they feel like they are in control of their lives (i.e., locus of control; Wang et al., 2010). Therefore, it is suggested that experiences of control,

both at the sensorimotor level and at the trait-level, is broadly associated with more positive affective experiences. Taken together, these findings support the following proposition:

> H9. There will be a positive relationship between experiences of agency and positive affect.

5.2 **Authenticity**

Authenticity refers to the feeling of being true to oneself (Metin, Taris, Peeters, van Beek, & van den Bosch, 2016). The construct of authenticity has been conceptualized as both a trait, reflecting the general tendency to act in accordance with one's true self across a variety of situations (Kernis & Goldman, 2006; Wood, Linley, Maltby, Baliousis, & Joseph, 2008), and as a state, which reflects a person's feeling of acting true to oneself in a particular moment (Lenton, Slabu, & Sedikides, 2016; Sedikides, Lenton, Slabu, & Thomaes, 2018). Metin, Taris, Peeters, van Beek, and van den Bosch (2016) found that authenticity was positively related to work engagement, job satisfaction and performance and that feelings of autonomy in one's work role was significantly related to all three dimensions of authenticity they tested. Conversely, Erickson and Wharton (1997) found that feelings of inauthenticity were related to increased depression among workers in interactive service occupations, but that individuals who had more control over how they completed their work experienced less inauthenticity in those service roles, which provided a buffer against feelings of depression. These results suggest that individuals who have the ability to exert more influence over their work environments also have higher experiences of being true to themselves on the job.

Therefore, it should follow that individuals who experience more control in the moment also experience higher levels of authenticity. An explanation for these results may be due to the underlying comparative mechanisms within each of these constructs. Within agency, there is a comparison between one's intentions and outcomes that leads to low or high experiences of agency, depending on the extent to which intentions and outcomes match. Authenticity entails the comparison of one's actual and 'true' selves to understand the extent to which one has been authentic or inauthentic in one's behaviors. These two experiential states go hand in hand. The extent to which one satisfies one's intentions should emerge simultaneously with one's feelings of being true to oneself if a person is successfully carrying out his or her true intentions. Conversely, if individuals are unable to achieve their goals within their work, they may also feel as though they are being inauthentic to themselves due to their inability to realize their intentions in their outcomes. Thus, I propose the following:

> H10. There will be a positive relationship between experiences of agency and feelings of authenticity.

5.3 **Work Engagement**

There are many definitions of work engagement, although a commonly accepted definition states that engagement is "a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption" (Schaufeli, Salanova, Bakker, & Gonzalez-Roma, 2002). Multiple theoretical models suggest that work engagement is a positive outcome of job resources (Bakker, Schaufeli, Leiter, & Taris, 2008; Britt, Dickinson, Greene-Shortridge, & McKibben, 2007; Macey & Schneider, 2008; Maslach &

Leiter, 2008). Job resources are broadly conceptualized as "psychological, social, or organizational aspects of the job that are either/or: functional in achieving work goals, reduce job demands and the associated physiological and psychological costs, stimulate personal growth, learning, and development" (Bakker & Demerouti, 2007, p. 312). A fundamental job resource is individuals' feelings of autonomy or control in their jobs, typically operationalized as the amount of control a person has over the way their work is completed. Control in one's job has consistently been shown to be one of the most significant predictors of work engagement (Crawford, LePine, & Rich, 2010; Hakanen, Bakker, & Schaufeli, 2006; Koyuncu, Burke, & Fiksenbaum, 2006; Mauno, Kinnunen, & Ruokolainen, 2007; Saks, 2015), which emphasizes the important role that control plays in well-being at work. Of course, the ways in which 'control' has been examined in these studies reflects the amount of control offered in one's job, rather than momentary feelings of control as assessed from the first-person perspective. This study aims to extend this past research to examine the relationship between momentary feelings of control within agency and work engagement. I expect that individuals' momentary feelings of control tied to various performance episodes will accumulate to reflect higher levels of work engagement, whereas individuals who do not experience control within their daily work tasks are expected to report more distanced feelings about their work.

H11. There will be a positive relationship between the experience of agency and work engagement.

5.4 **Summary of Proposed Investigation**

The complete theoretical model that is tested in the proposed investigation can be seen in Figure 1. The primary purpose of the current research is to illuminate the psychological impact of automated technologies on the experience of work by examining the direct relationships between the experiential features of automation and experienced control (not shown in Figure 1 to reduce confusion) and the indirect relationships between those constructs through perceived intention-outcome match. The secondary hypotheses in this study involve examining trait-level predictors of experiences of automation and proximal well-being outcomes of experiences of agency. Here is a full list of the hypotheses tested in the current study:

H1a: Perceived level of automation will be negatively related to experiences of agency.

H1b: The relationship between perceived level of automation and the experiences of agency will be mediated by perceived intention-outcome match.

H2a: The perceived ease of use of an automation will be positively related to experiences of agency.

H2b: The relationship between perceived ease of use and the experiences of agency will be mediated by perceived intention-outcome match.

H3a. The perceived usefulness of an automation will be positively related to the experience of agency.

H3b: The relationship between perceived usefulness and the experiences of agency will be mediated by perceived intention-outcome match.

H4a. The perceived reliability of an automation will be positively related to the experience of agency.

H4b: The relationship between perceived reliability and the experiences of agency will be mediated by perceived intention-outcome match.

H5a. The experience and skill level of the human operator of an automation will be positively related his or her experience of agency with that technology.

H5b: The relationship between experience/skill and the experiences of agency will be mediated by perceived intention-outcome match.

H6a-c. There will be positive relationships between affinity for technology and (a) perceived ease of use, (b) perceived usefulness, and (c) perceived reliability.

H7a-c. There will be negative relationships between age and (a) perceived ease of use, (b) perceived usefulness, and (c) perceived reliability.

H8a-c. There will be positive relationships between technology self-efficacy and (a) perceived ease of use, (b) perceived usefulness, and (c) subjective skill.

H9. There will be a positive relationship between experiences of agency and positive affect.

H10. There will be a positive relationship between experiences of agency and feelings of authenticity.

H11. There will be a positive relationship between the experience of agency and work engagement.

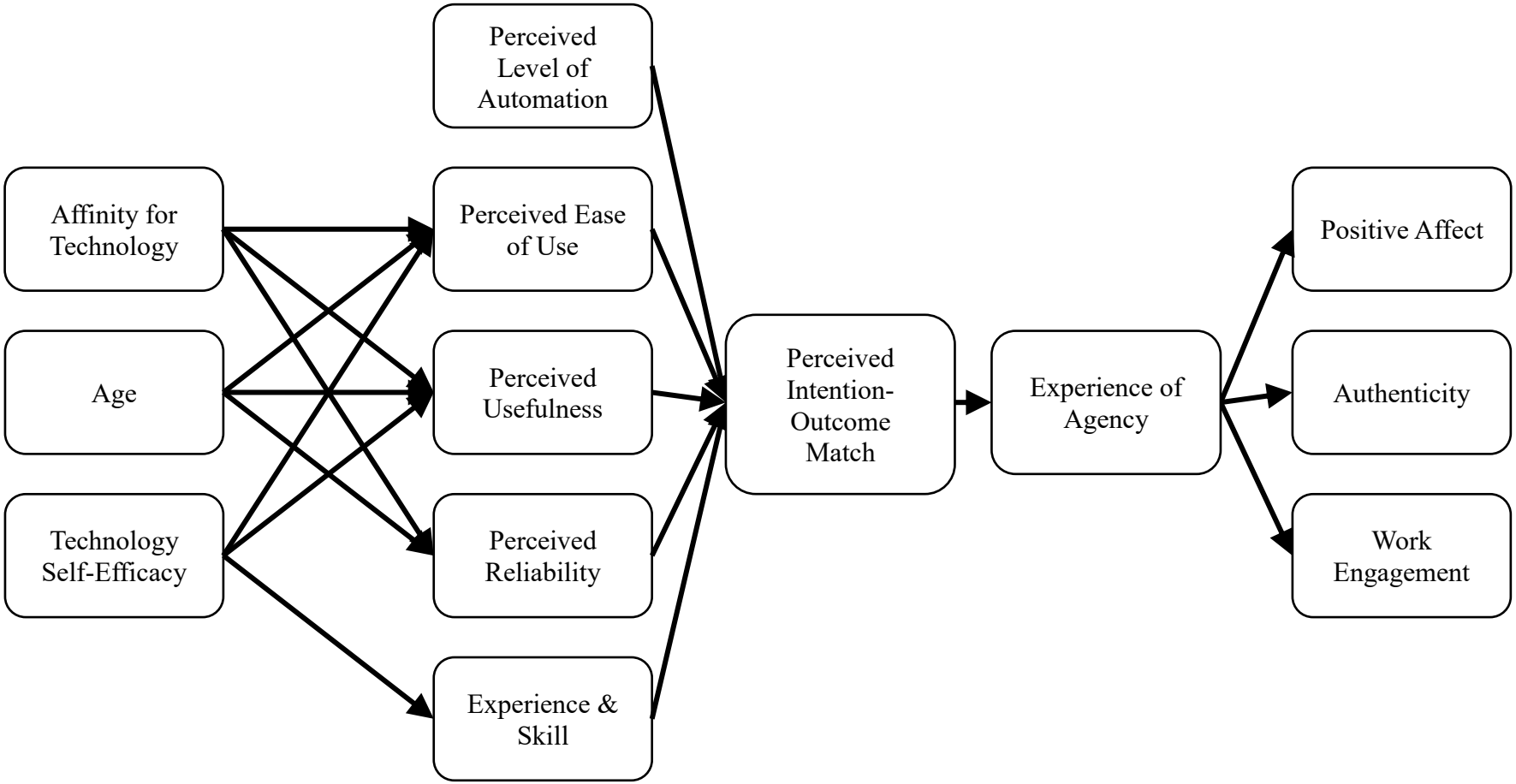


Figure 1 – Proposed Theoretical Model

CHAPTER 6. METHOD

This study explored the experiential role of automation in the workplace by examining workers' experiences of using automated business software within performance episodes across three workdays. I will first describe what is meant by 'automated business software' and then give a brief description and motivation of the use of experience sampling method (ESM) for this the study, before turning to the sample, procedure, and materials used in the study.

6.1 Automated Business Software

To measure the experiential impact of automation in the workplace, this study examined full-time workers' experiences of agency while using automated business software in their daily work activities. Automated business software, also referred to as business automation software and business process automation, is a broad class of technology that refers to any software developed to automate business processes and improve workflows. Automated business software was operationalized in the current study as any computerized software that automates some aspect(s) of workers' required tasks, including information acquisition, information analysis, decision selection, and action implementation. I conducted a pilot study in part to determine whether I could limit the automated business software in the current study to those used for a single function (e.g., decision selection). In the pilot study, participants reported using automated business software for multiple functions, even within the same task, so the current study included automated business software that performed any of the functions above, and participants

were also able to indicate additional functionality after each use. A full description of the pilot study, including the results, can be found in Appendix A.

Some examples of automated business software that would qualify for inclusion in the study are customer relationship management (CRM) software (e.g., Salesforce), automated accounting software (e.g., FreshBooks), and HR management software (e.g., Zenefits). CRM software, for example, is a very popular tool that allows organizations to automate many aspects of customer management. Without a CRM software, a salesperson may be independently responsible for keeping track of customer histories and reaching out to those customers at regular intervals or when customers threaten to leave. With a CRM software, a salesperson can use the software solution to store and organize customer information and the CRM software can provide notifications when customers perform certain actions (e.g., clicking on a 'pricing' page on the company website). Some CRM solutions, like Salesforce, use artificial intelligence to track "key leads" and provide suggested actions to maintain and build customer relationships.

A broad class of technology was chosen for the current study to capture variance in the experiences of automation. As with any other industry, different providers and types of automated business software were expected to range in the extent and quality of their offerings and functionalities, and these differences were expected to contribute to differences in individuals' experiences with those technologies. Moreover, the inclusion of a variety of automated business software allowed for an examination of the proposed relationships across a variety of jobs. A primary goal of the current research was to outline a shared set of experiential characteristics of automation, and that goal was best achieved

by examining a broad class of automated technologies, rather than limiting the investigation to a single technology or work role.

I did not expect that I would be familiar with every business automation software that would be eligible for the study at the outset of the investigation, so each technology was examined on a case-by-case basis (for the list of eligible automated business software that was continually updated throughout the study, please see Appendix B). As will be described in greater detail in the Procedure section, I conducted phone screenings to provide potential participants with examples of eligible automated business software and to screen for ineligible software. Examples of software that were not eligible for the current study included Microsoft Office Suite products (e.g., Word, PowerPoint, Outlook) and any internal communication software (e.g., Slack) or external communication software (e.g., Gmail). The Microsoft Office Suite products were not eligible because of the ubiquity of those tools in both work and nonwork settings and the wide range of uses for those tools. Communication tools were not eligible for the current research because the potential range of 'communication tasks' was too broad and fell beyond the scope of a performance episode that involves a specific task-related goal with a defined start and end time.

6.2 Experience Sampling Method

This study used experience sampling methodology (ESM) to examine participants' momentary experiences of agency within performance episodes that involved automated business software across three workdays. ESM was used to capture the experiential constructs (i.e., experiences of agency, task characteristics, and momentary well-being outcomes) in the moment, when they occurred, rather than through generalized

retrospective accounts. The use of a one-time survey for the current research questions would have been too far removed from the experience of working with automation and associated phenomenology, which would lead to distortions in participants' self-reports of those phenomena. For example, if a researcher were interested in understanding students' test-taking anxiety, it would be more appropriate to capture those experiences when they occur (directly before a test), rather than by polling students at a random moment in the semester. Certain students' responses could be biased after a particularly hard test, others by a particularly easy test, not to mention differences in time since test-taking and intervening experiences. Individuals' reports of their momentary experiences are least biased when they are captured as they occur, rather than through a random, one-time drop-in, which was the primary motivation for the use of ESM in this study.

In the performance episode surveys, participants only reported about their experiences of using a single automated business software throughout the duration of the study, even if they used many different types of software in their jobs. As such, participants' experiences of automation and concomitant experiences of agency were not expected to vary much within-person, even though the measurement of within-person trends is the most common use of ESM. The three-day ESM design was used to gain more robust estimates of individuals' experiences of automated business software in their work roles, rather than only examining responses from a single work day. This sampling strategy was designed to buffer some of the potential variance that could have contributed to individuals' reports of their experiences of agency that were not due to the technology in their jobs. For example, one workday may have been particularly frustrating because of a high workload, whereas another day may have been much more pleasant because of

friendly coworkers. The choice of three versus four workdays was somewhat arbitrary, although, given the potential for habitual responses among participants over a prolonged data collection, particularly given that the performance episode surveys stayed the same, a short study duration was preferred. Additionally, it was not critical for the current design to achieve many within-person observations across a full workweek or multiple workweeks because the performance episode responses were ultimately aggregated to the person-level to examine between-person trends among the proposed relationships.

Although the resulting analyses based on the aggregated data do not reflect momentary, dynamic within-person relationships between the variables of interest, they still reflect the relationships between momentary experiential constructs. To return to the test-taking anxiety example, it is possible that the researcher would want to gain a more accurate picture of students' test-taking anxiety by measuring students' test-related stress over the course of the semester. If the researcher then aggregated each students' reports to obtain one score per student, the researcher would not be able to examine changes within-students across time, which is the typical use for ESM, but the resulting data would still reflect the momentary experiences of test-taking anxiety in a more psychologically precise manner than if the same construct were examined by administering a one-time survey to students at a random time in the semester. I aimed for such precision in the measurement of agency and the other experiential variables of interest in the current study, although between-person relationships were ultimately of primary interest because of the inclusion of only a single automated technology per participant.

The experience sampling portion of the study was preceded by an online orientation in which participants provided baseline measures of trait and demographic characteristics,

as well as their typical experiences of the automated business software in their jobs. The items assessing the experiential features of automation were included in the orientation to reduce the concern for common method bias that could occur from measuring all constructs at the same time within the same survey (Podsakoff, MacKenzie, & Podsakoff, 2012). Although participants also rated the experiential features of automation within the performance episode surveys as well, to help account for any experiential discrepancies (e.g., the software malfunctions for the first time), these ratings were averaged with the orientation ratings to create a composite score. The details of the aggregation methods are described in greater detail below in the Data Analytic Strategy section.

6.3 Participants

Participants for this study were recruited from the Work Experience Lab participant database, online ads (i.e., Facebook, LinkedIn, Reddit), and word-of-mouth. To be eligible for the study, participants had to live and work in the United States, work at least 30 hours per week (full-time), own a smartphone device, and confirm that they used automated business software within performance episodes in their daily or almost-daily work experiences. Prior to data collection, I conducted a power analysis in MPlus5 (Muthén & Muthén, 2007) using a Monte Carlo simulation to determine the appropriate sample size for the study based on a path analysis of the entire theoretical model displayed in Figure 1.

For the power analysis, the estimated effects for the proposed relationships were set to .30, except for the relationship between perceived intention-outcome match and agency, which was set to .60. The latter relationship was set to .60 based on previous data gathered by the researcher that indicates a beta coefficient of .61 for perceived intention-

outcome match predicting the experience of control. The other relationships in the power analysis were set to .30 to represent moderate effects. The residual variances of all endogenous variables in the model were set to .9 and all exogenous variables were set to 1, based on examples from prior research (Lane, Hennes, & West, 2016; Thoemmes, MacKinnon, & Reiser, 2010). With a sample size set at 75 participants, the estimated power to detect the proposed effects ranged from .68 to .99, with an average estimated power of .81. I aimed to recruit 80-85 participants to account for possible participant attrition. A total of 85 participants completed the online orientation, but four participants failed to complete the ESM portion of the study, resulting in a final sample size of 81 full-time workers.

All participants were above the age of 18 years old, lived and worked in the United States, and used automated business software in their work roles. Participants held a variety of different job titles, such as Biomedical Technician, Staff Engineer, and Strategic Account Manager, and they used a variety of different types of automated software, including Salesforce, Jira, and Margo (for a full list of automated business software included in the study, see Appendix B). Most of the sample was female (60%) and Caucasian (60%), and the average age of the sample was 33.69 years (*SD* = 9.66). Over half of the participants (51%) reported holding a bachelor's degree, 28% reported holding a master's degree and 6% reported holding a professional or doctoral degree. Participants worked an average of 43.10 hours per week (*SD* = 6.49), and the average tenure in their current positions was 3.30 years (*SD* = 4.63).

6.4 **Procedure**

Participants were first required to complete a short phone screening (about 10 minutes in length) to determine if they were eligible to participate in the study (for phone screening script, see Appendix C). If participants were determined to be eligible from the phone screening, they were then sent the online orientation via email. The online orientation included the informed consent for the study, some trait-level questionnaires, and instructions for how to complete the daily survey portion of the study. The daily survey instructions included information about how to download the survey app, MetricWire, which participants used to complete the performance episode surveys and the exit survey. Participants were reminded at the beginning and at the end of the online orientation that they could reach out to me at any time if they had questions or trouble with any aspect of the study.

After participants completed the online orientation and notified me to let me know they had finished, participants were able to begin the daily survey (ESM) portion of the study. The daily survey portion of the study lasted for a total of three workdays (that may not have been consecutive, depending on participants' use of automated software in their work tasks and/or ability to respond to the daily surveys). During this part of the study, participants completed one event-signaled survey during each workday to report a performance episode in which they used the automated business software that they described in the online orientation. The performance episode surveys contained items about the experiential features of automation, experiences of agency, positive affect, work engagement, authenticity, and task characteristics.

The items regarding experiential features of automation were included to examine whether there were differences between participants' ratings of the features of automation

within the performance episode surveys and the ratings provided in the online orientation. This feature helped to adjust for any technological issues that participants may have encountered (e.g., the technology breaks for the first time) that would not be accounted for in their orientation responses. After participants completed three performance episode surveys, they were asked to complete the exit survey. The exit survey several open-ended items that allowed participants to report their experiences in the study, their opinion about what the study was about, and a space to provide their mailing address to receive their compensation.

Compensation for this study was based on the extent of participation. Participants earned $15 for completing the online orientation, $5 for each performance episode survey, and $5 for the exit survey, for a total possible compensation of $35. If participants did not complete all portions of the study, their compensation reflected the components of the study that they did complete (e.g., completing the online orientation and one performance episode survey would earn a participant $20).

6.4.1 Orientation Measures

6.4.1.1 Experiential features of automation.

The experiential features of automation were measured along the following five dimensions: perceived level of automation, perceived ease of use, perceived usefulness, perceived reliability, and the level of experience/skill of the participant with the technology. To assess perceived level of automation, participants were shown the 10-level decision-making automation taxonomy by Parasuraman, Sheridan, and Wickens (2000). This taxonomy and other similar taxonomies for automation were primarily developed to

aid in the design and research of automation as it is used by humans in various performance contexts. However, given the straightforward nature of the scale (See Appendix D), it was utilized in the current study to aid participants' understanding and concomitant ratings of the level of automation of the technologies they used in their own jobs. Using this taxonomy as a visual aid, I developed an item for this study in which participants rated the level of automation of the automated software in their own work roles on a 10-point scale that ranges from 1 (*No automation – total human control*) to 10 (*Total automation – no human control*).

Perceived ease of use and perceived usefulness were measured using eight items from the TAM2 measurement scales (Venkatesh & Davis, 2000). Perceived ease of use was measured with four items (e.g., "My interaction with the system is clear and understandable") and perceived usefulness was measured with four items (e.g., "Using the system improves my performance in my job"). These two constructs have been examined in past research as predeterminants of intentions to use technology and actual technology usage behaviors (Lee et al., 2003), and internal consistencies for the scales have ranged from .86 to .98 for perceived ease of use and from .87 to .98 for perceived usefulness. The internal consistency of perceived ease of use was notably lower in the current study, average $\alpha = .73$, although the internal consistency of perceived usefulness was consistent with past research, average $\alpha = .93$. These measures have not been used in an ESM context before, which could account for the heightened variability among items within the perceived ease of use scale. The term 'system' was replaced with the names of the automated software that participants provided. All items were measured on a 7-point Likert

scale on a scale of 1 (*Strongly disagree*) to 7 (*Strongly agree*) and the full scales are available in Appendix D.

Perceived reliability was measured using a total of three items (average $\alpha = .90$). Two items were taken from the Checklist for Trust between People and Automation (Jian, Bisantz, Drury, & Llinas, 1998): "The system is reliable" and "The system is dependable". Both items were measured on a 7-point Likert scale from 1 (*Not at all*) to 7 (*Extremely*). The third item was inspired by Yagoda and Gillan's (2012) human-robot interaction (HRI) scale and assessed perceived consistency: "The system is consistent". This item was measured on the 7-point Likert scale referenced above. Although these items had not been examined together in past research, there was high internal consistency among them (average $\alpha = .90$), suggesting that they jointly reflected the same construct. The term 'system' was replaced with the names of the automated software that participants provided.

Participants' levels of experience and skill with the automated software in their jobs were measured with two items that I developed for the current investigation. Experience was measured by asking participants to report their familiarity with the automated software in their jobs with the following item: "How familiar are you with the technology?", on a scale from 1 (*Not at all familiar*) to 5 (*Very familiar*). Skill was assessed with one item, "Please rate your level of skill with the [software]", on a scale from 1 (*Not at all skilled*) to 5 (*Highly skilled*). The experience and skill variables were grouped together within the same hypothesis because they were assumed to be strongly correlated, and indeed they were, $r = 0.82$. For the following analyses, I created a composite score of these two variables to reflect the higher-order factor that they were meant to reflect, that is,

participants' proficiency with their respective automated business software. The composite score will be referred to as "Experience/Skill" in subsequent descriptions.

6.4.1.2 Affinity for technology

Affinity for technology, or 'technology optimism,' was measured with the 10-item Affinity for Technology scale developed by Edison and Geissler (2003). This scale assesses individuals' level of positive affect towards technology based on items that were inspired from past research on attitudes towards technology (Brosnan, 1998; Heinssen, Glass, & Knight, 1987; Parasuraman, 2000; Rosen, Sears, & Weil, 1993; Simpson & Troost, 1982), and the Cronbach's alpha of this scale was 0.88 in the validation study. The current study found an internal consistency of 0.91. The items are measured on a 5-point Likert scale that ranged from 1 (*Strongly disagree*) to 5 (*Strongly agree*). An example item from this scale is, "I enjoy learning new computer programs and hearing about new technologies". All items for this scale can be found in Appendix D.

6.4.1.3 Technology self-efficacy

Technology self-efficacy was measured with a 10-item scale (Holden & Rada, 2011) that assessed participants' "personal confidence towards successfully and purposefully using…technology" (p. 353). The items were preceded with the general statement, "In general, I could complete any desired task using any computer/Internet application if…" and example statement ends are "…I had never used a technology like it before" and "…someone else had helped me get started". All items were measured using a 10-point Guttman scale that ranges from 1 (*Not at all confident*) to 10 (*Totally confident*). This scale has been used to examine technology adoption among teachers and students

within educational settings (Klassen & Tze, 2014), and prior research has found a Cronbach's alpha of 0.93. The current study found a Cronbach's alpha of 0.88. The full scale can be found in Appendix D.

6.4.1.4 Demographics

Participants were asked to fill out questions about their demographic information including items related to age, gender, job title, job tenure, work task characteristics, and the number of hours worked per week.

6.4.2 Performance Episode Surveys

6.4.2.1 Experiential features of automation

The items that measured the experiential features of automation within the performance episode surveys were the same as those included in the online orientation, except the frame of reference was for the most recent performance episode with the automated software, rather than participants' average experiences.

6.4.2.2 Perceived intention-outcome match

The perceived match between one's intentions and outcomes was measured using three items from a larger scale that I developed and validated to assess multiple components of the experience of agency. There is a total of 10 items that measure perceived intention-outcome match within the larger agency scale, and they are meant to assess the extent to which one's intentions have been realized in the outcome(s) of a recent activity. The three intention-outcome match items that I chose for this study had the highest loadings on the

higher order control factor within the multi-dimensional agency scale and were as follows: "I achieved my ideal outcome", "What I wanted to happen actually happened", and "I was able to achieve the results that I wanted'. These items were measured on a 5-point Likert scale that ranged from 1 (*Strongly disagree*) to 5 (*Strongly agree*). The internal consistency of these items was $\alpha = 0.90$, and the average internal consistency in this study (across all performance episodes) was also 0.90.

6.4.2.3 Experience of agency

For this study, the experience of agency was operationalized as the feeling of control and it was measured using three control-related items (average $\alpha = .94$) taken from the control subscale of 10 items within the larger agency scale mentioned above. The items were "I felt like I was in charge", "I felt like I was in the driver's seat", and "I felt like I was calling the shots", measured on a 5-point Likert scale that ranged from 1 (*Strongly disagree*) to 5 (*Strongly agree*). The term 'experience of agency' and 'experienced control' will be used interchangeably in the subsequent analyses and discussion of results.

6.4.2.4 Positive affect

Positive affect was measured with a 9x9 square grid, called an affect grid, with two axes that represent the two theoretical dimensions of affect: arousal and valence (Russell, Weiss, & Mendelsohn, 1989). The arousal axis ranges from low to high activation and the valence axis ranges from negative to positive feelings. Sample emotions are offered in each different quadrant. For example, "Excited" appears in the upper right quadrant, indicating a positive, high activation emotion. Participants were shown the grid at each time-signaled prompt and asked to indicate how they felt in the moment by choosing a square on the grid.

The affect grid shows moderate correlations with other measures of the affective experience (Killgore, 1998). For the purposes of the current research, positive affect was operationalized using only the valence dimension of the scale, as it was thought to better align with previous research examining emotionally valenced outcomes in relation to the sense of agency (for an example, see Christensen, Yoshie, di Costa, & Haggard, 2016). An example of the affect grid can be found in Appendix D.

6.4.2.5 Task characteristics

Task characteristics were measured to determine the level of difficulty, enjoyableness, importance, and intrinsic interest of the tasks within participants' performance episodes. Level of difficulty was assessed with the statement, "The task in this performance episode was interesting", enjoyableness was assessed with the statement, "The task in this performance episode was enjoyable", importance was assessed with the statement, "The task in this performance episode was important to my job", and intrinsic interest was assessed with the statement, "The task in this performance episode was interesting". Each statement was measured on a 5-point Likert scale that ranged from 1 (*Strongly disagree*) to 5 (*Strongly agree*).

6.4.2.6 Authenticity

Authenticity was assessed using a modified 3-item scale (Fleeson & Wilt, 2010) that measured how true participants felt that they were being to themselves in the most recent performance episode with the following three statements: "I was true to myself", "I felt authentic in the way I acted", and "I felt like I was really being myself". Fleeson and Wilt (2010) originally used these items to assess authenticity within the past 20 minutes

(e.g., “I felt authentic in the way I acted during the last 20 minutes”) and reported a 7-point scale but did not give scale anchors. In addition to the modification of removing the temporal referent point, the items (average $\alpha = .92$) were measured on a 5-point Likert scale that ranged from 1 (*Strongly disagree*) to 5 (*Strongly agree*).

6.4.2.7 Work engagement

Momentary work engagement was measured using a modified version of five items from the Utrecht Work Engagement Scale (UES; Schaufeli, Bakker, & Salanova, 2006; Seppälä et al., 2009). These items are based on those reported in an ESM study that measured experiences of work engagement in the moment (Bledow, Schmitt, Frese, & Kühnel, 2011), rather than the standard trait-level conceptualization of work engagement. The five items captured the three dimensions of engagement, vigor, dedication, and absorption, and were modified to be in the past tense to reflect the participant’s most recent performance episode. The modified vigor items were “I felt strong and vigorous in my work” and “I felt bursting with energy”, the dedication items were “I was enthusiastic about my work” and “My work inspired me”, and the absorption item was “I was happily engrossed in my work”. All items (average $\alpha = .88$) were measured on a 7-point Likert scale that ranged from 1 (*Does not apply at all*) to 7 (*Fully applies*).

6.4.3 Exit Survey

The exit survey included both quantitative and qualitative items. The quantitative item assessed participants’ average level of awareness of the automated business software in their jobs across the three performance episodes they reported, on a scale from 1 (*Not at all aware*) to 5 (*Extremely aware*). Participants were also asked to provide short responses

(1-3 sentences) about their experiences participating in the study and their thoughts on what the study intended to measure. There was also space for participants to list any questions or concerns they had about the study, as well as space for them to provide their mailing addresses to receive their compensation for the study.

6.5 Data Analytic Strategy

Given the aim of aggregating the momentary-level responses to the person-level for analysis, I first computed r_{wg} indices of the performance episode measures to determine the consistency of participants' responses across the three performance episode surveys (James, Demaree, & Wolf, 1984). The r_{wg} values were calculated to indicate if the aggregation of the within-person observations was warranted, with higher consistency between the responses indicating a stronger between-person than within-person trend in the data. A rule of thumb for r_{wg} values is that it is appropriate to aggregate lower level responses to a higher level if the mean r_{wg} value equals or exceeds .70 (Klein & Kozlowski, 2009). The r_{wg} indices can be found in Table 1 below. There was high within-person consistency on most of the recurrent measures, save for positive affect (r_{wg} = .56) and some of the task characteristics (r_{wg} range = .64 - .83), which is not unexpected. However, given that most of the measures were well above acceptable limits, I felt that it was warranted to aggregate the performance episode measures to the person-level. I will describe the aggregation method here before turning to the hypotheses.

For the experiential features of automation, I felt that it was most appropriate to retain the ratings gathered in the orientation, in addition to the ratings gathered during the performance episode surveys. There were two reasons for this choice. First, the hypotheses

for this study assumed that the experiential features of automation would be relatively stable during the study period, which was the impetus for including the measures in the orientation. Second, this method also accounted for momentary changes in the experiential features of automation (e.g., the software crashes for the first time), which may have introduced noise into the relationship with the experience of agency that would be unaccounted for if only the orientation ratings of experiential features of automation were used in analyses. Additionally, the correlations between the orientation measures and performance episode survey measures for each experiential feature of automation were significantly correlated at $p < .001$, which provided additional justification for the aggregation (See Table 2 below). Therefore, I averaged the orientation and performance episode surveys together, each with equal weights for the subsequent analyses for the experiential features of automation.

The remaining performance episode measures were not collected during the orientation, so those were all aggregated by averaging the performance episode ratings to create person-level scores. To address the lower-than-acceptable r_{wg} values for the positive affect and task characteristic measures, I utilized both single level and multilevel regression analyses among relevant formal hypotheses and exploratory analyses to account for the higher levels of within-person variability within those measures. All multilevel analyses indicated stronger between-person than within-person trends in the data, which, in combination with the generally high r_{wg} values, provided sufficient justification for the aggregation of the momentary responses to the person-level.

Table 1 – R_{wg} Values of Performance Episode Measures

Variable	r_{wg}
Experiential Features of Automation	
Perceived Level of Automation	0.84
Perceived Ease of Use	0.91
Perceived Usefulness	0.92
Perceived Reliability	0.90
Experience	0.84
Skill	0.87
Agency	
Perceived Intention-Outcome Match	0.79
Experienced Control	0.82
Proximal Well-Being Outcomes	
Positive Affect	0.56
Authenticity	0.85
Work Engagement	0.87
Task/Technology Characteristics	
Task Difficulty	0.64
Task Interestingness	0.66
Task Enjoyability	0.68
Task Importance	0.83
Software Consistency	0.79

Table 2 – Correlations between Orientation and Performance Episode Measures of Experiential Features of Automation

	LoA Orient	*PEU Orient*	*PU Orient*	*Rel Orient*	*ExpSkill Orient*
LoA PE 1	0.651***				
LoA PE 2	0.605***				
LoA PE 3	0.619***				
PEU PE 1		0.599***			
PEU PE 2		0.439***			
PEU PE 3		0.510***			
PU PE 1			0.816***		
PU PE 2			0.639***		
PU PE 3			0.814***		
Rel PE 1				0.715***	
Rel PE 2				0.662***	
Rel PE 3				0.608***	
ExpSkill PE 1					0.726***
ExpSkill PE 2					0.638***
ExpSkill PE 3					0.493***

Note. *** indicates $p < .001$; 'Orient' = collected during the orientation; 'PE 1', 'PE 2' and 'PE 3' = collected across the three performance episode surveys. 'LoA' = Perceived Level of Automation; 'PEU' = Perceived Ease of Use; 'PU' = Perceived Usefulness; 'Rel' = 'Perceived Reliability'; 'ExpSkill' = Experience and Skill.

CHAPTER 7. RESULTS

I collected a total of 251 responses from 81 participants from the performance episode surveys. It is important to note that about halfway through data collection, I realized that I had made an error in setting up the performance episode surveys in Qualtrics. Instead of receiving all six blocks of survey items (experiential features of automation, agency, affect grid, authenticity, work engagement, and task characteristics) in each performance episode survey, participants had only received a random set of five out of the total six blocks of survey items. This issue resulted in a random set of missing data for the participants who responded to the performance episode survey before I corrected the error, which affected 29% of the total observations. However, given the random nature of the missing survey blocks, I determined that this data was missing completely at random (MCAR). MCAR is arguably the 'best' type of missing data, as it does not present any theoretical bias.

I conducted follow-up analyses to examine whether there were any statistical differences between the responses collected from the performance episode survey before and after I corrected the error. I conducted multilevel linear regressions to examine whether a dummy-coded variable, that indicated whether the response was collected from the survey before or after the error was corrected, predicted any of the survey variables of interest. None of those analyses were significant. I examined whether any of the survey variables of interest were significantly correlated with the dummy-code, and none were. Finally, I performed multilevel logistic regressions to examine whether the dummy-coded variable was significantly predicted by any of the survey variables of interest, and none of

those analyses were significant. Given the MCAR nature of the data and the non-significance of the follow-up analyses, I did not choose to omit the affected responses nor to perform any imputation methods on the missing observations. Thus, although the error in the survey decreased the study's power by reducing the number of total observations, it did not pose a threat to the external validity of the study.

I examined the performance episode survey data to screen for duplicate responses using the timestamps of the surveys and the episode descriptions to remove any responses that occurred on the same day for the same tasks, which led me to discard 6 responses. Some participants provided more than three performance episode survey responses, but the additional responses were retained for analysis if they did not occur within 30 minutes of other responses and did not have the same episode description. I retained a total of 248 performance episode survey responses. I aggregated the responses to the person-level for subsequent analysis, which resulted in a total of 81 unique person-level responses for each of the path model variables, including the data gathered from the online orientation. The descriptive statistics and correlations for the variables to be included in the path model variables can be found in Tables 2 and 3.

I screened the data for normality and outliers by examining the descriptive statistics and Q-Q plots for the path model variables. The data generally displayed a negative skew, such that responses were more positive than would be expected under a normal distribution. Variables that were negatively skewed outside of the normal range of -1 to 1 included perceived usefulness (-2.14), perceived reliability (-1.20), and perceived intention-outcome match (-1.09), and age was positively skewed (1.23). Additionally, perceived usefulness had a leptokurtic distribution (6.98), which together with the negatively skewed

distribution indicated that many of the responses fell in the same area on the high end of the scale (i.e., most participants rated the software in their jobs as highly useful at every measurement). In the Results section, I describe the additional precautions taken with perceived usefulness as a dependent variable within the preliminary regression tests due to the likelihood of non-normally distributed residuals.

To test the hypotheses, I conducted a path analysis to simultaneously test the proposed relationships. Before doing so, I also conducted three sets of preliminary regressions to get a sense of the relationships to aid model fitting. I took additional precautions with the regressions involving perceived usefulness and those methods will be described where appropriate. In this section, I first discuss these three sets of analyses, which have been segmented based on the three major sets of hypotheses. Finally, I describe the path models, including the originally proposed model and the refitted model based on the information gathered in the preliminary regression analyses.

Table 3 – Descriptive Statistics for Path Model Variables

Variable	Mean	SD	Median	Min	Max	Skew	Kurtosis	N Obs
Affinity for Technology	4.11	0.70	4.2	2.3	5	-0.75	-0.14	81
Age	33.69	9.66	30	22	63	1.23	0.83	81
Technology Self-Efficacy	8.05	1.23	8.2	4.9	10	-0.40	-0.66	81
Perceived LoA	5.01	2.11	5	1	10	0.01	-0.8	81
Perceived Ease of Use	5.64	0.81	5.62	2.75	6.92	-0.60	0.66	81
Perceived Usefulness	6.18	0.97	6.56	1.19	7	-2.14	6.98	81
Perceived Reliability	5.84	0.91	5.89	2.33	7	-1.20	2.26	81
Experience/Skill	4.07	0.65	4.12	2	5	-0.57	-0.12	81
Perceived I-O Match	4.41	0.56	4.56	2.17	5	-1.09	1.68	81
Experienced Control	4.23	0.70	4.33	2.11	5	-0.76	-0.06	81
Positive Affect	1.05	1.52	1.33	-3.33	4	-0.64	0.24	81
Authenticity	4.31	0.68	4.56	3	5	-0.54	-1.11	81
Work Engagement	4.45	1.08	4.33	2.22	7	0.03	-0.44	81
Task Interestingness	3.29	0.91	3.33	1	5	-0.19	-0.65	81
Task Enjoyability	3.17	0.82	3	1	5	-0.15	0.22	81
Task Importance	4.51	0.54	4.67	2.5	5	-1.11	1.19	81
Task Difficulty	2.33	0.93	2.33	1	5	0.50	-0.15	81

Note. Values represent person-level averages for orientation responses and performance episode survey responses that have been averaged to the person-level. The experiential features of automation variables represent person-level orientation and performance episode survey responses that have been averaged together.

Table 4 – Correlations of Path Model Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Affinity for Technology												
2. Age	-.04											
3. Technology Self-Efficacy	.60**	-.08										
4. Perceived Level of Automation	.31**	-.08	.24*									
5. Perceived Ease of Use	.05	.11	.04	.06								
6. Perceived Usefulness	.15	-.09	.21	.27*	.42**							
7. Perceived Reliability	.14	.08	.15	.23*	.66**	.59**						
8. Experience/Skill	.08	.23*	.09	.07	.50**	.26*	.23*					
9. Perceived Intention-Outcome Match	.07	.18	.11	-.06	.47**	.38**	.51**	.35**				
10. Experienced Control	.15	.17	.02	-.03	.43**	.37**	.42**	.30**	.45**			
11. Positive Affect	.08	.25*	.15	.07	.04	.04	.06	-.10	-.03	.17		
12. Authenticity	.03	.31**	.06	.09	.21	.25*	.08	.20	.31**	.32**	.14	
13. Work Engagement	.24*	.39**	.27*	.28*	.24*	.21	.27*	.13	.13	.30**	.45**	.40**

Note. * indicates $p < .05$; ** indicates $p < .01$.

7.1 The Impact of Automation on Agency

The primary goal of this investigation was to examine whether there were shared experiential features of automation across different types of automated business software that were related to individuals' experiences of agency while working with the software. I suggested that the various experiential features of automation would be related to the experience of control and that those relationships would be mediated by perceived intention-outcome match, which was proposed to be the mechanism of the experience of agency. To preliminarily test the direct relationships, I conducted separate linear regressions between the different experiential features and the experience of agency, and I tested the mediated relationships by computing confidence intervals (CIs) for the indirect effects using the *RMediation* package (Tofighi & MacKinnon, 2011). The *RMediation* package computes CIs for indirect effects by calculating the distribution of the product of the a and b path coefficients from the mediated model.

In Hypotheses 1a and 1b, I proposed that there would be a negative direct relationship between the perceived level of automation and the experience of agency and an indirect relationship between those variables through perceived intention-outcome match. I did not find support for either the direct effect, b = -.01, p = .81 nor the indirect effect, ab = -.01, 95% CI [-0.04, 0.02]. The remainder of the main hypotheses (2a-5b) proposed positive direct relationships between the experiential features of automation (perceived ease of use, perceived usefulness, perceived reliability, experience/skill) and the experience of agency, as well as the mediation of those relationships by perceived intention-outcome match. I found support for each of these hypotheses, and the coefficients for the direct effects and indirect effects can be found below in Tables 2 and 3, respectively.

Perceived ease of use, perceived usefulness, perceived reliability, and experience/skill were all positively related to experienced control and those relationships were all mediated by perceived intention-outcome match. Thus, Hypotheses 2a-2b were supported. Although I conducted each of these regression analyses separately, the significant direct effects remained significant after controlling for Type I error using the Holm-Bonferroni method. P-values cannot be computed for the indirect effects using the product of coefficients method, which prevented a similar test of the family-wise error rate for the indirect effects.

Table 5 – Direct Effects of Experiential Features of Automation on Experienced Control

Independent Variables	*B*	*SE B*	*β*	*CI*	*Standardized CI*	*p*
Perceived Level of Automation	-0.01	0.04	-0.03	-0.08 – 0.19	-0.25 – 0.19	0.815
Perceived Ease of Use	0.37	0.09	0.43	0.20 – 0.55	0.23 – 0.63	<0.001
Perceived Usefulness	0.26	0.08	0.37	0.12 – 0.41	0.16 – 0.57	0.001
Perceived Reliability	0.32	0.08	0.42	0.16 – 0.47	0.22 – 0.62	<0.001
Experience/Skill	0.32	0.11	0.30	0.10 – 0.55	0.09 – 0.51	0.006

Table 6 – Indirect Effects of Experiential Features of Automation on Experienced Control through Perceived Intention-Outcome Match

Independent Variables	Indirect Effect		95% CI	
	Estimate	*SE*	*LL*	*UL*
Perceived Level of Automation	-0.01	0.02	-0.04	0.02
Perceived Ease of Use	0.13	0.05	0.04	0.24
Perceived Usefulness	0.10	0.04	0.03	0.19
Perceived Reliability	0.12	0.05	0.03	0.23
Experience/Skill	0.15	0.06	0.06	0.28

Note. The indirect effects reflect the product of the a and b path coefficients within the mediated relationships, based on the distribution of the product method introduced by MacKinnon, Lockwood, Hoffman, West, and Sheets (2002). I calculated these effects using the *RMediation* package (Tofighi & MacKinnon, 2011), which provides information about the effects' significance with CIs, rather than p values.

7.2 Traits and Task Characteristics

To test Hypotheses 6a – 8c, I conducted three sets of multivariate regressions to examine the impact of the three individual difference variables (affinity for technology, age, and technology self-efficacy) on the various experiential features of automation. I followed up tests involving perceived usefulness as a dependent variable with separate robust regression tests because of the non-normal distribution of this variable. Hypotheses 6a-c proposed that affinity for technology would be positively related to (a) perceived ease of use, (b) perceived usefulness, and (c) perceived reliability. Hypotheses 6a and 6c were not supported, but Hypothesis 6b was supported, $b = .26$, $p = .02$, such that affinity for technology was positively related to perceived usefulness.

Hypotheses 7a-c proposed that age would be negatively related to (a) perceived ease of use, (b) perceived usefulness, and (c) perceived reliability, and none of these hypotheses were supported. Coefficients ranged from -.009 to .009 and p-values ranged from .32 to .48. Hypotheses 8a-c proposed that technology self-efficacy would be positively related to (a) perceived ease of use, (b) perceived usefulness, (c) experience/skill. Hypotheses 8a and 8c were non-significant, but the relationship between technology self-efficacy and perceived usefulness was significant in the expected, positive direction, b = .18, p = .005. I conducted some exploratory analyses on the relationships between the individual differences and experiential features of automation that were not explicitly predicted, and these results, as well as those mentioned above, can be found in Table 6. There were some unexpected significant relationships among the exploratory analyses, including a positive relationship between affinity for technology and perceived level of automation, b = 0.92, p = .005, age and experience/skill, b = .02, p = .04, and technology self-efficacy and perceived level of automation, b = 0.41, p = .03.

Although not formally hypothesized, it was an exploratory aim of this study to examine the effects of task characteristics on the relationships between the experiential features of automation and agency. The r_{wg} values of the task characteristic measures did not meet the recommended .70 cutoff (See Table 1), so I first explored the relationships between the task characteristics, perceived intention-outcome match, and experienced control within multilevel analyses to see if there were effects at the within-person or between-person levels. I found that, among all the task characteristics, effects were being driven at the between-person level, so I proceeded with the following analyses with data aggregated to the person-level.

Table 7 – Multivariate Regressions for Experiential Features of Automation by Individual Difference Predictors

	Perceived Level of Automation			Perceived Ease of Use			Perceived Usefulness[1]			Perceived Reliability			Experience/Skill		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Affinity for Technology	0.92	0.32	0.31**	0.05	0.13	0.05	0.25	0.10	0.19*	0.19	0.19	0.14	0.08	0.10	0.08
Age	-0.02	0.02	-0.08	0.01	0.01	0.11	-0.01	0.01	-0.09	0.01	0.01	0.08	0.02	0.01	0.23*
Technology Self-Efficacy	0.41	0.19	0.24*	0.03	0.07	0.04	0.18**	0.09	0.23**	0.11	0.08	0.15	0.05	0.06	0.09

Note. *p < 0.5; ** *p* < .001. [1]The unstandardized coefficients, standard errors, and standardized coefficients for the analyses in which Perceived Usefulness is a predictor are extracted from robust regression analyses due to the non-normality of perceived usefulness. All other data are extract from OLS regression analyses.

The task characteristics that I examined included task difficulty, task interestingness, task enjoyability, and task importance. Because these were exploratory analyses, I only discuss the significant results with a specific focus on the interaction terms between the experiential features of automation and the task characteristics on experienced control. For task difficulty, I found a significant interaction term between task difficulty and level of automation, b = .11, p = .004, such that high levels of perceived level of automation were related to reduced levels of experienced control when coupled with easy tasks and high levels of experienced control when coupled with difficult tasks (See Figure 1). To further explore this interaction, I conducted a mediated moderation model to examine whether perceived intention-outcome match mediated the interaction effects of perceived level of automation and task difficulty on experienced control. The mediated moderation was not significant, ab = 0.03, 95% CI [-0.001, 0.065].

There was a significant interaction between task interestingness and perceived ease of use, b = -0.19, p = 0.028, such that at low levels of perceived ease of use (difficult-to-use software), experienced control was higher when coupled with interesting tasks than with non-interesting tasks, yet task interestingness did not seem to play a role in experienced control at high levels of perceived ease of use (See Figure 2). There were also significant interactions between task enjoyability and perceived ease of use, b = -0.19, p = 0.010, perceived usefulness, b = -.23, p < 0.001, and experience/skill, b = -0.23, p = 0.016. For each of these unique experiential features of automation, the effect of task enjoyability was similar: at low levels of perceived ease of use, perceived usefulness, or experience/skill, experienced control is higher when coupled with enjoyable tasks than

with unenjoyable tasks, but the effects of task enjoyability faded at high levels of those experiential features (See Figures 3 – 6).

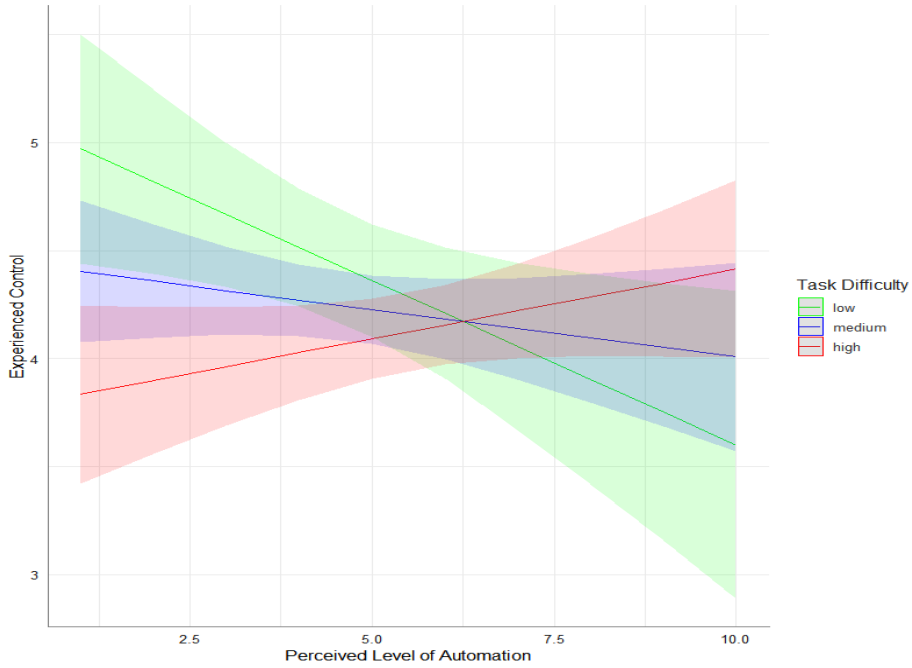


Figure 2 – Interaction between Perceived Level of Automation and Task Difficulty on Experienced Control

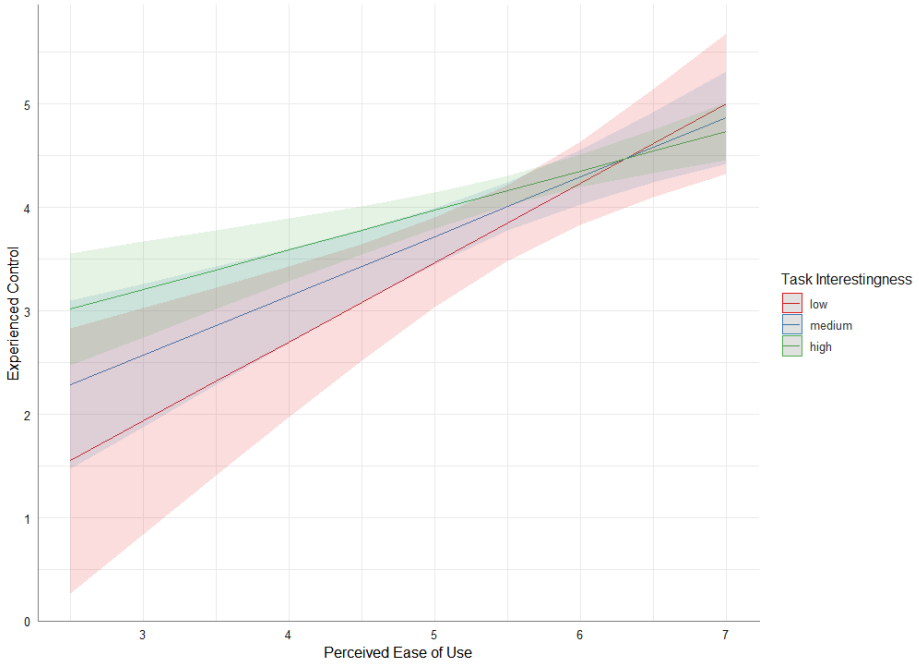


Figure 3 – Interaction between Perceived Ease of Use and Task Interestingness on Experienced Control

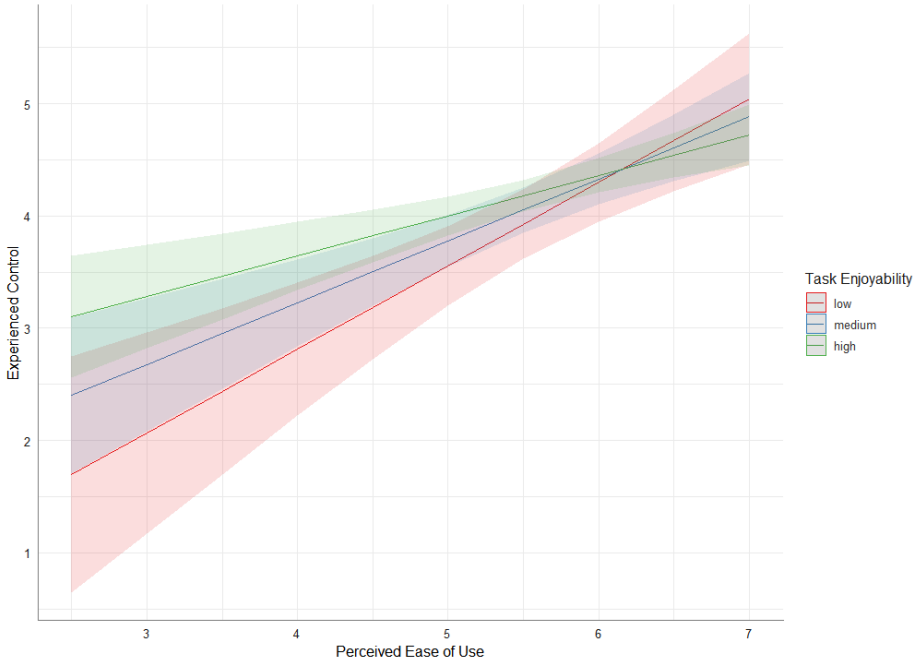


Figure 4 – Interaction between Perceived Ease of Use and Task Enjoyability on Experienced Control

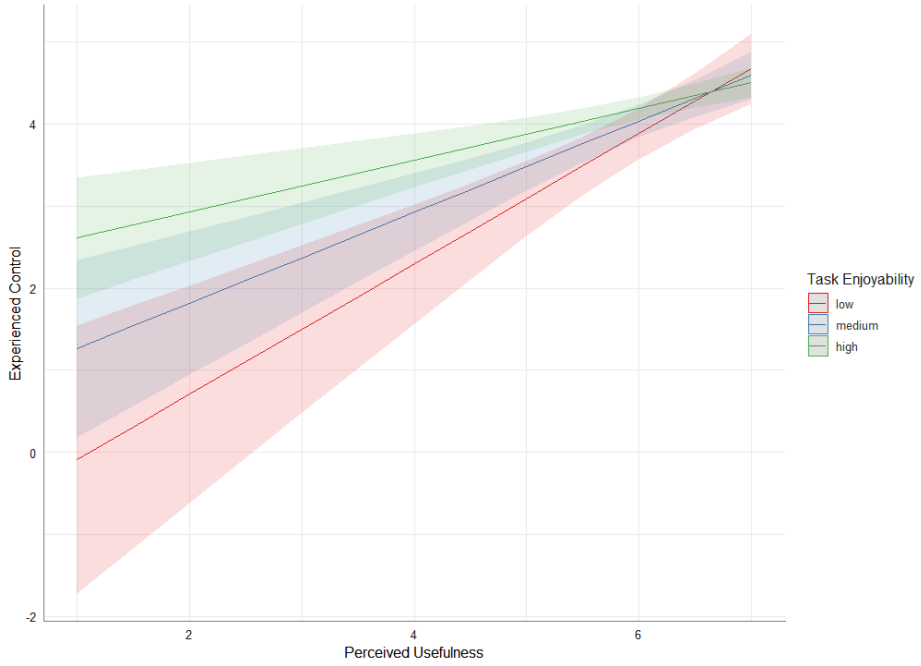


Figure 5 – Interaction between Perceived Usefulness and Task Enjoyability on Experienced Control

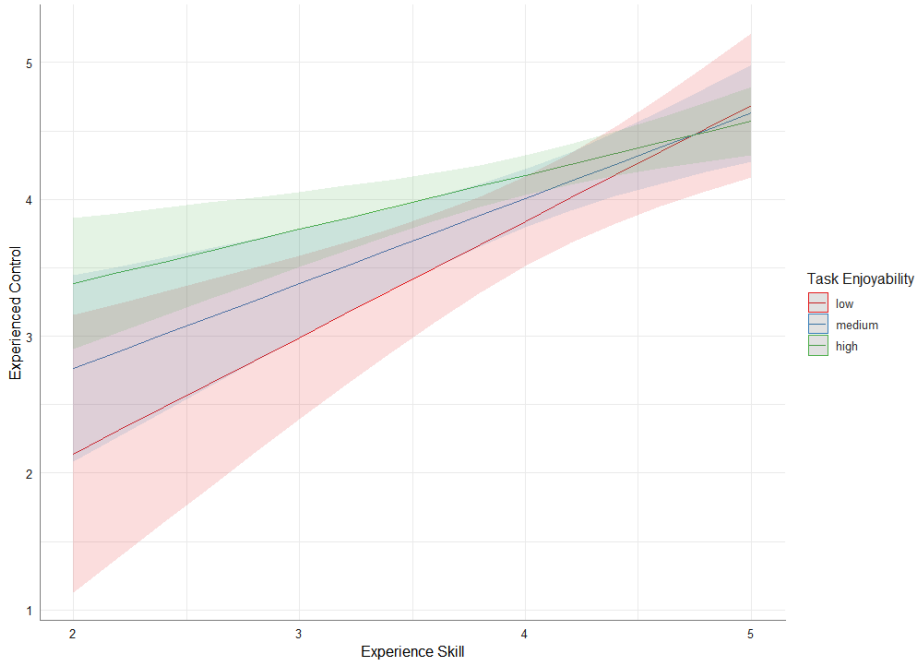


Figure 6 – Interaction between Experience/Skill and Task Enjoyability on Experienced Control

7.3 Well-Being Outcomes

For the final set of preliminary analyses, I conducted simple linear regressions to examine the relationships between the experience of agency and positive affect (H9), authenticity (H10), and work engagement (H11a). For Hypothesis 9, I expected a positive relationship between the experience of agency and positive affect, but this relationship was not significant, $b = 0.36$, $p = .14$. For hypotheses 10 and 11, I expected positive relationships between the experience of agency and authenticity and work engagement, and found significant relationships for both authenticity, $b = 0.32$, $p = 0.003$, and work engagement, $b = 0.47$, $p = 0.006$. Therefore, Hypothesis 9 was not supported but Hypotheses 10 and 11 were.

7.4 Path Model

To conduct the path analysis, I first tested the proposed path model that included all hypothesized relationships, and then I modified the fit based on the results of the preliminary analyses. As expected, the original path model exhibited poor fit, $\chi^2(46) = 183.81$, CFI = 0.40, RMSEA = 0.19, SRMR = 0.18. To improve model fit, I removed the paths that were non-significant in the preliminary analyses, which essentially involved removing all paths related to the individual difference variables (affinity for technology, age, technology self-efficacy), perceived level of automation, and positive affect. I initially included the significant paths from affinity for technology and technology self-efficacy to perceived usefulness, but the model still exhibited poor fit with these paths included. Although structural equation modeling (SEM) does not require normally distributed data, the lack of model fit with these paths included suggests that the significant robust

regressions for these relationships should be considered with caution. After those paths were removed, the modified path model exhibited acceptable fit, $\chi^2(10) = 16.49$, CFI = 0.92, RMSEA = 0.09, SRMR = 0.06. The modified path model is shown in Figure 7.

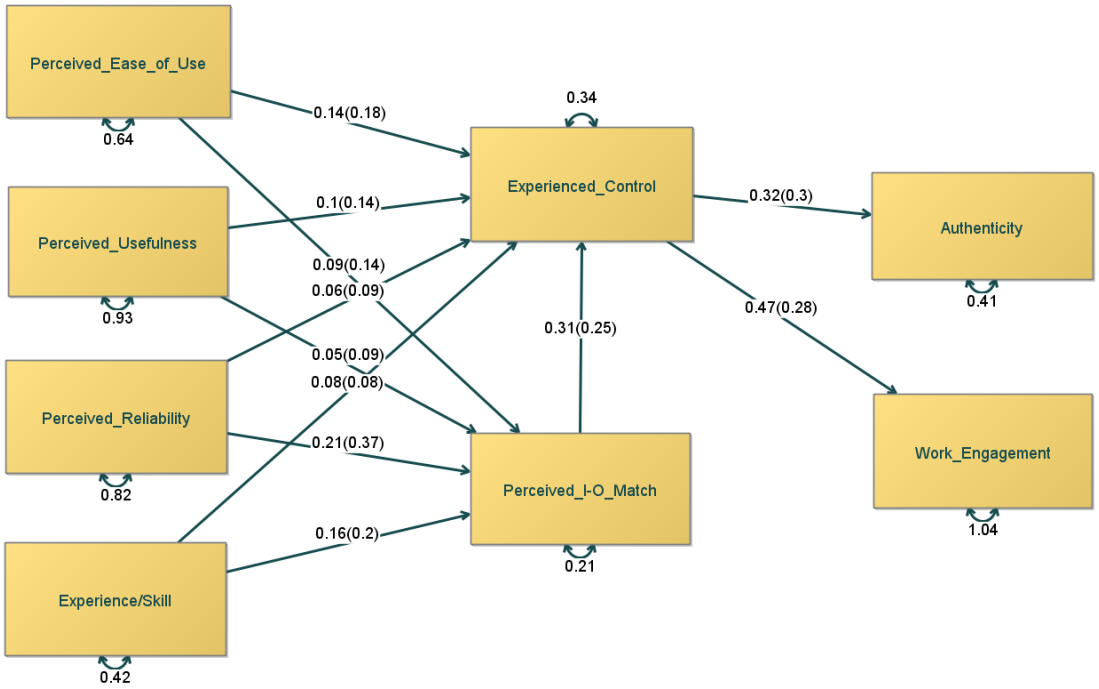


Figure 7 – Modified Path Model

CHAPTER 8. DISCUSSION

The purpose of the current research was to examine the relationship between automated technologies and workers' experiences of agency. I also examined several individual difference variables as potential trait-like predictors of individuals' experiences with automation and boundary conditions of the relationships between the features of automation and agency in the form of task characteristics. Finally, I explored the relationships between experiences of agency and proximal well-being outcomes to assess whether agency is related to aspects of well-being at work. In this section, I discuss the results of each of these three aims in the context of the broader literature. I also provide theoretical and practical implications, limitations, and future directions for research on these topics.

8.1 The Impact of Automation on Agency

The primary propositions within the current research related to the experiential impact of automation on workers' sense of agency. First, I suggested that there are shared experiential features of automation that can be meaningfully examined across different automated technologies. I suggested that these experiential features influence individuals' experiences of agency while working with automated technologies by impacting the mechanism of agency, which was conceptualized as the perceived match between one's intentions and outcomes for work-related activities. Overall, there was strong support for these propositions, such that five out of the six experiential features of automation were directly related to the experience of agency (experienced control), and those relationships were significantly mediated by perceived intention-outcome match. The perceived ease of

use, perceived usefulness, and perceived reliability of an automated technology, as well as one's experience and skill working with the automated technology, were all found to be significant predictors of one's experience of agency within work activities coupled with the technology.

Although I did not find support for the direct or indirect relationship between perceived level of automation and the experience of agency, exploratory analyses revealed a significant interaction effect between level of automation and task difficulty on the experience of agency. Under low levels of task difficulty, the relationship between the perceived level of automation and the experience of agency was negative, in the hypothesized direction, such that high levels of automation were related to low levels of experienced control. However, the relationship between perceived level of automation and the experience of agency was in the opposite direction under high levels of task difficulty, such that high levels of automation were related to high levels of experienced control. Past research has examined the influence of task difficulty on the sense of agency, although those findings have shown a negative effect, such that task difficulty decreased the sense of agency (Howard, Edwards, & Bayliss, 2016; Sidarus & Haggard, 2016). I found no main effect of task difficulty on experienced control in the current study. Although I am not aware of any existing research that has examined the moderating role of task difficulty on the relationship between the perceived level of automation and agency, I will offer a potential explanation of the results.

In the context of difficult tasks, individuals may experience high automation as an enhancement to control because they are able to accomplish more than what they would be able to do alone. Alternatively, individuals working with low automation on difficult tasks

may experience diminished control because they do not have the resources available to meet the demands of the task. For example, I would feel a much greater sense of control conducting linear regressions in R than if I were to try to do so with a calculator. With R (high automation), the software handles the complex statistics, and I only need to provide the correct code. I feel a high sense of control in this scenario because with R I can quickly and easily obtain the results I need, and I trust that those results are accurate, which is not something I would experience without the use of such software. With a calculator (low automation), I am responsible for setting up the appropriate equations to achieve the correct answer, which might make me feel less confident over the results, thereby reducing my feelings of control over the task. These findings may relate to the well-established curvilinear relationship between personal ability and strain within person-environment fit theory (French, Caplan, & Van Harrison, 1982). For example, the scenario with the calculator may represent high strain (and low control) because the demands of the task exceed my personal ability, whereas the scenario with R represents low strain (and high control) because I have enough resources to meet the demands of the task.

The effects of the perceived level of automation on the experience of agency are different in the context of easy tasks. Individuals may experience high levels of agency while working on easy tasks with low automated technologies because they are more confident about their abilities to accomplish the task: they have enough resources to meet the demands of the task and the low automated technology is merely serving as an aid. However, I suggest that there is a unique experiential shift when individuals are working with high automated technologies on easy tasks. In this scenario, I suggest that the joint perception of low demands (easy task) and high assistance (high automation) may cause

individuals to form weaker intentions around the task (i.e., become less invested) which causes their experiences of control to suffer. This interpretation is in line with Obhi and Hall's (2012) interpretation, relating to the OOL performance problem. When high automated technologies are primarily responsible for the components of a given activity, individuals may become less invested in the task (i.e., OOL) and experience lower feelings of control in relation to the task's outcomes. I would argue that the current findings also suggest that individuals are becoming disinvested from the task and experiencing decreased agency because the task is perceived as being 'easy' because it is primarily managed by the technology.

In addition to the moderating effect of task difficulty on the relationship between perceived level of automation and experienced control, there were several other interaction effects between task characteristics and experiential features of automation on the experience of control. Task interestingness moderated the relationship between perceived ease of use and experienced control such that at low levels of perceived ease of use, interesting tasks were related to higher experienced control than were non-interesting tasks, but task interestingness did not influence experienced control at high levels of perceived ease of use. I found similar results for interactions between task enjoyability and perceived ease of use, usefulness, and experience skill, such that enjoyable tasks were related to high agency under low levels of those experiential features but the effect of task enjoyability was diminished at high levels of the experiential features. These preliminary results seem to suggest that the nature of the task might have a greater impact on individuals' experience of agency when the technology is 'bad' but not so much when the technology is 'good'.

However, these results were based on exploratory analyses, so further research is needed on these relationships before such conclusions can be made.

8.2 The Roles of Individual Differences

While the hypotheses regarding the relationships between the experiential features of automation and agency were largely supported, those that focused on the individual difference predictors were largely non-significant. Although there was some indication that affinity for technology and technology self-efficacy were significantly related to perceived usefulness using robust regression analyses, these results were not supported by the path analysis. Although there is relatively little research about these traits in relation to perceptions of technology, the current findings are contrary to past evidence. I will first address the lack of findings for the affinity for technology and technology self-efficacy variables before turning to a discussion of the role of age and the role of individual differences in experiences of technology more generally.

Participants provided their ratings for affinity for technology and technology self-efficacy based on their attitudes towards technology and their abilities with technology generally, rather than with the specific automated business software they used in the study. Although the relationships between these two variables and the experiential features of automation would have almost certainly been stronger if the referent point of the scales had been the automated business software versus technology generally (Karsten et al., 2012), I intentionally kept the referent point of the items to technology in general. For these hypotheses, I really wanted to know whether there were trait-like constructs, such as affinity for technology and technology self-efficacy, that could significantly predict

individuals' experiences of automation. Data that affirmed this question would have then allowed me to generalize my findings more broadly to say something like, "People who are more efficacious with technology or positively view technology will generally have a better experience with automated technology in their jobs". However, no such claims can be made considering the current data. Future research in this area may benefit from including more specific trait constructs (e.g., self-efficacy with the software of interest) to gain a better understanding of whether these predictors could be meaningful at a narrower level of conceptualization.

The non-significant effects of age on the experiential features of automation could have several causes. An initial concern was a lack of variance in participants' ages, with the belief that most workers who self-selected into the study were younger due to the automated business software requirement. There was a wide range of ages among participants in the study sample (22 – 63 years old), so the variance in age was likely not a reason for the lack of effects. However, there may have still been a self-selection problem with study sample, such that the older participants who participated in this study were not representative of older adults generally, in terms of their attitudes towards technology. Participants who completed this study were required to signal interest in the study and understanding of the term 'automated business software', use an automated business software in their jobs, and complete all portions of the study online through either a computer or mobile device. These selection barriers may have precluded the inclusion of older adults who have less positive attitudes towards technology and who would have reported more negative experiences with the technologies in their jobs.

Moreover, past research on the topic of age and technology has generally focused on older adults' negative perceptions of technology, wherein older adults represent individuals above the age of 65 (Czaja et al., 2006; Mitzner et al., 2010; Olson, O'Brien, Rogers, & Charness, 2011; Xie, Watkins, Golbeck, & Huang, 2012). It is possible that a generational effect, rather than a linear age effect, is a more appropriate way to examine age differences in perceptions of technology. Furthermore, it is likely that younger generations (i.e., Generation X, Millennials, and Gen Z) display more similar perceptions of technology than do older adults because of the development and rise of digital technologies in the 1990s and 2000s. Older adults fall into the Baby Boomer generation (those born between 1946 – 1964), although I only had five people in the current study that would have qualified for inclusion in such a category. Thus, it was not possible to examine meaningful generational differences in the current study, although it remains an interesting question for future research to explore.

Beyond the limitations already mentioned, it is possible that the lack of findings noted here highlights a broader conceptual issue regarding the momentary nature of experiences of technology. Participants were asked to provide their ratings of the various experiential features of automation regarding their experiences both generally, during the orientation, and within the moment, during the performance episode surveys. These referent points invite participants to think about how they feel while they are using the specific software in their jobs, which may be a unique experience from how they may use another technology in their lives (e.g., their cell phones). In other words, it may be the case that experiences with different technologies are not well-predicted by broad individual differences because the individual's experience with the technology may only be invoked

by the experiential features of the technologies themselves. As I stated earlier, it is likely that more specific constructs to certain technologies (e.g., technology self-efficacy with technology X) would provide more information, which may be a useful starting point to better understand these relationships. Future research on this topic should include these and other trait-like constructs to gather more information about the viability of individual differences as predictors of experiences with technologies.

8.3 Well-Being Outcomes

The last set of hypotheses focused on the relationships between agency and the proximal well-being outcomes of positive affect, authenticity, and work engagement. It was expected that the experience of agency would be positively related to positive affect, which was measured as valence, but this relationship was not significant. The within-person variance of valence was much higher than that of experienced control, which suggests that there were contextual factors that contributed to participants' momentary levels of positive affect that were not accounted for in the current study. This is not unexpected – it is well established that emotional states are transient (Ashkanasy & Humphrey, 2011) and that events at work can cause substantial emotion shifts (Weiss & Cropanzano, 1996). Given prior research, it was expected that a significant portion of this transience could be predicted by momentary experiences of agency (Christensen, Yoshie, Di Costa, & Haggard, 2016; Gentsch & Synofzik, 2014; Yoshie & Haggard, 2013, 2017), however, these studies were all conducted in laboratory settings and with slightly different designs. Specifically, these studies manipulated the affective valence of the outcomes of participants' actions, rather than eliciting emotional reports following agentic or non-agentic behaviors. Thus, positive outcomes may encourage stronger feelings of agency, but

it is an open question whether the opposite is true. It was not possible to test directional effects in the current study, but future research should examine the nature of this relationship more closely.

I expected that the experience of agency would be positively related to authenticity and work engagement and found support for both of those hypotheses: higher experienced control was related to higher feelings of authenticity and higher feelings of work engagement. Agency and authenticity are conceptually quite similar, in that agency can be understood as the experience of doing what one wanted or intended to do, whereas authenticity can be understood as the feeling that one has been true to oneself, which should naturally include the achievement of intentions (e.g., I said I was going to do this and I did). These results suggest that momentary experiences of agency contribute to momentary experiences of authenticity, which may accumulate to form individuals' attributions of themselves as authentic or inauthentic persons (Kraus, Chen, & Keltner, 2011). Future research should examine whether momentary experiences of agency over time are related to more stable self-concepts related to authenticity.

In a similar vein, these findings suggest that momentary experiences of control in one's work are related to momentary feelings of work engagement, yet agency may also be an important window to understanding more stable levels of work engagement. The positive relationship between trait-level measurements of job control and work engagement has been established (Mauno et al., 2007; Swanberg, McKechnie, Ojha, & James, 2011), but this relationship can be examined in a more temporally precise manner through constructs like agency and momentary engagement. Just as momentary healthy behaviors such as healthy eating and exercise contribute to long-term health outcomes, the

momentary experiences of high and low agency at work likely contribute to individuals' more positive stable attributions and workplace attitudes. Future research should examine the question of whether momentary experiences of high agency contribute to feelings of work engagement over time, as well as if decreased experiences of agency can lead to the manifestation of job burnout.

8.4 Theoretical and Practical Implications

There are two major contributions of the current research that have related theoretical and practical implications, so I will discuss them jointly here. The first is that this investigation represents a novel attempt at understanding the role that automation serves in the daily experiences of the modern workforce. Much of the past research on technology in the workplace has focused on how the introduction of new technologies changes existing paradigms in different areas like recruitment, selection, and teams. For example, researchers have been interested in how new sources of online information from social media can be used to attract new candidates (Davison, Maraist, & Bing, 2011), how mobile assessments of test batteries affect their predictive validity (Illingworth, Morelli, Scott, & Boyd, 2015), and how virtual teams communicate and coordinate with each other (Kanawattanachai & Yoo, 2007). Taken together, these research streams all work towards optimizing organizational performance by accounting for the new contexts that technology affords. The current study expands on the existing literature by underscoring the impact of technology on the individual worker, rather than on organizational outcomes.

This new orientation towards the understanding the psychological impact of technology is important because work is becoming more automated every day and these

changes have real implications for the average worker. Researchers at McKinsey Global Institute published a report in 2018 on the future of work with several important insights (Manyika & Sneader, 2018). One was that work is changing – automation is not only creating or eliminating jobs, but it is also transforming them: "At retailer Amazon, employees who previously lifted and stacked objects are becoming robot operators, monitoring the automated arms and resolving issues such as interruption in the flow of objects". Another insight was that automation is changing both workplaces and workflows: "As self-checkout machines are introduced in stores, for example, cashiers can become checkout assistance helpers, who can help answer questions or troubleshoot the machines". These kinds of work role changes have major implications for the kinds of skills and abilities that are needed for future jobs, but there are also implications for how work alongside automation will be experienced. How will work with automation affect workers' basic experiences of motivation and work engagement? How will individuals' sense of work identity change? These research questions were not included in the present investigation, but it is my hope that this project has instigated these types of considerations because of its focus on the impact of technology on the worker, rather than on organizations' bottom lines.

The second major contribution is the study of agency in a workplace context. Past research on agency has examined how the sense of agency emerges from individuals' specific psychomotor actions, such as moving a hand or clicking a mouse and how the sense of agency might be altered by manipulating individuals' perceptions of their own actions (Aarts et al., 2005; Engbert et al., 2008; Wegner & Wheatley, 1999; Wohlschläger et al., 2003). This research is important for understanding how and when our feelings of

volition arise in relation to our actions, particularly in the context of disorders of volition (e.g., schizophrenia), although it is not obviously impactful to research on the psychology of work. However, in this study, I have attempted to demonstrate how the extrapolation of the sense of agency from lower level psychomotor phenomena to the level of performance episodes at work provides a meaningful way to understand how individuals experience control in their daily work activities. Extant research on control in I-O and OB literatures has conceptualized control constructs as relatively stable, with constructs like locus of control and self-efficacy as major examples. Research on these topics has greatly aided the understanding of how individuals' orientations towards control affect long-term outcomes like mental and physical health, but they do not provide a clear picture on what the daily experiences of those phenomena are like.

Likewise, work specific control constructs such as job autonomy have also been conceptualized as being relatively stable across time and have largely addressed the amount of control offered in the organizational environment rather than the amount of experienced control on behalf of the worker. For example, job autonomy can be broken down into subscales of work scheduling autonomy, (e.g., "The job allows me to make my own decisions about how to schedule my work"), decision-making autonomy, (e.g., "The job gives me a chance to use my personal initiative or judgment in carrying out the work"), and work methods autonomy, (e.g., "The job allows me to make decisions about what methods I use to complete my work."). These features reflect the amount of control available in the job itself, rather than an individual's actual experience of control in his or her daily work activities. The construct of agency is unique to existing control constructs in this way because it focuses on the first-person, momentary experience of control, which

allows for a more precise investigation of how control and accompanying experiential states unfold across time in one's work.

In addition to the novelty of this construct to organizational research, the current research has provided preliminary evidence of the relationship between agency and important workplace outcomes, like authenticity and work engagement. Although there is not a large literature on authenticity in the workplace, research that has been done shows that authenticity is positively related to outcomes like work engagement and job performance (van den Bosch & Taris, 2014). Work engagement has been a hot topic for the past decade, particularly for organizations that seek to increase employee engagement with the goal of improving organizational performance. The current research has demonstrated that increasing workers' experiences of agency may be a way to achieve higher feelings of authenticity and work engagement, which could also have positive benefits on performance outcomes. Moreover, given the temporal precision afforded by the measurement of agency at the performance episode level, it will be possible in future research to examine how experiences of control (or lack thereof) may accumulate over time to affect outcomes like engagement and performance.

8.5 **Limitations**

This study had several limitations. First, the implications that can be made regarding the effects of automation on agency at work are limited because the study was not able to examine individuals' experiences of agency with and without automated technologies in place. The current study examined the relationships between the experiential features of automation and agency within individuals' daily work tasks, which

allowed for an understanding of how different experiences of automation may relate to different experiences of agency. However, this research design did not permit an examination of how experiences of agency within work might change with the introduction of automated technologies versus the same work that does not involve automation. The comparison of similar work tasks, with and without automation, would allow for stronger claims regarding the impact of automation on agency, although this type of research design would be difficult to achieve outside of an experimental setting.

In this study, I felt it was more important and meaningful to illuminate the role of automation as it exists in individuals' work lives, rather than provide an isolated test of those relationships that might not be generalizable. The use of automation is already prevalent across many different work settings, as can be noted from the variety of software and job types included in this relatively small study. Thus, it was really my goal to understand how individuals' work experiences are already adapting to fit the automation in place, rather than understanding how individuals' experiences might change if automation is introduced. However, this is not to say that the latter question is unimportant. It remains an extremely important question that was beyond the scope of this study. Future research would benefit from exploring how specific tasks and roles change, in terms of experiences, as well as productivity and performance, in reaction to the introduction of automated technologies.

Second, it is possible that the automated software included in the current study were not wholly reflective of the types of automation described in this paper's introduction. I built the study's theoretical framework and hypotheses with the notion that automation can be experienced as a 'partner' within work activities, although that might not be well-

represented by some of the automated business software used by participants in this study. For example, there were many types of data management software used by participants in this study, and participants reported work tasks such as 'pulling information' and 'generating reports' with those technologies. It is not clear that the experiences of these kinds of tasks are qualitatively different with the use of the automated software noted by participants than if they were using any other less-automated technology. In other words, some of the software and tasks reported by participants seemed to reflect the experience of the software as a tool, rather than as a highly automated technology partner with which the task was shared. This issue could also be a reason for the lack of findings for a main effect between perceived level of automation and agency in the current study.

Although the inclusion of a diverse array of automated software was an important starting point for the current study because it was representative of the types of automation that many workers are currently using, future research would benefit from using a more precise operationalization of automation. Specifically, future research could employ an experimental design to manipulate the level of automation such that participants are exposed to high 'partnership' levels of automation, as well as low 'assistance-only' levels of automation to more explicitly understand whether there is unique experiential influence of high automation on agency beyond lower forms of automation. Additionally, such a design could include perceptions of level of automation, like those measured in this study, to examine how closely perceived and objective levels of automation align. This design could also include a manipulation of task difficulty, to provide an a priori test of the significant interaction found between perceived level of automation and task difficulty in the current study.

Third, the relationships examined in this study were based entirely on self-report data, and it is well-established that such an approach has several potential weaknesses. The collection of all this study's data through the same method (i.e., self-report) raises the possibility of common method variance between the constructs of interest (Campbell & Fiske, 1959). Common method variance refers to variance that is attributable to a shared measurement method rather than to the true relationships between the constructs of interest. Thus, it is possible that by collecting the experiential features of automation and experiences of agency through self-report, the relationships between these variables are artificially inflated because of the shared measurement method. Although I attempted to overcome this issue by providing temporal separation between the measurement of the experiential features of automation at the orientation and the experience of agency within performance episode surveys, I ultimately combined the orientation and performance episode reports of the experiential features of automation and all of these measures were self-report in nature.

In addition to the problem of common method variance, self-report data is also prone to biased response styles, including consistency and social desirability (Podsakoff & Organ, 1986). Consistency, or the consistency motif, refers to the tendency of participants to provide what they believe is a consistent pattern of responses, perhaps to reduce cognitive dissonance that could occur from seemingly conflicting answers. For example, the consistency motif would suggest that participants have a desire to answer positively about their levels of work engagement if they had previously responded in a positive manner regarding their experiences of control and vice versa. Additionally, social desirability relates to the tendency of participants to respond in such a way as to appear

'desirable' to the researcher. For example, a participant may be more likely to report high experiences of agency and work engagement because of the societal value placed on those feeling states, rather than their actual feelings. Much of the data in this study did exhibit a slight negative skew, which provides some indication that social desirability bias may have occurred.

Although these issues are well-known problems with self-report research, it is also true that the constructs of interest in this study were inherently dependent on individuals' perceptions and experiences. How can we understand how people feel about technology without asking them? However, this type of self-report research could be supplemented with additional methods in future studies to gain a better understanding of exactly how much of the variance in the relationships described in this paper could be attributed to common method variance, consistency, and social desirability effects. For example, future research could include an implicit measure of agency, intentional binding, by asking participants to report temporal duration judgments of recent performance episodes and comparing those judgments to the timestamps of the surveys to assess whether intentional binding (i.e., the feeling of agency) is occurring or not. Although implicit and explicit measures of agency are not exactly the same (Dewey & Knoblich, 2014; Saito, Takahata, Murai, & Takahashi, 2015), this approach could provide some additional buffering against common method variance. Moreover, participants would likely not be motivated to respond in a socially desirable manner in providing these duration judgments. Similarly, it may be helpful to include some additional instruction to participants in future research efforts regarding the acceptability of 'not feeling in control all the time' (i.e., "feeling a low sense

of agency right now does not mean you are not an 'agentic person'"), and emphasizing the importance of providing honest, reflective feedback of one's momentary experiences.

Fourth, in addition to the potential of socially desirable response sets, there are a few additional concerns regarding the negative skew of many of the scales included in the performance episode surveys. In one scenario, participant responses may have reflected their true experiences and were not reflective of response bias(es), but this scenario further entails either a lack of representativeness in the study sample (e.g., the participants were unusually happy with the automated technologies in their work) or a lack of negative experiences with automated technologies. The latter scenario would suggest that future research on this topic would be unnecessary because people generally feel agentic while using automated business software because the experiential features, like perceived ease of use and reliability, are all satisfactory. While it is more likely that the study sample is non-representative (despite a wide variety of jobs and types of software in the study sample), another possibility is that the data reflect response bias(es) to the performance episode surveys, such as social desirability or acquiescence bias, wherein survey respondents tend to agree with all the survey statements. There were no reverse-coded items or bogus questions within the performance episode surveys, which could have helped to prevent (or at least detect) acquiescent responding. Future studies may benefit from larger sample sizes to help ensure a more diverse study population, as well as the inclusion of negatively-worded items.

Fifth, the strict focus on between-person, rather than within-person trends was a limitation of the current study. Due to the novelty of the current research questions, I was not sure how much noise would be involved in including a wide range of automated

business software in the study. As such, I restricted each participant to responding about a single automated business software in the orientation and performance episode surveys, even though many participants indicated that they used several different types of automated business software in their jobs. The restriction to between-person analyses permitted a shorter study duration which fit within the cost constraints of the study, although it precluded the collection of potentially meaningful information regarding within-person trends between experiences of automation and experiences of agency. A future examination of workers who use several diverse types of automated business software in their jobs would help to shed light on potential differences or similarities between within- and between-person relationships of these variables.

8.6 Future Directions

The current study has provided several avenues for future research by introducing the novel topics of automated technology and the experience of agency to the organizational literature. First, given the preliminary evidence regarding the between-person relationships between the experiential features of automation and agency provided by the current study, future research should examine the within-person relationships between the experiential features of automation and agency. A true ESM examination of this relationship could serve many purposes. ESM research could better illuminate the extent to which individuals' experiences of the software in their jobs vary across time and across types of software, which would provide more stable estimates of the relationships reported here. Additionally, ESM research could capture individuals' performance episodes that include and omit automated business software across the workday and workweek, which would demonstrate whether the use of automated software leads to

meaningful changes in workers' experiences of agency compared to work activities that do not involve automation. Finally, future research in this vein could easily capture additional work-relevant outcomes that were not included in the current research, including objective performance outcomes like productivity, efficiency, and accuracy in tasks coupled with automated technologies.

Beyond the above research questions that stem naturally out of the current findings, I have two propositions for future research in this area that are quite different from this study and from each other. First, despite the current study's focus on generalizability within a naturalistic setting, experimental research in this area would be quite informative. The current study made several extrapolations from the extant laboratory research that has been conducted on the effects of automation on the sense of agency, yet a closer approximation to the traditional research methods could yield more precise information regarding the unique impacts of each of the experiential features of automation on the experience of agency. A full factorial design could examine the unique and joint effects of some or all of the experiential features of automation, as well as potential moderating factors of the relationships. For example, an experimental study could examine whether the interaction effect between task difficulty and level of automation on the experience of agency replicates in a laboratory setting and whether the effect is driven more by the perceived or actual level of automation.

Another completely different future direction would be an examination of how work with automated technologies impacts individuals' choice and quality of leisure time. Automation is changing the nature of work, which has clear implications for the types of work and the amount of work available for future generations of workers. I am interested

to know how individuals who are greatly impacted by these changes will respond in terms of the ways in which they spend their time outside of work. Decades ago, Kabanoff (1980) presented a review of the literature on work/leisure relations, which included the notions of 'generalization' and 'compensation' uses of leisure for individuals who lack control in their work. The generalization theory suggests that individuals who are alienated by their work (i.e., individuals who experience low control in their work) will also exhibit passive behavior in their leisure time, which could be characterized by passive political and social involvement. Alternatively, the compensation theory suggests that individuals who are alienated from their work may attempt to make up for that lack of control by pursuing leisure activities that are personally meaningful and enriching. These theories could be easily applied to the modern context of workers who experience diminished agency in their jobs due to increased automation (e.g., cashier workers who are now 'checkout assistance helpers'). Future research could examine the conditions under which either or both of these theories help to explain how modern workers cope with the changing nature of work due to automation.

8.7 Conclusion

This study represented an important first step in the understanding of automated technologies in the workplace, particularly as it pertains to workers' experiences of agency. The findings suggest that there are several experiential features of automation that can impact agency, both positively and negatively. Additionally, agency was positively related to feelings of authenticity and work engagement, which suggests that agency is an important workplace construct that should be incorporated more broadly into research

within the organizational sciences. Future research is needed to more fully explicate the role of automation in the psychological experience of modern workers.

APPENDIX A. PILOT STUDY

A.1 Pilot Study Description

A pilot study was conducted to answer two primary research questions. The first research question was whether the full study can limit eligible automated business software to a single function, for example, only automated business software that supports decision-making. The second research question was whether individuals' report differing experiences of the features of automation with the automated software in their jobs across different work tasks. The pilot study was conducted using a Qualtrics survey and participants will be recruited through word-of-mouth and online ads. Recruitment for the pilot study was restricted to participants who use an automated business software in their jobs. Pilot study participants were also required to live and work in the United States, be at least 18 years old, and work full-time. Participants were paid $5 for the completion of the survey.

In the pilot study survey, participants were asked to provide the name and a short qualitative description of the automated software they use in their jobs. Participants were asked to provide the names of the top three tasks (or fewer, if necessary) that accompany their software use. Participants completed a checklist to identify the function(s) that the software provides for each task: (a) information acquisition, (b) information analysis, (c) decision selection, and/or (d) action implementation, (e) other (write-in option). This component of the pilot study provided insight into whether the full study could limit the inclusion of automated business software to a specific function (e.g., those that aid decision-making), particularly at a task level. If participants mostly used software for

functions other than decision-making or most reported tasks involved multiple functions, it would not be possible to limit the eligible automated business software to a single function for the full study.

In addition to providing task descriptions, participants were also asked to rate the experiential features of automation (perceived level of automation, perceived ease of use, perceived usefulness, perceived reliability, and experience/skill) of the automated business software and associated experiences of agency for each reported task. This component of the pilot study provided insight into the general relationships between the features of automation and agency, as well as if there were differences in these relationships between different types of automation functions and/or tasks. If there are practical within-person differences in the relationships between the experiential features of automation and agency between the reported tasks, the experiential features of automation items would be included in the Performance Episode surveys to capture potential within-person trends in the full study.

Results

40 full-time workers participated in the pilot study. There were a wide range of reported software types, including Salesforce, Quickbooks, Schoolzilla, and Concerto. A full list of all of the reported automated business software brands, as well as the broader categories that they fall into, can be found in Appendix A.1. Of the total 40 participants who participated in the pilot study survey, there were 31 participants who completed all parts of the survey.

To address the first pilot study research question about whether the automated business software could be limited to a single function for the full study, I examined the functions of the reported automated business software at software- and task-levels. At the software-level, there was an average of 3.19 functions (SD = 1.08), and at the task level there was an average of 2.08 functions (SD = 0.98). These results suggest that rather than using automated business software for a single function, participants reported using automated business software for multiple functions, even at the task level. Additionally, the four automation functions that were provided to participants were endorsed at similar levels. Across all software types and tasks, the function 'information acquisition' was endorsed 57 times, information analysis was endorsed 51 times, action implementation was endorsed 39 times, and decision selection was endorsed 31 times. Thus, it was decided for the full study that eligible automated business software would not be restricted by automation function and all types of automated business software would be included.

The second major research question of the pilot study was whether participants' reports of the features of automation may differ across tasks, which would necessitate additional measurement of those items within the performance episode surveys in the full study, rather than just within the orientation survey. This question was addressed by examining the ICCs of the features of automation within person, such that an ICC of 1 would indicate perfect within-person agreement on a given feature between the three reported tasks, on average, across all participants. The descriptive statistics and computed ICCs for each of the features of automation, as well as the reported experiences of agency, can be found in this appendix. The ICCs for the features of automation ranged from .38 - .97, indicating that there was a large portion of variance accounted for at the within-person

level for many of the features. Given the wide range in variability of the features of automation across tasks, the full study will incorporate the features of automation items at the performance episode level to account for any task-based differences in individuals' experiences of automation that may account for their experiences of agency in those tasks, above and beyond their average experiences of the automated software in their jobs.

Another secondary research question of the pilot study was whether individuals' experience with automated business software would be better operationalized as the amount of time spent working with the software or as the level of familiarity with the software. The measure of individuals' experience with the automated business software by *time* had an ICC of .97, whereas the measure of individuals' experience by *familiarity* had an ICC of .48. Given that the other features of automation had ICCs that ranged between .38 - .70, the measure of experience by familiarity displayed much more similar within- versus between-person variance than did the measure of experience by time. Moreover, the measure of experience by familiarity displayed more consistent relationships (in the expected direction) with the other variables of interest than did the measure of experience by time. Thus, the full study will utilize the measure of experience by familiarity rather than the measure of experience by time.

A.2 Pilot Study Automated Business Software and Software Categories

Software Name	N
Adobe Photoshop CC 2018	1
Atlassian Bamboo/Bitbucket	2
Bloomberg	1
Concerto	1
Design Manager	1
Ellucian	1
Etelmar	1
Greenhouse	1
iCIMS	1
Milliman PRM Analytics	1
MRI	1
NVivo	1
Pega	1
Quickbooks	1
R	1
Rundeck	1
Salesforce	5
SAP	1
Schoolzilla	1
SkySlope	1
Solve	1
Spark	1
SPSS	1
Square	1
Tableau	1
Trackwise	1

Software Categories	N
Accounting	1
Business Process Management	1
Continuous Integration	2
Customer Relationship Management	7
Data Analysis	3
Data Visualization	1
Educational Data Management	1
Enterprise Resource Planning	1
Financial Services	1
Healthcare Risk Management	1
Interior Design	1
IT Operations Management	1
Media Planning	1
Photo Editing	1
Point of Sale	1
Portfolio Management	1
Quality Management System	1
Real Estate	2
Talent Acquisition	2
Team Email Client	1

A.3 Descriptive statistics and Correlations of Pilot Study Variables

Variable	*M*	*SD*	*ICC*	1	2	3	4	5	6	7	8
1. Perceived Level of Automation	4.48	2.54	.70								
2. Perceived Ease of Use	5.54	1.18	.50	.15							
3. Perceived Usefulness	6.24	0.73	.43	.08	.76**						
4. Perceived Reliability	6.05	1.05	.52	-.10	.50**	.47**					
5. Experience (Familiarity)	4.02	0.75	.48	-.18	.49**	.55**	.28				
6. Experience (Time)	3.65	3.34	.97	-.02	-.30	-.44*	-.10	-.14			
7. Skill	3.76	0.72	.38	-.27	.50**	.52**	.11	.90**	-.10		
8. Intention-Outcome Match	4.38	0.60	.45	.00	.77**	.77**	.58**	.55**	-.37*	.54**	
9. Experienced Control	4.18	0.86	.70	-.23	.42*	.49**	.23	.35	-.34	.47**	.58**

Note. M, *SD*, and *ICC* are used to represent mean, standard deviation, and intraclass correlation, respectively. * indicates $p < .05$. ** indicates $p <$

APPENDIX B. AUTOMATED BUSINESS SOFTWARE

B.1 Automated Business Software Eligible for Full Study

- 3DS Max
- 99 Dollar Social
- Adobe InDesign
- Apptivo
- Arena Simulation
- Asana
- Asset Panda
- athenahealth
- Atlassian - Bamboo and Bitbucket
- AutoCAD
- Autodesk
- BambooHR
- Banq
- Basecamp
- Bloomberg
- BrandsEye
- Brightbook
- Brilliant
- Buffer
- CATIA
- Chatfuel
- Chatlio
- Comindware Tracker
- Concerto
- Culture Amp
- Design Manager
- EBSuite
- ECOUNT ERP
- Ellucian CRM
- ePROMIS ERP
- ERPNext
- EZOfficeInventory
- Fastflow
- Fieldbook
- FivePoint
- Flokzu
- Freightview
- Freshbooks
- Freshdesk
- GravityFlow
- Greenhouse Software
- Hippo CMMS
- Hootsuite
- HubSpot
- iCIMs
- iLab Core
- Infusionsoft
- Integrify
- Intercom
- Kareo Billing
- Kissflow
- Kissmetrics
- Marketo
- MATLAB
- Microsoft Dynamics 365
- Midas Health Analytics
- MIE Trak Pro
- Milliman PRM
- MRI Software
- Namely
- NextGen Healthcare

- Nutcache
- NVivo
- Ontraport
- Pega
- Photoshop
- Pipedrive
- Printful
- Process Director
- ProcessMaker
- Python
- Quick Base
- QuickBooks
- Quuu
- R
- REDCap
- Revit
- Rundeck
- Salesforce
- Samanage
- SAP
- SAS Enterprise Guide
- ScheduleOnce
- Schoolzilla
- Sellsy
- ServiceNow
- ShippingEasy
- ShipStation
- Shopify
- Simio simulation
- Sisense
- SketchUp
- Skyslope
- Solve CRM
- Spark
- Spexx
- Spiceworks Network Monitor
- SPSS
- SQL
- Square
- Tableau
- Tallyfy
- TheraNest
- TrackVia
- Trackwise
- Trello
- Vend
- Vocus
- WorkDay
- Wunderlist
- Xero
- Zapier
- Zendesk
- Zenefits
- Zoho Books
- Zoho CRM
- ZW3D

B.2 List of Software Categories Eligible for Full Study

- Accounting Software
- Architecture Software
- Asset Management Software
- Customer Relationship Management (CRM) Software
- Customer Support Software
- Data Analysis Software
- Design Engineering Software
- EHR Software
- Enterprise Resource Planning Software
- Facility Management Software
- Human Resource (HR) Management Software
- Marketing & Social Media Software
- Medical Software
- Point of Sale Software
- Real Estate Software
- Supply Chain Management Software

B.3 Automated Business Software Used in Full Study

Software Name	Count	Software Name	Count
Adobe After Effects	1	MAP	1
AllPay	1	Margo	4
Biomedical Help Desk	1	Microsoft Dynamics 365	1
Blackboard	1	Mindbody	1
Bloomberg	1	Mitchell and McCormick	2
Bluestar	1	Monday	1
Brokermetrics	1	Moodle	1
BST	2	Nextech	1
Business Intelligence	1	Notepad ++	1
Campus Lab Org Sync platform	1	PeopleSoft	2
Camtasia	1	Practice CS	1
Cerner	1	Procore	1
CHCS	1	QuickBooks	2
Clockwork	1	Raiser's Edge	1
Commissioning Test	1	REDCap	1
CommShop360	1	RF Scanner	1
CorpTax	1	RStudio	1
CoSchedule	2	Salesforce	10
DegreeWorks	1	SEI Trust and Bank Compliance Software	1
Enterprise RX	1	ServiceNow	1
EPIC	2	Shiftboard	1
E-Recruit	1	Smartsheet	1
FivePoints	1	Sprout Social	1
HPe Unified Functional Testing	1	SQL Developer	1
HubSpot	1	Starrez	1
IBM	1	Teamwork	1
iCIMS	1	Tri-Tech CAD	1
InfusionSoft	1	Ultipro	1
JIRA	1	Workday	1
Kaseya	1	Workfront	1
Link	1	Zendesk	1
MailChimp	1		

B.4 List of Software Categories in Full Study

Broad Software Category	Count
CRM	16
Data Management	15
Education	4
Finance Management	8
Healthcare Information	8
Human Capital Management	6
IT Management	4
Marketing Management	7
Project Management	8
Real Estate (Data Management)	1
Service Management	4

APPENDIX C. PARTICIPANT PHONE SCREENING SCRIPT

Hello,

My name is [] and I am a researcher in the Work Experience Lab at Georgia Tech, is this still a good time to talk? Thank you for expressing interest in participating in our research study. Just so you know, I will be reading from a script so that I don't miss anything. The purpose of our research study is to understand the role of technology in people's work lives. Participation in this study involves completing an online orientation and three days of short, mobile-based surveys. The maximum compensation for this study is $35.

Do you have any questions or concerns?

Wait for response.

Okay, great. Before you can enroll in the study, I need to ask you some questions to ensure that you are eligible to participate. The questions should take more than 10 minutes of your time to answer.

Wait for response.

Okay, great. As a reminder, I will be reading the questions from a script so that I don't miss any important information, but please feel free to ask me to slow down or to repeat or rephrase a question whenever necessary.

Do you currently live and work in the United States?

If yes, continue.

If no:

"Thank you for your answer, but unfortunately we are only including participants who live and work in the United States for this study. If you would like, we can keep your contact information in our participant database and reach out to you for future studies that you might be eligible for……Thank you, good bye."

How many hours a week do you currently work?

If 30 or more hours per week, continue.

If less than 30 hours per week:

"Thank you for your answer, but unfortunately we are only including participants who work at least 30 hours per week for this study. If you would like, we can keep your contact information in our participant database and reach out to you for future studies that you might be eligible for……Thank you, good bye."

Do you own a smartphone device?

If yes, continue.

If no:

"Thank you for your answer, but unfortunately we are only including participants who own smartphone devices because we use a smartphone application to administer the daily surveys in this study. If you would like, we can keep your contact information in our participant database and reach out to you for future studies that you might be eligible for……Thank you, good bye."

Now I am going to read a short description of the kinds of automated technologies that we are interested in for this study, and I will ask you a question at the end.

As I have mentioned, in this study we are interested in examining the role of technology in people's work lives. For this purpose, we are only including participants who use some kind of automated software in their work roles. By 'automated software', I mean any kind of automated software solution that you use in your work role that helps you accomplish one or more tasks in your job. The term 'automation' is broad, and it does not necessarily mean that the software 'does everything for you'. Automation can exist on many levels, that range on how much or how little assistance the software provides.

An example of a popular automated software is Customer Relationship Management software or 'CRM' software. This software is considered to be a form of 'automation' because it organizes information about a business's customers and can provide users with next steps and data insights based on that information.

Please feel free to ask questions you may have or please let me know if it would be helpful for me to repeat the description. If you think that you may use a software that qualifies, but aren't sure, please let me know and we can discuss it. Based on this description, do you believe that you use an automated software in your job?

If yes, continue.

If not sure:

"Okay, I will ask some you some questions about the technology that will help me determine whether or not it is an automated software that is eligible for this study"

If no:

"Thank you for your answer, but unfortunately we are only including participants who use automated software in their jobs for this study. If you would like, we can keep your contact information in our participant database and reach out to you for future studies that you might be eligible for……Thank you, good bye."

What is the name of the automated software that you use in your job?

Record name. If not in pre-defined list, look up the software online while on the phone with participant, and tell participant to please hold while researching the software. If online descriptions of software fall into one of the major categories listed in Appendix B, add the name of the software to the list and continue. If the software is not listed in a predefined major category, record any description of the software found online and note follow-up procedures for the next question.

Can you please provide a short description of the kinds of tasks that you use the software for?

Record description.

If the software was not already in the example list of automated business software and was not a part of any major category listed, please let the participant know that the eligibility screening will continue, but follow-up research on the specific software mentioned will need to be conducted to ensure final eligibility (and modify language when finishing the phone call if answers to all other questions indicate eligibility). If otherwise eligible by the end of all questions in the phone screen, tell participants that a final verdict regarding eligibility will be provided in 24-48 hours from the end of the phone conversation.

"Thank you for your answer, but unfortunately we are only including participants who use automated software for decision-making tasks for this study. If you would like, we can keep your contact information in our participant database and reach out to you for future studies that you might be eligible for……Thank you, good bye."

How many days per week, on average, do you use this software in your job?

If 3 days or more per week, continue.

If less than 2-3 days per week, but still weekly:

"Okay, thank you. Just so you know, the daily survey portion of this study involves responding to three short surveys across three days of work directly after working with the automated software in your job. Since you don't use your software everyday, we just ask that you respond to the surveys when you can, even if it's not three consecutive days in a row."

If not weekly:

"Thank you for your answer, but unfortunately we are only including participants who use the software daily or almost daily in their jobs. If you would like, we can keep your contact information in our participant database and reach out to you for future studies that you might be eligible for……Thank you, good bye."

For my last question, I will give you a short description of the way we plan to measure your use of the software in your job and then ask if it applies to you. *Pause*.

For this study, we are interested in examining people's performance episodes with automated software. 'Performance episodes' refer to people's use of automated software for specific tasks in their jobs. Performance episodes have noticeable start and end times and are organized around performance goals. For example, a salesperson may use a CRM software to track a client's data from 9 am to 10 am on a given workday, and that would qualify as a performance episode. In a performance episode, a person may completely finish a task, but they don't have to and performance episodes can last any amount of time. The most important part of

performance episodes in this study is that they are meaningful chunks of time where a person is working with the automated software towards a specific work goal.

Based on this description, do you believe that your work with the automated software in your job could be described in 'performance episodes'?

> *(if people are confused or need more explanation)*
>
> *Another way to think about it is... different ways that you might use the software in your job and then ask which description fits you better. For this study, we think about software use in two ways: task-based or continual. By task-based, we mean that you use the technology for specific tasks that have a noticeable start and end time and your work episodes with the technology are organized around performance goals.*
>
> *Task-based use of technology means that you probably use the technology for some of your work tasks and responsibilities, but not all of them. On the other hand, continual use of technology would mean that you use the technology throughout the workday for all of your work tasks and responsibilities, and would not be able to report start and end times with your tasks with the technology because your use of the technology is constant. Based on these two descriptions, would you say that your use of the software in your job is task-based or continual?*

If Yes:

"Okay, thank you. Based on your responses, it appears that you are eligible to participate in this study. The next step in participation is completing the online orientation, which I will email to you when we finish this call. The orientation includes an informed consent, which has a complete description of the study and payment information, and there are also some questionnaires and information about the daily survey portion of the study. The orientation will take at most 30 minutes to complete, and you can complete it on your own time. Once you have completed the orientation, you'll be able to start the daily survey portion of the study. Do you have any questions before we end the call? …. Thank you for your time, have a good day. Good bye."

If No:

"Thank you for your answer, but unfortunately we are only including participants who use the software in performance episodes in their jobs. If you would like, we can keep your contact information in our participant database and reach out to you for future studies that you might be eligible for……Thank you, good bye."

APPENDIX D. STUDY MEASURES

D.1 Level of Automation Taxonomy

Parasuraman, Sheridan, & Wickens, 2000

TABLE I
LEVELS OF AUTOMATION OF DECISION AND ACTION SELECTION

HIGH	10. The computer decides everything, acts autonomously, ignoring the human.
	9. informs the human only if it, the computer, decides to
	8. informs the human only if asked, or
	7. executes automatically, then necessarily informs the human, and
	6. allows the human a restricted time to veto before automatic execution, or
	5. executes that suggestion if the human approves, or
	4. suggests one alternative
	3. narrows the selection down to a few, or
	2. The computer offers a complete set of decision/action alternatives, or
LOW	1. The computer offers no assistance: human must take all decisions and actions.

D.2 Perceived Ease of Use and Usefulness Scales

Perceived Ease of Use Scale (Venkatesh & Davis, 2000)

1. My interaction with the [system] is clear and understandable.
2. Interacting with the [system] does not require a lot of my mental effort.
3. I find the [system] to be easy to use.
4. I find it easy to get the system to do what I want it to do.

Perceived Usefulness Scale (Venkatesh & Davis, 2000)

1. Using the [system] improves my performance in my job.
2. Using the [system] in my job increases my productivity.
3. Using the [system] enhances my effectiveness in my job.
4. I find the [system] to be useful in my job.

D.2 Affinity for Technology Scale

Affinity for Technology Scale (Edison & Geissler, 2003)

1. Technology is my friend.
2. I enjoy learning new computer programs and hearing about new technologies.
3. People expect me to know about technology and I don't want to let them down.
4. If I am given an assignment that requires that I learn to use a new program or how to use a machine, I usually succeed.
5. I relate well to technology and machines.
6. I am comfortable learning new technology.
7. I know how to deal with technological malfunctions or problems.
8. Solving a technological problem seems like a fun challenge.
9. I find most technology easy to learn.
10. I feel as up-to-date on technology as my peers.

D.3 Technology Self-Efficacy Scale

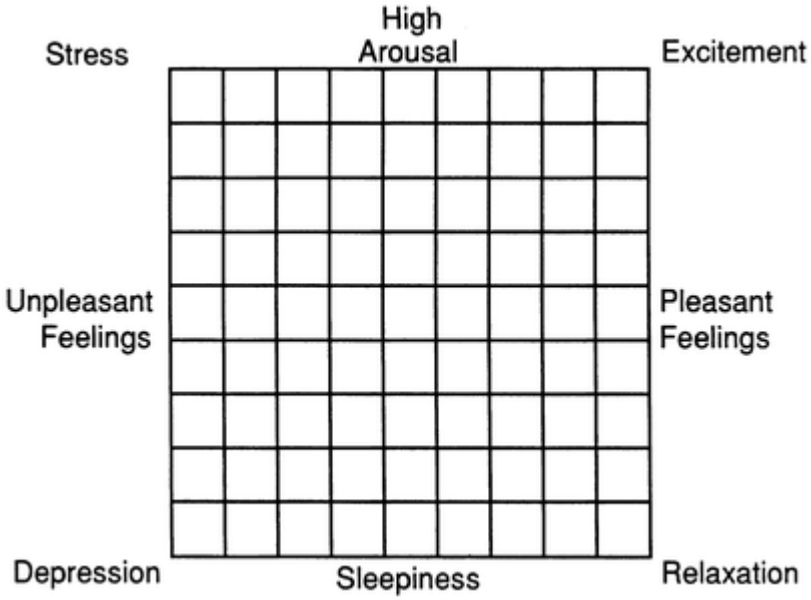
Technology Self-Efficacy Scale (Holden & Rada, 2011)

Statement: In general, I could complete any desired task using any computer/Internet application if…

1. …there was no one around to tell me what to do as I go.
2. …I had never used a technology like it before.
3. …I had only the manuals for reference.
4. …I had seen someone else using it before trying it myself.
5. …I could call someone for help if I get stuck.
6. …someone else had helped me get me started.
7. …I had a lot of time to complete the task for which the technology was provided.
8. …I had just the built-in help facility for assistance.
9. …someone showed me how to do it first.
10. …I had used similar technologies before this one to do the same task.

D.5 Affect Grid

Affect Grid (Russell, Weiss, & Mendelsohn, 1989).



REFERENCES

Aarts, H., Custers, R., & Wegner, D. M. (2005). On the inference of personal authorship: Enhancing experienced agency by priming effect information. *Consciousness and Cognition*, *14*(3), 439–458. https://doi.org/10.1016/j.concog.2004.11.001

Abele, A. E., & Wojciszke, B. (2007). Agency and communion from the perspective of self versus others. *Journal of Personality and Social Psychology*, *93*(5), 751–763. https://doi.org/10.1037/0022-3514.93.5.751

Ackerman, S., Zuroff, D. C., & Moskowitz, D. S. (2000). Generativity in midlife and young adults: links to agency, communion and subjective well-being. *International Journal of Aging & Human Development*, *50*(1), 17–41. https://doi.org/10.2190/9F51-LR6T-JHRJ-2QW6

Alkire, S. (2005). Subjective quantitative studies of human agency. *Social Indicators Research*, *74*(1), 217–260. https://doi.org/10.1007/s11205-005-6525-0

Ashkanasy, N. M., & Humphrey, R. H. (2011). Current emotion research in organizational behavior. *Emotion Review*, *3*(2), 214–224. https://doi.org/10.1177/1754073910391684

Bakker, A. B., & Demerouti, E. (2007). The Job demands-resources model: State of the art. *Journal of Managerial Psychology*, *22*(3), 309–328. https://doi.org/10.1108/02683940710733115

Bakker, A. B., Schaufeli, W. B., Leiter, M. P., & Taris, T. W. (2008). Work engagement: An emerging concept in occupational health psychology. *Work & Stress*, *22*(3), 187–200. https://doi.org/10.1080/02678370802393649

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191–215. https://doi.org/10.1037/0033-295X.84.2.191

Bandura, A. (2006). Toward a psychology of human agency. *Perspectives on Psychological Science*, *1*(2), 164–180. https://doi.org/10.1111/j.1745-6916.2006.00011.x

Barlas, Z., Hockley, W. E., & Obhi, S. S. (2017). The effects of freedom of choice in action selection on perceived mental effort and the sense of agency. *Acta Psychologica*, *180*, 122–129. https://doi.org/10.1016/j.actpsy.2017.09.004

Barlas, Z., & Kopp, S. (2018). Action choice and outcome congruency independently affect intentional binding and feeling of control judgments. *Frontiers in Human Neuroscience*, *12*, 1–10. https://doi.org/10.3389/fnhum.2018.00137

Barlas, Z., & Obhi, S. S. (2013). Freedom, choice, and the sense of agency. *Frontiers in*

Human Neuroscience, *7*, 1–7. https://doi.org/10.3389/fnhum.2013.00514

Bayne, T. (2008). The phenomenology of agency. *Philosophy Compass*, *3*(1), 182–202. https://doi.org/10.1111/j.1747-9991.2007.00122.x

Bayne, T., & Levy, N. (2006). The feeling of doing: Deconstructing the phenomenology of agency. In N. Sebanz & W. Prinz (Eds.), *Disorders of volition* (pp. 49–68). Cambridge, MA: MIT Press.

Bayne, T., & Pacherie, E. (2007). Narrators and comparators: The architecture of agentive self-awareness. *Synthese*, *159*, 475–491. https://doi.org/10.1007/s11229-007-9239-9

Beal, D. J., Weiss, H. M., Barros, E., & MacDermid, S. M. (2005). An episodic process model of affective influences on performance. *Journal of Applied Psychology*, *90*(6), 1054–1068. https://doi.org/10.1037/0021-9010.90.6.1054

Berberian, B., Le Blaye, P., Maille, N., & Sarrazin, J. C. (2012). Sense of control in supervision tasks of automated systems. *Aerospace Lab Journal*, (4), 1–10. Retrieved from http://aerospacelab.onera.fr/sites/www.aerospacelab-journal.org/files/AL04-09_1.pdf

Berberian, B., Sarrazin, J. C., Le Blaye, P., & Haggard, P. (2012). Automation technology and sense of control: A window on human agency. *PLoS ONE*, *7*(3), 1–6. https://doi.org/10.1371/journal.pone.0034075

Blakemore, S.-J., Wolpert, D., & Frith, C. (2000). Why can't you tickle yourself? *NeuroReport*, *11*(11), 11–16. https://doi.org/10.1586/14737175.7.10.1337

Blakemore, S.-J., Wolpert, D. M., & Frith, C. D. (2002). Abnormalities in the awareness of action. *TRENDS in Cognitive Sciences*, *6*(6), 237–241. https://doi.org/10.1098/rstb.2000.0734

Bledow, R., Schmitt, A., Frese, M., & Kühnel, J. (2011). The affective shift model of work engagement. *Journal of Applied Psychology*, *96*(6), 1246–1257. https://doi.org/10.1037/a0024532

Brenner, F. S., Ortner, T. M., & Fay, D. (2016). Asynchronous video interviewing as a new technology in personnel selection: The applicant's point of view. *Frontiers in Psychology*, *7*(JUN), 1–11. https://doi.org/10.3389/fpsyg.2016.00863

Britt, T. W., Dickinson, J. M., Greene-Shortridge, T. M., & McKibben, E. S. (2007). Self-engagement at work. In D. L. Nelson & C. L. Cooper (Eds.), *Positive Organizational Behavior* (pp. 143–158). Thousand Oaks, CA: SAGE Publications, Inc.

Brosnan, M. J. (1998). *Technophobia: The psychological impact of infromation technology*. New York, NY: Routledge.

Buhrmann, T., & Di Paolo, E. (2017). The sense of agency - A phenomenological

consequence of enacting sensorimotor schemes. *Phenomenology and the Cognitive Sciences*, *16*(2), 207–236. https://doi.org/10.1007/s11097-015-9446-7

Bureau of Labor Statistics, U.S. Department of Labor. (2017). Retrieved November 10, 2018, from https://www.bls.gov/oes/current/oes_nat.htm#00-0000

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*, *56*(2), 81–105.

Carlson, R. (1971). Sex differences in ego functioning: Exploratory studies of agency and communion. *Journal of Consulting and Clinical Psychology*, *37*(2), 267–277. https://doi.org/10.1037/h0031947

Chapman, D. S., & Webster, J. (2003). The use of technologies in the recruiting, screening, and selection processes for job candidates. *International Journal of Selection and Assessment*, *11*(2–3), 113–120. https://doi.org/10.1080/09585190600696572

Christensen, J. F., Yoshie, M., Di Costa, S., & Haggard, P. (2016). Emotional valence, sense of agency and responsibility: A study using intentional binding. *Consciousness and Cognition*, *43*, 1–10. https://doi.org/10.1016/j.concog.2016.02.016

Cote, J. E., & Levine, C. G. (2002). *Identity formation, agency, and culture: A social psychological synthesis*. Mahwah, NJ: Laurence Erlbaum Associates.

Crawford, E. R., LePine, J. A., & Rich, B. L. (2010). Linking job demands and resources to employee engagement and burnout: A theoretical extension and meta-analytic test. *Journal of Applied Psychology*, *95*(5), 834–848. https://doi.org/10.1037/a0019364

Czaja, S. J., Charness, N., Fisk, A. D., Hertzog, C., Nair, S. N., Rogers, W. A., & Sharit, J. (2006). Factors predicting the use of technology: Findings from the center for research and education on aging and technology enhancement (CREATE). *Psychology and Aging*, *21*(2), 333–352. https://doi.org/10.2217/nnm.12.167.Gene

Czaja, S. J., & Sharit, J. (1998). Age differences in attitudes toward computers. *Journals of Gerontology: Psychological Sciences*, *53B*(5), 329–340. https://doi.org/10.1093/geronb/53B.5.P329

David, N., Newen, A., & Vogeley, K. (2008). The "sense of agency" and its underlying cognitive and neural mechanisms. *Consciousness and Cognition*, *17*(2), 523–534. https://doi.org/10.1016/j.concog.2008.03.004

Davison, H. K., Maraist, C., & Bing, M. N. (2011). Friend or Foe? The Promise and Pitfalls of Using Social Networking Sites for HR Decisions. *Journal of Business and Psychology*, *26*(2), 153–159. https://doi.org/10.1007/s10869-011-9215-8

Demanet, J., Muhle-Karbe, P. S., Lynn, M. T., Blotenberg, I., & Brass, M. (2013). Power to the will: How exerting physical effort boosts the sense of agency. *Cognition*, *129*(3), 574–578. https://doi.org/10.1016/j.cognition.2013.08.020

Dewey, J. A., & Knoblich, G. (2014). Do implicit and explicit measures of the sense of agency measure the same thing? *PLoS ONE*, *9*(10). https://doi.org/10.1371/journal.pone.0110118

Dixon, S. R., Wickens, C. D., & McCarley, J. S. (2007). On the independence of compliance and reliance: Are automation false alarms worse than misses? *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *49*(4), 564–572. https://doi.org/10.1518/001872007X215656

Ebert, J. P., & Wegner, D. M. (2010). Time warp: Authorship shapes the perceived timing of actions and events. *Consciousness and Cognition*, *19*, 481–489. https://doi.org/10.1016/j.concog.2009.10.002

Edison, S. W., & Geissler, G. L. (2003). Measuring attitudes towards general technology: Antecedents, hypotheses and scale development. *Journal of Targeting, Measurement and Analysis for Marketing*, *12*(2), 137–156. https://doi.org/10.1057/palgrave.jt.5740104

Endsley, M. R. (1987). The application of human factors to the development of expert systems for advanced cockpits. In *Proceedings of the Human Factors Society Annual Meeting* (pp. 1388–1392). Los Angeles, CA: SAGE Publications, Inc.

Endsley, M. R., & Kaber, D. B. (1999). Level of automation effects on performance, situation awareness and workload in a dynamic control task. *Ergonomics*, *42*(3), 462–492. https://doi.org/10.1080/001401399185595

Endsley, M. R., & Kiris, E. O. (1995). The out-of-the-loop performance problem and level of control in automation. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *37*(2), 381–394. https://doi.org/10.1518/001872095779064555

Engbert, K., Wohlschlager, A., & Haggard, P. (2008). Who is causing what? The sense of agency is relational and efferent-triggered. *Cognition*, *107*(2), 693–704. https://doi.org/10.1016/j.cognition.2007.07.021

Erickson, R. J., & Wharton, A. S. (1997). Inauthenticity and depression: Assessing the consequences of interactive service work. *Work and Occupations*, *24*(2), 188–213.

Fleeson, W., & Wilt, J. (2010). The relevance of big five trait content in behavior to subjective authenticity: Do high levels of within-person behavioral variability undermine or enable authenticity achievement? *Journal of Personality*, *78*(4), 1353–1382. https://doi.org/10.1111/j.1467-6494.2010.00653.x.The

French, J. R., Caplan, R. D., & Van Harrison, R. (1982). *The mechanisms of job stress and strain*. New York, NY: John Wiley & Sons.

Frey, C. B., & Osborne, M. (2013). *The future of employment on technology*.

Frith, C. (2005). The self in action: Lessons from delusions of control. *Consciousness and*

Cognition, *14*, 752–770. https://doi.org/10.1016/j.concog.2005.04.002

Fry, R. (2018). *Millennials are the largest generation in the U.S. labor force*. Washington, DC.

Gallagher, S. (2000). Philosophical conceptions of the self: Implications for cognitive science. *Trends in Cognitive Sciences*, *4*(1), 14–21. https://doi.org/10.1016/S1364-6613(99)01417-5

Gallagher, S. (2012). Multiple aspects in the sense of agency. *New Ideas in Psychology*, *30*(1), 15–31. https://doi.org/10.1016/j.newideapsych.2010.03.003

Gentsch, A., & Synofzik, M. (2014). Affective coding: The emotional dimension of agency. *Frontiers in Human Neuroscience*, *8*, 1–7. https://doi.org/10.3389/fnhum.2014.00608

Gentsch, A., Weiss, C., Spengler, S., Synofzik, M., & Schütz-Bosbach, S. (2015). Doing good or bad: How interactions between action and emotion expectations shape the sense of agency. *Social Neuroscience*, *10*(4), 418–430. https://doi.org/10.1080/17470919.2015.1006374

Haggard, P. (2005). Conscious intention and motor cognition. *Trends in Cognitive Sciences*, *9*(6), 290–295. https://doi.org/10.1016/j.tics.2005.04.012

Haggard, P. (2017). Sense of agency in the human brain. *Nature Reviews Neuroscience*, *18*(4), 197–208. https://doi.org/10.1038/nrn.2017.14

Haggard, P., & Tsakiris, M. (2009). The experience of agency. *Current Directions in Psychological Science*, *18*(4), 242–246. https://doi.org/10.1111/j.1467-8721.2009.01644.x

Hakanen, J. J., Bakker, A. B., & Schaufeli, W. B. (2006). Burnout and work engagement among teachers, *43*, 495–513. https://doi.org/10.1016/j.jsp.2005.11.001

Hanson, V. L. (2010). Influencing technology adoption by older adults. *Interacting with Computers*, *22*(6), 502–509. https://doi.org/10.1016/j.intcom.2010.09.001

Harmon-Jones, E., Amodio, D. M., & Harmon-Jones, C. (2009). Action-based model of dissonance: A review, integration, and expansion of conceptions of cognitive conflict. In M. P. Zanna (Ed.), *Advances in experimental social psychology. Advances in experimental social psychology* (Vol. 41, pp. 119–166). San Diego, CA: Elsevier Academic Press. https://doi.org/10.1016/S0065-2601(08)00403-6

Hedge, J. W., Borman, W. C., & Lammlein, S. E. (2006). *The aging workforce: Realities, myths, and implications for organizations*. Washington, DC: American Psychological Association.

Heinssen, R. K., Glass, C. R., & Knight, L. A. (1987). Assessing computer anxiety:

Development and validation of the Computer Anxiety Rating Scale. *Computers in Human Behavior*, *3*(1), 49–59. https://doi.org/10.1016/0747-5632(87)90010-0

Helgeson, V. S. (1994). Relation of agency and communion to well-being: Evidence and potential explanations. *Psychological Bulletin*, *116*(3), 412–428. https://doi.org/10.1037/0033-2909.116.3.412

Hitchcock, E. M., Warm, J. S., Matthews, G., Dember, W. N., Shear, P. K., Tripp, L. D., … Parasuraman, R. (2003). Automation cueing modulates cerebral blood flow and vigilance in a simulated air traffic control task. *Theoretical Issues in Ergonomics Science*, *4*(1), 89–112. https://doi.org/10.1080/14639220210159726

Hohwy, J. (2007). The sense of self in the phenomenology of agency and perception. *Psyche*, *13*(1), 1–20.

Holden, H., & Rada, R. (2011). Understanding the influence of perceived usability and technology self-efficacy on teachers' technology acceptance. *Journal of Research on Technology in Education*, *43*(4), 343–367. https://doi.org/10.1080/15391523.2011.10782576

Hon, N., Poh, J. H., & Soon, C. S. (2013). Preoccupied minds feel less control: Sense of agency is modulated by cognitive load. *Consciousness and Cognition*, *22*, 556–561. https://doi.org/10.1016/j.concog.2013.03.004

Howard, E. E., Edwards, S. G., & Bayliss, A. P. (2016). Physical and mental effort disrupts the implicit sense of agency. *Cognition*, *157*, 114–125. https://doi.org/10.1016/j.cognition.2016.08.018

Ihde, D. (1990). *Technology and the lifeworld: From garden to earth*. Indianapolis, IN: Indiana University Press. https://doi.org/10.1049/et:20060114

Illingworth, A. J., Morelli, N. A., Scott, J. C., & Boyd, S. L. (2015). Internet-Based, Unproctored Assessments on Mobile and Non-Mobile Devices: Usage, Measurement Equivalence, and Outcomes. *Journal of Business and Psychology*, *30*(2), 325–343. https://doi.org/10.1007/s10869-014-9363-8

James, L. R., Demaree, R. G., & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology*, *69*(1), 85–98. https://doi.org/10.1037/0021-9010.69.1.85

Jian, J.-Y., Bisantz, A. M., Drury, C. G., & Llinas, J. (1998). *Foundations for an empirically determined scale of trust in automated systems*. Buffalo, NY.

Kabanoff, B. (1980). Work and nonwork: A review of models, methods, and findings. *Psychological Bulletin*, *88*(1), 60–77. https://doi.org/10.1037/0033-2909.88.1.60

Kanawattanachai, P., & Yoo, Y. (2007). The Impact of Knowledge Coordination on Virtual Team Performance Over Time. *MIS Quarterly*, *31*(4), 783–808.

Karsten, R., Mitra, A., & Schmidt, D. (2012). Computer self-efficacy: A meta-analysis. *Journal of Organizational and End User Computing*, *24*(4), 54–80.

Kernis, M. H., & Goldman, B. M. (2006). A multicomponent conceptualization of authenticity: Theory and research. *Advances in Experimental and Social Psychology*, *38*, 283–357. https://doi.org/10.1016/S0065-2601(06)38006-9

Killgore, W. D. S. (1998). The affect grid: A moderately valid, nonspecific measure of pleasure and arousal. *Psychological Reports*, *83*, 639–642.

King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information and Management*, *43*(6), 740–755. https://doi.org/10.1016/j.im.2006.05.003

Kiran, A. H. (2015). Four dimensions of technological mediation. In R. Rosenberger & P. P. Verbeek (Eds.), *Postphenomenological investigations: essays on human-technology relations* (pp. 123–140). New York, NY: Lexington Books.

Klassen, R. M., & Tze, V. M. C. (2014). Teachers' self-efficacy, personality, and teaching effectiveness: A meta-analysis. *Educational Research Review*, *12*, 59–76. https://doi.org/10.1016/j.edurev.2014.06.001

Klein, K. J., & Kozlowski, S. W. J. (2009). From micro to meso: Critical steps in conceptualizing and conducting multilevel research. *Organizational Research Methods*, *3*(3), 211–236. https://doi.org/10.1177/109442810033001

Koyuncu, M., Burke, R. J., & Fiksenbaum, L. (2006). Work engagement among women managers and professionals in a Turkish bank: Potential antecedents and consequences. *Equal Opportunities International*, *25*(4), 299–310. https://doi.org/10.1108/02610150610706276

Kraus, M. W., Chen, S., & Keltner, D. (2011). The power to be me: Power elevates self-concept consistency and authenticity. *Journal of Experimental Social Psychology*, *47*(5), 974–980. https://doi.org/10.1016/j.jesp.2011.03.017

Kristiansen, M. H. (2014). *Agency as an empirical concept: An assessment of theory and operationalization* (No. 2014/9). The Hague.

Kumar, D., & Srinivasan, N. (2011). Hierarchical control and sense of agency: Differential effects of control on implicit and explicit measures of agency. In *Proceedings of 35th Annual Meeting of the Cognitive Science Society* (pp. 2790–2795).

Landers, R. N. (2014). Developing a theory of gamified learning: Linking serious games and gamification of learning. *Simulation and Gaming*, *45*(6), 752–768. https://doi.org/10.1177/1046878114563660

Landers, R. N. (2015). An introduction to game-based assessment: Frameworks for the measurement of knowledge, skills, abilities and other human characteristics using

behaviors observed within videogames. *International Journal of Gaming and Computer-Mediation Simulations*, *7*(4), iv–viii.

Landers, R. N., & Schmidt, G. B. (2016). Social media in employee selection and recruitment: Current knowledge, unanswered questions, and future directions. In R. N. Landers & G. B. Schmidt (Eds.), *Social media in employee selection and recruitment: Theory, practice, and current challenges* (pp. 343–368). London, UK: Springer. https://doi.org/10.1007/978-3-319-29989-1

Lane, S. P., Hennes, E. P., & West, T. V. (2016). "I've got the power": How anyone can do a power analysis of any type of study using simulation [Powerpoint]. In *Workshop presented at the 17th Annual Convention of the Society for Social and Personality Psychology* (pp. 1–107). San Diego, CA.

Lee, J. D., & Moray, N. (1994). Trust, self-confidence, and operators' adaptation to automation. *International Journal of Human-Computer Studies*, *40*, 153–184.

Lee, J., & Moray, N. (1992). Trust, control strategies and allocation of function in human-machine systems. *Ergonomics*, *35*(10), 1243–1270.

Lee, Y., Kozar, K. A., & Larsen, K. R. T. (2003). The technology acceptance model: Past, present, and future. *Communications of the Association for Information Systems*, *12*(50), 752–780.

Lenton, A. P., Slabu, L., & Sedikides, C. (2016). State authenticity in everyday life. *European Journal of Personality*, *30*, 64–82.

Limerick, H., Coyle, D., & Moore, J. W. (2014). The experience of gency in human-computer interactions: A review. *Frontiers in Human Neuroscience*, *8*, 1–10. https://doi.org/10.3389/fnhum.2014.00643

Little, T. D., Snyder, C. R., & Wehmeyer, M. (2006). The agentic self: On the nature and origins of personal agency across the lifespan. In D. Mroczek & T. D. Little (Eds.), *The Handbook of Personality Development* (pp. 61–79). Mahwah, NJ: Lawrence Erlbaum Associates.

Macey, W. H., & Schneider, B. (2008). The meaning of employee engagement. *Industrial and Organizational Psychology*, *1*, 3–30.

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods*, *7*(1), 83–104. https://doi.org/10.3816/CLM.2009.n.003.Novel

Manyika, J., Chui, M., Miremadi, M., Bughin, J., George, K., Willmott, P., & Dewhurst, M. (2017). *A future that works: Automation, employment, and productivity*. *Mckinsey Global Institute*. Retrieved from http://njit2.mrooms.net/pluginfile.php/688844/mod_resource/content/1/Executive

Summary of McKinsey Report on Automation.pdf

Manyika, J., & Sneader, K. (2018). *AI, automation, and the future of work: Ten things to solve for*. Retrieved from https://www.mckinsey.com/featured-insights/future-of-work/ai-automation-and-the-future-of-work-ten-things-to-solve-for#part3

Martin, J., Sugarman, J., Thompson, J., Thompson, & Thompson, J. (2003). *Psychology and the question of agency*. *Psychology and the question of agency*. Albany, NY: SUNY Press.

Maruping, L. M., & Agarwal, R. (2004). Managing team interpersonal processes through technology: A task-technology fit perspective. *Journal of Applied Psychology*, *89*(6), 975–990. https://doi.org/10.1037/0021-9010.89.6.975

Maslach, C., & Leiter, M. P. (2008). Early predictors of job burnout and engagement. *The Journal of Applied Psychology*, *93*(3), 498–512. https://doi.org/10.1037/0021-9010.93.3.498

Mauno, S., Kinnunen, U., & Ruokolainen, M. (2007). Job demands and resources as antecedents of work engagement: A longitudinal study. *Journal of Vocational Behavior*, *70*(1), 149–171. https://doi.org/10.1016/j.jvb.2006.09.002

McAdams, D. P., Hoffman, B. J., Mansfield, E. D., & Day, R. (1996). Themes of agency and communion in significant autobiographical scenes. *Journal of Personality*, *64*(2), 339–377. https://doi.org/10.1111/j.1467-6494.1996.tb00514.x

McFarland, L. A., & Ployhart, R. E. (2015). Social Media: A contextual framework to guide research and practice. *Journal of Applied Psychology*, *100*(6), 1653–1677. https://doi.org/10.1037/a0039244

Meier, L. L., Semmer, N. K., Elfering, A., & Jacobshagen, N. (2008). The double meaning of control: Three-way interactions between internal resources, job control, and stressors at work. *Journal of Occupational Health Psychology*, *13*(3), 244–258. https://doi.org/10.1037/1076-8998.13.3.244

Metin, U. B., Taris, T. W., Peeters, M. C. W., van Beek, I., & van den Bosch, R. (2016). Authenticity at work – A job-demands resources perspective. *Journal of Managerial Psychology*, *31*(2), 483–499. https://doi.org/10.1108/JMP-03-2014-0087

Midgley, C., Kaplan, A., & Middleton, M. (2001). Performance-approach goals: Good for what, for whom, under what circumstances, and at what cost? *Journal of Educational Psychology*, *93*(1), 77–86. https://doi.org/10.1037/0022-0663.93.1.77

Mitzner, T. L., Boron, J. B., Fausset, C. B., Adams, A. E., Charness, N., Czaja, S. J., … Sharit, J. (2010). Older adults talk technology: Technology usage and attitudes. *Computers in Human Behavior*, *26*(6), 1710–1721. https://doi.org/10.1016/j.chb.2010.06.020

Moore, J. W. (2016). What is the sense of agency and why does it matter? *Frontiers in Psychology*, *7*, 1–9. https://doi.org/10.3389/fpsyg.2016.01272

Moore, J. W., & Obhi, S. S. (2012). Intentional binding and the sense of agency: A review. *Consciousness and Cognition*, *21*, 546–561. https://doi.org/10.1016/j.concog.2011.12.002

Moore, J. W., Wegner, D. M., & Haggard, P. (2009). Modulating the sense of agency with external cues. *Consciousness and Cognition*, *18*, 1056–1064. https://doi.org/10.1016/j.concog.2009.05.004

Morris, M. G., & Venkatesh, V. (2000). Age Differences in Technology Adoption Decisions: Implications for a Changing Workforce. *Personnel Psychology*, *53*(2), 375–403.

Mosier, K. L., Skitka, L. J., Heers, S., & Burdick, M. (1998). Automation bias: Decision making and performance in high-tech cockpits. *The International Journal of Aviation Psychology*, *8*(1), 47–63. https://doi.org/10.1207/s15327108ijap0801

Muir, B. M., & Moray. (1996). Trust in automation. Part II. Experimental studies of trust and human intervention in a process control simulation. *Ergonomics*, *39*(3), 429–460.

Muthén, L. K., & Muthén, B. O. (2007). *Mplus User's Guide. Fifth Edition*. Los Angeles, CA.

Ng, T. W. H., Sorensen, K. L., & Eby, L. T. (2006). Locus of control at work: A meta-analysis. *Journal of Organizational Behavior*, *27*(8), 1057–1087. https://doi.org/10.1002/job.416

Niehaves, B., & Plattfaut, R. (2014). Internet adoption by the elderly: Employing IS technology acceptance theories for understanding the age-related digital divide. *European Journal of Information Systems*, *23*(6), 708–726. https://doi.org/10.1057/ejis.2013.19

Obhi, S. S., & Hall, P. (2011a). Sense of agency and intentional binding in joint action. *Experimental Brain Research*, *211*(3–4), 655–662. https://doi.org/10.1007/s00221-011-2675-2

Obhi, S. S., & Hall, P. (2011b). Sense of agency in joint action: Influence of human and computer co-actors. *Experimental Brain Research*, *211*, 663–670. https://doi.org/10.1007/s00221-011-2662-7

Olson, K. E., O'Brien, M. A., Rogers, W. A., & Charness, N. (2011). Diffusion of technology: Frequency of use for younger and older adults. *Ageing International*, *36*, 123–145. https://doi.org/10.1007/s12126-010-9077-9

Pacherie, E. (2007). The sense of control and the sense of agency. *Psyche*, *13*(1), 1–30. https://doi.org/10.1093/acprof:oso/9780190267278.001.0001

Pacherie, E. (2008). The phenomenology of action: A conceptual framework. *Cognition*, *107*, 179–217. https://doi.org/10.1016/j.cognition.2007.09.003

Pacherie, E. (2012). The phenomenology of joint action: Self-agency vs. joint-agency. In A. Seemann (Ed.), *Joint Attention: New Developments* (pp. 343–389). Cambridge, MA: MIT Press. https://doi.org/10.1007/s13164-011-0052-5

Parasuraman, A. (2000). Technology readiness index (TRI): A multiple-item scale to measure readiness to embrace new technologies. *Journal of Service Research*, *2*(4), 307–320.

Parasuraman, R., Molloy, R., & Singh, I. L. (1993). Performance consequences of automation-induced "complacency." *The International Journal of Aviation Psychology*, *3*(1), 1–23.

Parasuraman, R., & Riley, V. (1997). Humans and automation: use, misuse, disuse, abuse. *Human Factors*, *39*(2), 230–253.

Parasuraman, R., Sheridan, T. B., & Wickens, C. D. (2000). A model for types and levels of human interaction with automation. *IEEE Transactions on Systems, Man, and Cybernetics. Part A, Systems and Humans : A Publication of the IEEE Systems, Man, and Cybernetics Society*, *30*(3), 286–297. https://doi.org/10.1109/3468.844354

Parasuraman, R., Sheridan, T. B., & Wickens, C. D. (2008). Situation awareness, mental workload, and trust in automation: Viable, empirically supported cognitive engineering constructs. *Journal of Cognitive Engineering and Decision Making*, *2*(2), 140–160. https://doi.org/10.1518/155534308X284417.

Paul, K. I., & Moser, K. (2009). Unemployment impairs mental health: Meta-analyses. *Journal of Vocational Behavior*, *74*(3), 264–282. https://doi.org/10.1016/j.jvb.2009.01.001

Podsakoff, P. M., & Organ, D. W. (1986). Self-Reports in Organizational Research: Problems and Prospects. *Journal of Management*, *12*(4), 531–544. https://doi.org/10.1177/014920638601200408

Pop, V. L., Shrewsbury, A., & Durso, F. T. (2015). Individual differences in the calibration of trust in automation. *Human Factors*, *57*(4), 545–556. https://doi.org/10.1177/0018720814564422

Rosen, L. D., Sears, D. C., & Weil, M. M. (1993). Treating technophobia: A longitudinal evaluation of the computerphobia reduction program. *Computers in Human Behavior*, *9*(1), 27–50. https://doi.org/10.1016/0747-5632(93)90019-O

Rosenberger, R. (2009). The sudden experience of the computer. *AI and Society*, *24*(2), 173–180. https://doi.org/10.1007/s00146-009-0190-9

Russell, J. A., Weiss, A., & Mendelsohn, G. A. (1989). Affect grid: A single-item scale of

pleasure and arousal. *Journal of Personality and Social Psychology*, *57*(3), 493–502. https://doi.org/10.1037/0022-3514.57.3.493

Saito, N., Takahata, K., Murai, T., & Takahashi, H. (2015). Discrepancy between explicit judgement of agency and implicit feeling of agency: Implications for sense of agency and its disorders. *Consciousness and Cognition*, *37*, 1–7. https://doi.org/10.1016/j.concog.2015.07.011

Saks, A. M. (2015). Antecedents and consequences of employee engagement. *Journal of Managerial Psychology*, *21*(7), 600–619. https://doi.org/10.1108/02683940610690169

Sato, A., & Yasuda, A. (2005). Illusion of sense of self-agency: Discrepancy between the predicted and actual sensory consequences of actions modulates the sense of self-agency, but not the sense of self-ownership. *Cognition*, *94*(3), 241–255. https://doi.org/10.1016/j.cognition.2004.04.003

Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006). The measurement of work engagement with a short questionnaire: A cross-national study. *Educational and Psychological Measurement*, *66*(4), 701–716. https://doi.org/10.1177/0013164405282471

Schaufeli, W. B., Salanova, M., Bakker, A. B., & Gonzalez-Roma, V. (2002). The measurement of engagement and burnout: A two sample confirmatory factor analytic approach. *Journal of Happiness Studies*, *3*, 71–92.

Sedikides, C., Lenton, A. P., Slabu, L., & Thomaes, S. (2018). Sketching the contours of state authenticity. *Review of General Psychology*, (June). https://doi.org/10.1037/gpr0000156

Seppälä, P., Mauno, S., Feldt, T., Hakanen, J., Kinnunen, U., Tolvanen, A., & Schaufeli, W. (2009). The construct validity of the Utrecht Work Engagement Scale: Multisample and longitudinal evidence. *Journal of Happiness Studies*, *10*(4), 459–481. https://doi.org/10.1007/s10902-008-9100-y

Sheridan, T. B., & Verplank, W. L. (1978). *Human and Computer Control of Undersea Teleoperators*. Cambridge, MA.

Sidarus, N., & Haggard, P. (2016). Difficult action decisions reduce the sense of agency: A study using the Eriksen flanker task. *Acta Psychologica*, *166*, 1–11. https://doi.org/10.1016/j.actpsy.2016.03.003

Simpson, R. D., & Troost, K. M. (1982). Influences on Commitment to and Learning of Science among Adolescent Students. *Science Education*, *66*(5), 763–781.

Stone, D. L., Deadrick, D. L., Lukaszewski, K. M., & Johnson, R. (2015). The influence of technology on the future of human resource management. *Human Resource Management Review*, *25*(2), 216–231. https://doi.org/10.1016/j.hrmr.2015.01.002

Strother, L., House, K. A., & Obhi, S. S. (2010). Subjective agency and awareness of shared actions. *Consciousness and Cognition*, *19*(1). https://doi.org/10.1016/j.concog.2009.12.007

Swanberg, J. E., McKechnie, S. P., Ojha, M. U., & James, J. B. (2011). Schedule control, supervisor support and work engagement: A winning combination for workers in hourly jobs? *Journal of Vocational Behavior*, *79*(3), 613–624. https://doi.org/10.1016/j.jvb.2011.04.012

Thoemmes, F., MacKinnon, D. P., & Reiser, M. R. (2010). Power analysis for complex mediational designs using monte carlo methods. *Structural Equation Modeling*, *17*(3), 510–534. https://doi.org/10.1080/10705511.2010.489379.POWER

Thompson, C. A., & Prottas, D. J. (2006). Relationships among organizational family support, job autonomy, perceived control, and employee well-being. *Journal of Occupational Health Psychology*, *11*(1), 100–118. https://doi.org/10.1037/1076-8998.10.4.100

Tofighi, D., & MacKinnon, D. P. (2011). RMediation: An R package for mediation analysis confidence intervals. *Behavior Research Methods*, *43*(3), 692–700. https://doi.org/10.3758/s13428-011-0076-x

Townsend, A. M., DeMarie, S. M., & Hendrickson, A. R. (1998). Virtual teams: Technology and the workplace of the future. *Academy of Management Executive*, *12*(3), 17–29. https://doi.org/10.5465/AME.1998.1109047

Turner, M., Kitchenham, B., Brereton, P., Charters, S., & Budgen, D. (2010). Does the technology acceptance model predict actual use? A systematic literature review. *Information and Software Technology*, *52*(5), 463–479. https://doi.org/10.1016/j.infsof.2009.11.005

van den Bosch, R., & Taris, T. W. (2014). The authentic worker's well-being and performance: The relationship between authenticity at work, well-being, and work outcomes. *Journal of Psychology: Interdisciplinary and Applied*, *148*(6), 659–681. https://doi.org/10.1080/00223980.2013.820684

van Marrewijk, M. (2003). Concepts and definitions of CSR and corporate sustainability: Between agency and communion. *Journal of Business Ethics*, *44*, 95–105. https://doi.org/10.1023/A:1023331212247

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, ontrinsic motivation, and emotion into the Technology Acceptance Model. *Information Systems Research*, *11*(4), 342–365. https://doi.org/10.1287/isre.11.4.342.11872

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, *39*(2), 273–315. https://doi.org/10.1111/j.1540-5915.2008.00192.x

Venkatesh, V., & Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences*, *27*(3), 451–481.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204. https://doi.org/10.5815/ijigsp.2012.01.06

Verbeek, P. P. (2005). *What things do: Philosophical reflections on technology, agency, and design*. University Park, PA: The Pennsylvania State University Press.

Wang, Q., Bowling, N. A., & Eschleman, K. J. (2010). A meta-analytic examination of work and general locus of control. *Journal of Applied Psychology*, *95*(4), 761–768. https://doi.org/10.1037/a0017707

Wegner, D. M. (2002). *The illusion of conscious will*. Cambridge, MA: Bradford Books.

Wegner, D. M., & Wheatley, T. (1999). Apparent mental causation: Sources of the experience of will. *American Psychologist*, *54*(7), 480–492. https://doi.org/10.1037/0003-066X.54.7.480

Weiss, H. M. (2014). Working as human nature. In J. K. Ford, J. R. Hollenbeck, & A. M. Ryan (Eds.), *The nature of work: Advances in psychological theory, methods, and practice* (pp. 35–47). Washington, DC, US: American Psychological Association. https://doi.org/10.1037/14259-003

Weiss, H. M., & Cropanzano, R. (1996). Affective Events Theory: A Theoretical Discussion of the Structure, Causes, and Consequences of Affective Experiences at Work. *Research in Organizational Behavior*, *18*, 1–74.

Weiss, H. M., & Rupp, D. E. (2011). Experiencing work: An essay on a person-centric work psychology. *Industrial and Organizational Psychology*, *4*, 83–97. https://doi.org/10.1111/j.1754-9434.2010.01302.x

Wiggins, J. S. (1991). Agency and communion as conceptual coordinates for the understanding and measurement of interpersonal behavior. In D. Cicchetti & W. M. Grove (Eds.), *Thinking clearly about psychology: Essays in honor of Paul E. Meehl, Vol. 2: Personality and Psychopathology* (pp. 89–113). Minneapolis, MN: University of Minnesota Press. https://doi.org/10.1017/CBO9781107415324.004

Wike, R., & Stokes, B. (2018). *In advanced and emerging economies alike, worries about job automation*. Retrieved from www.pewresearch.org.

Wohlschläger, A., Haggard, P., Gesierich, B., & Prinz, W. (2003). The perceived onset time of self- and other-generated actions. *Psychological Science*, *14*(6), 586–591. https://doi.org/10.1046/j.0956-7976.2003.psci_1469.x

Wood, A. M., Linley, P. A., Maltby, J., Baliousis, M., & Joseph, S. (2008). The authentic personality: A theoretical and empirical conceptualization and the development of the

authenticity scale. *Journal of Counseling Psychology*, *55*(3), 385–399. https://doi.org/10.1037/0022-0167.55.3.385

Xie, B., Watkins, I., Golbeck, J., & Huang, M. (2012). Understanding and Changing Older Adults' Perceptions and Learning of Social Media. *Educational Gerontology*, *38*(4), 282–296. https://doi.org/10.1080/03601277.2010.544580.Understanding

Yagoda, R. E., & Gillan, D. J. (2012). You want me to trust a ROBOT? The development of a human-robot interaction trust scale. *International Journal of Social Robotics*, *4*(3), 235–248. https://doi.org/10.1007/s12369-012-0144-0

Yoshie, M., & Haggard, P. (2013). Negative emotional outcomes attenuate sense of agency over voluntary actions. *Current Biology*, *23*(20), 2028–2032. https://doi.org/10.1016/j.cub.2013.08.034

Yoshie, M., & Haggard, P. (2017). Effects of emotional valence on sense of agency require a predictive model. *Scientific Reports*, *7*, 1–8. https://doi.org/10.1038/s41598-017-08803-3