HUMANS AND TECHNOLOGY: FORMS OF CONJOINED AGENCY IN ORGANIZATIONS

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ABSTRACT

Organizations are increasingly deploying technologies that have the ability to parse through large amounts of data, acquire skills and knowledge, and operate autonomously. These technologies diverge from prior technologies in their capacity to exercise intentionality over protocol development and/or action selection in the practice of organizational routines, thereby affecting organizations in new and distinct ways. In this article, we categorize four forms of conjoined agency between humans and technologies: conjoined agency with assisting technologies, conjoined agency with arresting technologies, conjoined agency with augmenting technologies, and conjoined agency with automating technologies. We then theorize on the different ways in which these forms of conjoined agency impact a routine's change at a particular moment in time as well as a routine's responsiveness to feedback over time. In doing so, we elaborate on how organizations may evolve in varied and diverse ways based on the form(s) of conjoined agency they deploy in their organizational design choices.

INTRODUCTION

> *"Change in organizational routines is intrinsic to organizational routines so long as human agents perform them."*
>
> *(Feldman, 2000: 627)*

Routines— repeated patterns of behavior—are critical to our understanding of organizations (Cyert & March, 1963; Nelson & Winter, 1982; Parmigiani & Howard-Grenville, 2011). Routines offer organizations both a stabilizing force as well as an apparatus to evolve with changing environmental demands (Feldman, 2000; Howard-Grenville, 2005; Pentland, Hærem, & Hillison, 2011). As a stabilizing force, routines enable organizations to consistently and repeatedly accomplish tasks, even those that are highly complex (Ashforth & Fried, 1988; Cohen & Bacdayan, 1994; Gersick & Hackman, 1990). As an apparatus for evolution, routines provide flexibility to adapt to new and changing demands (Feldman, 2000; Feldman & Pentland, 2003; Pentland & Reuter, 1994; Turner & Rindova, 2012). Recognizing the apparent tension in routines serving as both a source of stability and flexibility, recent work has focused on how routines "are produced and reproduced, and to what extent the patterns remain stable versus change over time" (Parmigiani & Howard-Grenville, 2011: 421).

Central to this line of inquiry have been studies that dive into the "black box" of routines where humans and nonhumans—technologies that include tools and artifacts—interact in an "ensemble" (Pentland et al., 2011). While humans and nonhumans together can jointly produce gains for organizations, the driving force behind a routine's stability or evolution has rested with humans as they alone possessed a *temporally-embedded capacity to act with intent* (c.f., Emirbayer & Mische, 1998; Giddens, 1984; Howard-Grenville, 2005). However, in recent years, technologies in a variety of organizational settings have rapidly advanced in their capacity to parse through large amounts of data, acquire skills and knowledge, and operate autonomously (e.g., Agrawal, Gans, & Goldfarb, 2018; Beane, 2019; Faraj, Pachidi, & Sayegh, 2018; von

Krogh, 2018). For instance, blockchain-enabled smart contracts are automatically distributing payments to firms' exchange partners based on the achievement of key milestones in complex supply chains (Werbach, 2018), structured machine learning algorithms are identifying and recommending candidates in firms' hiring processes (Greenfield & Griffin, 2018), and smart robots equipped with artificial intelligence are making autonomous care decisions for the elderly (Sanyal, 2018). Importantly, these technologies differ from other advanced technologies in their capacity to make determinations by themselves, as well as evolve their determinations over time once they are deployed in an organization.

When embedded in human-nonhuman ensembles, these technologies fundamentally alter our understanding of how and why routines evolve or remain stable. Specifically, these technologies affect routines in distinct ways based on their differing capacities to *develop protocols,* determine rules and guidelines for what to do (Faraj & Xiao, 2006); and/or *select actions,* make choices of what to do (Feldman, 2000; Howard-Grenville, 2005)—both of which are foundational components of organizational routines. We describe these emerging types of technology as *agentic* since they themselves possess a temporally-embedded capacity to *intentionally* constrain, complement, and/or substitute for humans in the practice of routines. This shifts the locus of agency in protocol development and/or action selection away from the exclusive dominion of humans; thus affecting our understanding of how humans and nonhumans interact to provide either a stabilizing force or an apparatus for evolution in new ways. Yet, despite the increased prevalence of agentic technologies in organizational work, as scholars, we understand little about how this shift in the locus of agency affects the practice of routines.

We theorize that when various types of technology, including those with agentic properties, are embedded in the human-nonhuman ensemble, different forms of conjoined agency, which we define as *a shared capacity between humans and nonhumans to exercise intentionality,* emerge. Thus, in this article, we focus our theorizing on the ensemble between humans and technologies to investigate the following question: *How do different forms of conjoined agency impact organizational routines?* To address this question, we first separate routines into the distinct components of protocol development and action selection; describing why both are meaningful to a functioning routine. We next specify how humans and distinct types of technology exercise conjoined agency, and categorize four forms of conjoined agency based on the type of technology embedded in the human-nonhuman ensemble: *assisting technologies* (non-agentic) which are wielded by humans in both protocol development and action selection (e.g., Boudreau & Robey, 2005; Leonardi, 2007; Tyre & Orlikowski, 1994); *arresting technologies* (agentic) which exercise intentionality over action selection; *augmenting technologies* (agentic) which exercise intentionality over protocol development; and *automating technologies* (agentic) which exercise intentionality over protocol development and action selection.[1] We then theorize how distinct forms of conjoined agency differentially affect the *degree* and *predictability* of a routine's change at a particular moment in time, as well as *routine responsiveness*—the ability of a routine to evolve over time based on feedback.

This article primarily contributes to the literature on organizational routines, and secondarily contributes to the literature on technology and organizing more broadly. By categorizing forms of conjoined agency based on a technology's capacity to exercise intentionality over protocol development and/or action selection, we provide a more thorough treatment of the types of human-nonhuman ensembles that exist in contemporary organizations. Specifically, this allows us to theorize how distinct forms of conjoined agency differentially

[1] The authors acknowledge a *Deloitte Insights* report (January 2019) for inspiring our use of the terms *assisting, augmenting,* and *automating* (see Mittal, Hans, & Kuder, 2019). The authors independently developed the term *arresting*.

impact the degree and predictability of routine change at a particular moment in time (e.g., Feldman & Pentland, 2003), as well as a routine's responsiveness to feedback over time (e.g., Gilbert, 2005; Knott, 2003). This breathes new life into the study of routines by explicitly treating protocol development and action selection as distinct components of a routine. This distinction has largely been implicit since humans, alone, had exercised intentionality over both. Moreover, this allows for elaboration on how organizations may evolve in different ways based on the type (or types) of technology they adopt. More broadly, we offer a rich discussion of organizational design decisions stemming from these qualitatively different forms of conjoined agency. In doing so, we address how emerging technologies begin to overcome the longstanding human-based limitations of myopic search and bounded rationality (Cyert & March, 1963; March & Simon, 1958; Simon, 1947), and respond to recent calls for theory to address how emerging technologies impact our understanding of organizations and organizing (Afuah, 2017; Faraj et al., 2018; Murray, Kuban, Josefy, & Anderson, 2019; von Krogh, 2018).

ORGANIZATIONAL ROUTINES: PROTOCOLS AND ACTIONS

Nelson and Winter (1982: 14) described routines as "regular and predictable behavior patterns" that organizations use to coordinate tasks and subunits. These patterns emerge when two important components of routines—*protocol development* and *action selection*—harmonize.

In a functioning routine, protocols provide guidelines for what to do (Faraj & Xiao, 2006). Feldman (2000: 611) referred to protocols as "rules and customs" in her depiction of routines as "repeated patterns of behaviour that are bound by rules and customs." Reynaud (2005) detailed that protocol development was highly impactful in the practice of the Paris Metro's routine of route scheduling. Feldman and Pentland (2003: 95) further emphasized the role of multiple human actors in protocol development. Several studies have since shown how multiple human actors, in their practice of routines, develop and alter protocols in a variety of ways including conversing with each other (Dittrich, Guérard, & Seidl, 2016), holding meetings (Aroles & McLean, 2016), and generating timely feedback (Cohendet & Simon, 2016).

In recent years, scholars have also addressed another key component of routines: *action selection* (Goh & Pentland, 2019; Spee, Jarzabkowski, & Smets, 2016). For instance, Glaser (2017) found that humans select from available actions in his study of a patrolling routine at a law enforcement agency. Dittrich and Seidl (2018) found that humans shift the actions they select to be more ends-oriented over time as they come to understand what the routine is designed to accomplish. Moreover, Spee and colleagues (2016) found that humans become more adept at selecting actions that balance multiple intersecting routines as they become more skilled in a particular domain. Each of these studies suggests that exercising intentionality in action selection is critical to the practice of routines. Indeed, Goh and Pentland (2019) suggest that it is through action selection that patterns of behavior emerge.

Central to our treatment of protocol development and action selection is *agency*. Like other organizational routines scholars (e.g., Dittrich & Seidl, 2018; Howard-Grenville, 2005), we adopt a sociological perspective of agency as a *temporally-embedded capacity to act with intent* (c.f., Emirbayer & Mische, 1998; Giddens, 1984). Herein, actors with agency "simultaneously draw from the past (habit, prior experiences, interpretive schemes), the present (situation-at-hand, resources and artifacts available), and the future (projections, expectations, norms that inform ongoing practice) to inform their current practice" (Howard-Grenville, 2005: 627, citing Emirbayer & Mische, 1998). This perspective has, to date, mandated that agency in the practice of routines be the dominion of humans.

Routine Change and Routine Responsiveness

Organizational scholars have long attended to questions of routine change, with a specific focus on how routines operate as people enact them (Parmigiani & Howard-Grenville, 2011). This relates to what Pentland and Feldman (2003: 94) have described as the performative aspect of routines which "embodies the specific actions, by specific people, at specific times and places, that bring the routine to life." Central to this discussion is a routine's potential for change at a particular moment in time (Pentland & Feldman, 2007; Turner & Rindova, 2018). Here, the properties of routine change are *degree* of change, which reflects a routine's amount of change; and *predictability* of change, which reflects the direction of a routine's variation relative to expectations among focal actors in the routine (Feldman, 2000, 2003; Pentland & Reuter, 1994).

Scholars have also attended to questions of routine responsiveness, which describes the ability of a routine to evolve over time based on feedback such that the routine continues to achieve an organization's objectives (Gilbert 2005; Knott, 2003). This relates to what Pentland and Feldman (2003: 94) have described as the ostensive aspect of routines, which embodies the routine as a codified "structure." In this way, the routine acts as a script to enable its continued practice by multiple actors (Grodal, Nelson & Siino, 2015). In this vein, studies have focused on how humans, in exercising intentionality, either maintain a routine to provide a continued source of stability or change it to provide an apparatus for evolution (e.g., D'Adderio, 2014; Dittrich & Seidl, 2018; Glaser, 2017). For instance, Feldman (2000), in her study of a university's housing system, found that humans seek to alter a routine when outcomes fall short of desired results. Moreover, Howard-Grenville (2005), in her study of a semiconductor manufacturer, found that humans' intentions and orientations toward the past, the present, and the future influence how they practice a routine. Taken together, these studies suggest that whether a routine remains stable or evolves over time is impacted by humans' understanding of a routine's desired outcomes, as well as their capacity to interpret and act on feedback over time.

Technology in Routines

Technologies—nonhuman tools and artifacts—are fundamental in the practice of routines (e.g., Pentland et al., 2011). Organizations' rationale for developing and adopting many technologies has been to increase humans' efficiency and/or effectiveness in the practice of routines. For example, tractors enable farmers to aerate, fertilize, and seed more efficiently. Computer-aided design (CAD) software not only increases architects' efficiencies in designing buildings, but also their effectiveness in conceptualizing highly complex forms. When embedded in the human-nonhuman ensemble, these technologies generate organizational gains by abating many human foibles such as inconsistency, laxity, fatigue, and unreliability; while still allowing humans to exercise intentionality over a routine's practice. Indeed, Kaplan (2011), in her study of an organization's use of PowerPoint software, revealed how the technology afforded humans possibilities for displaying abstract ideas through slides that could be moved and cut without affecting other slides. Similarly, Edmondson and colleagues (2001), in their study of a cardiac surgery technology's adoption at several hospitals, found that cardiac procedures became faster and more consistent since the new technology shaped how humans performed the surgery routine even though humans continued to drive the procedure's practice.

Despite these technologies' level of sophistication, and the associated gains reaped by organizations that use them, they fall short of fully mitigating the human shortcomings of myopic search—humans' predisposition to look nearby rather than afar for problem solutions; and bounded rationality—humans' predilection to draw on biases and heuristics to select satisfactory rather than optimal actions due to limits in time, information availability, and capacity to process information (Cyert & March, 1963; Gavetti, Greve, Levinthal, & Ocasio, 2012; March, 1978; March & Simon, 1958; Simon, 1947, 1955). As such, emerging technologies are being developed to address these longstanding human shortcomings and, indeed, begin to do so through their endowment of agentic properties that enable them to intentionally constrain, complement, and substitute for humans in the practice of routines. As these technologies become more prevalent in organizational work, understanding how they differentially impact the degree and predictability of a routine's change as well as a routine's responsiveness is increasingly important for organizational scholars. We begin this effort by categorizing four forms of conjoined agency present in contemporary organizations.

FORMS OF CONJOINED AGENCY

Conjoined agency constitutes *a shared capacity between humans and nonhumans to exercise intentionality.* Humans have long worked alongside technologies—tools and artifacts—to practice organizational routines. Yet, agentic technologies—those that possess the capacity to intentionally constrain, complement, and/or substitute for humans in a routine's practice—shift the locus of agency away from humans in protocol development and/or action selection. This results in new and distinct forms of conjoined agency. We therefore categorize four distinct forms of conjoined agency based on which actor—human or technology—has the capacity to exercise intentionality over protocol development and/or action selection (see Figure 1).

---Insert Figure 1 about here---

Conjoined Agency with Assisting Technologies

As illustrated in the top left quadrant of Figure 1, *conjoined agency with assisting technologies* exists when the technology in the human-nonhuman ensemble (1) does not have the ability to develop protocols, and (2) does not have the ability to select actions. Numerous studies have addressed this form of conjoined agency wherein *assisting technologies*, which encompass an array of tools and artifacts such as cardiac surgery machines (Edmondson et al., 2001), virtual collaboration tools (D'Adderio, 2001, 2003), PowerPoint software (Kaplan, 2011), and Excel spreadsheets (Spee et al., 2016), are wielded by humans (e.g., Anthony, 2018; Beane, 2019; D'Adderio, 2010). Specifically, such studies have emphasized how humans use (or avoid using) these technologies in their practice of routines (Leonardi, 2011).

On one hand, introducing new assisting technologies in organizations has been shown to provide humans with previously unavailable information (Leonardi, 2007), alter advice networks across subgroups (Leonardi, 2013), and facilitate organizational change when new routines emerge from humans' use of the technology (DeSanctis & Poole, 1994). On the other hand, it has been shown that humans often attempt to circumvent the implementation of assisting technologies (Leonardi, 2011) by retrofitting new technologies to maintain existing routines (Tyre & Orlikowski, 1994), using new technologies in unintended ways (Boudreau & Robey, 2005), and resisting the use of new technologies altogether (Lapointe & Rivard, 2005). Such efforts often stem from the impending limitations that assisting technologies place on the ways a routine can be practiced. Illustrating this, Boudreau and Robey (2005), in their study of an enterprise resource planning system's introduction at a large government agency, show that individuals first resisted using the technology and then found ways to work around the constraints it introduced by using the technology in unintended ways. Taken together, the impact of assisting technologies on routines is highly dependent on the humans who wield them (e.g., Boe-Lillegraven, 2019; Kho, Spee, & Gillespie, 2019; Pentland & Feldman, 2008; Volkoff, Strong, & Elmes, 2007).

To illustrate the use of an assisting technology in the practice of an organizational routine, we draw upon *The New Yorker*—a weekly periodical with a circulation of over one million magazines. One critical routine practiced by *The New Yorker*'s editorial team is selecting the cover story for each issue. In the practice of selecting an appropriate cover story, the editorial team considers many variables including topic trends, story salience, and author-specific criteria such as reputation and quality. The use of evaluation software, an assisting technology, is critical in the practice of this routine since it allows the editorial team to efficiently sort, analyze, and identify articles based on the organization's objective of maximizing engagement potential with readers. In this way, the evaluation software is a tool wielded by the editorial team who apply procedures and rules (i.e., protocols) to rank articles and determine which one will be elevated to the magazine's cover story (i.e., select an action). While the evaluation software allows the editorial team to sort a large number of articles based on certain criteria and prevents them from sorting articles based on criteria not supported by its interface, the evaluation software itself does not exercise intentionality in protocol development and/or action selection.

Conjoined Agency with Arresting Technologies

As illustrated in the bottom left quadrant of Figure 1, *conjoined agency with arresting technologies* exists when the technology in the human-nonhuman ensemble (1) does not have the ability to develop protocols, but (2) does have the ability to select actions. Since arresting technologies automatically execute tasks without humans when predefined conditions are satisfied, and possess exclusive execution authority over the actions they select, these technologies intentionally *constrain* humans in a routine's practice. Important here is that individual human actors cannot work around an arresting technology's automatic and exclusive execution authority on their own. Moreover, altering an arresting technology's encoded protocols is challenging as it requires consensus among all designated actors.

A primary example of an arresting technology is a blockchain-based smart contract. This technology autonomously executes actions when encoded conditions are satisfied; magnifying security, transparency, and immutability of transaction records while increasing the consistency of action selection in a routine (Murray et al., 2019). Blockchain-based smart contracts are currently being used in several organizational settings, including supply chains where they ensure the authenticity of materials and products at each handoff (used by firms such as IBM and Wal-Mart) (Casey & Wong, 2017), and payment processing systems where they facilitate the automatic release of funds when tasks are completed (used by financial technology start-ups such as Circle and Ripple) (Tapscott & Tapscott, 2017). Highlighting an extreme use case, decentralized autonomous organizations are even using smart contracts in place of hierarchical management structures to securely allocate and monitor resources (Werbach, 2018). Each of these use cases show how smart contracts restrict deviations in the practice of a routine.

Further considering the interface of arresting technologies and humans, we return to the example of *The New Yorker*'s editorial team selecting a cover story. Hypothetically, *The New Yorker* has now encoded its evaluation protocols (e.g., guidelines and rules) into smart contracts. When a weekly submission deadline occurs, the smart contracts evaluate each submitted article based on real-time trends from reliable information sources, such as *The New York Times* or Google search data, to trigger a cover story's automatic selection. The article that scores the highest on the encoded cover story index is then selected without the editorial team's direct involvement. *The New Yorker*'s smart contracts can even be coded to automatically adjust their weightings based on seasonality to account for predictable long-term patterns or real-time trends.

Despite generating consistency in the practice of routines, arresting technologies severely restrict, or more accurately, prevent, humans from intervening (e.g., select different actions), even when contingent factors arise that are not accounted for in a smart contract's code. The technology will simply not act until the defined conditions are satisfied, regardless of whether these important, but un-coded, contingent factors result in a different action being more desirable. For example, *The New Yorker'*s smart contracts could prevent the editorial team from overriding a cover story's selection in real time, even if the technology selected an article that, despite aligning with current trends, was not factually accurate. Depending on the encoded information sources and their relative weightings, smart contracts could select "trendy" articles based on Internet search terms that are otherwise inappropriate for the publication's readership.

The implications of arresting technologies in preventing human intervention are evidenced by the example of The DAO, an investor-led decentralized investment fund that lost nearly $50 million due to a hack (DuPont, 2017). Since The DAO ran autonomously on smart contracts, humans were able to observe the hack as it occurred but unable to stop it in real time. Moreover, The DAO had no way to unilaterally establish safeguards to prevent future attacks in the hack's immediate aftermath since all designated actors would need to reach consensus about appropriate revisions before any change could be enacted. During this consensus-forming period, if consensus was ever reached at all, the routine would continue as initially encoded.

Conjoined Agency with Augmenting Technologies

As illustrated in the upper right quadrant of Figure 1, *conjoined agency with augmenting technologies* is a form of conjoined agency where the technology in the human-nonhuman ensemble (1) has the ability to develop protocols, but (2) does not have the ability to select actions. Since augmenting technologies parse through large amounts of data, detect patterns in this data, and provide predictive recommendations to solve defined problems, these technologies intentionally *complement* humans in a routine's practice.

A primary example of an augmenting technology is a structured machine learning algorithm. This technology has the capacity to identify complex patterns and make stochastic-based recommendations for humans to enact. The driving feature of structured machine learning is correlational pattern recognition inducted from training data to develop internal logics (i.e., protocols) that can then be applied to distinct data (i.e., situations at hand) (Jordan & Mitchell, 2015). Structured machine learning algorithms are currently being used in several institutional and organizational settings, ranging from courtrooms where their predictions of recidivism rates have influenced judges' parole decisions (Dressel & Farid, 2018), to police departments where their suggestions of likely crime areas have been used to make patrol decisions in the controversial practice of "predictive policing" (Brayne, 2017; Ferguson, 2017; Huq, 2019; Joh, 2016). Online retailers also use structured machine learning algorithms to make suggestions to consumers based on patterns derived from large data sets (i.e., many consumers' online behaviors) that are then applied to new data (i.e., a potential customer's online behavior). Rather than identifying causal mechanisms to explain why suggestions are relevant, these algorithms seek to optimize encoded objectives (i.e., increasing click-through rates and sales).

To illustrate the interface of augmenting technologies and humans in the practice of a routine, we return to our hypothetical treatment of *The New Yorker*'s editorial team selecting a cover story. *The New Yorker* now utilizes a structured machine learning algorithm to analyze available data and provide the editorial team with suggestions on which article should be selected as the cover story. When the submission deadline occurs, the algorithm scours through data from past issues to develop protocols that optimize the objective of maximizing reader engagement.

Applying its protocols to the current data point (i.e., the upcoming issue), the algorithm then suggests possible articles for the editorial team to consider by identifying correlational patterns, many of which may be unfamiliar to the editorial team. For instance, it could recognize a pattern—whether spurious or meaningful—where certain writing styles increase engagement with a broader range of individuals. This could result in the algorithm suggesting an article that the editorial team may otherwise overlook in the practice of this routine.

In the event that an augmenting technology makes a recommendation that diverges from humans' expectations, humans must determine whether to select the action in question. An example of an augmenting technology influencing humans' action selection has been documented in courtrooms where judges can consider "risk scores" calculated by structured machine learning algorithms when making sentencing and parole decisions (Berk, 2019; Berk & Bleich, 2014; Berk, Sorenson, & Barnes, 2016). These algorithms draw on large criminal databases to predict the likelihood that a convicted criminal will re-offend, but do not account for all the contingencies associated with a particular case. Thus, if humans (e.g., judges) do not consider relevant circumstances when selecting an action, but blindly follow an augmenting technology's recommendation, suboptimal or inappropriate action selection is possible.

Conjoined Agency with Automating Technologies

As illustrated in the lower right quadrant of Figure 1, *conjoined agency with automating technologies* is a form of conjoined agency where the technology in the human-nonhuman ensemble (1) has the ability to develop protocols, and (2) has the ability to select actions. Since automating technologies parse through large amounts of unstructured data, process multiple types of information, and continuously learn how to optimize their analyses without human intervention, these technologies intentionally *substitute* for humans in a routine's practice.

Specifically, automating technologies are given an objective and then expected to figure out how to accomplish it by developing protocols and selecting actions. This results in a degree of self-sufficiency, once initiated, that differentiates them from other types of technology.

A primary example of an automating technology is an unstructured machine learning program (often based on neural networks) that independently seeks data and learns from it, formulates rules to guide how to act upon it, and ultimately executes on it. The driving feature of unstructured machine learning programs is the capacity to seek and learn from multiple types of unstructured data such as videos, audio files, media articles, and emails (Hassabis, Kumaran, Summerfield, & Botvinick, 2017). As a result, unstructured machine learning programs often use processes that do not reflect how humans would logically write steps to achieve a task, but instead develop their own, often abstract, approaches to conducting analyses. An early example of an unstructured machine learning program is IBM's Deep Blue, a chess-playing program that defeated World Champion Garry Kasparov in a six-game match in 1997. From a Grandmaster chess database of 700,000 games, Deep Blue not only learned how to evaluate several complex moves, it also learned to manipulate its opponents, whether human or machine, by delaying its moves (Campbell, Hoane, & Hsu, 2002; Hassabis, 2017). This strategic hesitation played "mind games" with Kasparov, and ultimately contributed to Deep Blue's victory. More recently, AlphaZero, a program designed by Google DeepMind, taught itself to dominate human players in the complex games of Go, chess, and shogi in just hours (Silver et al., 2016, 2017, 2018).

Returning to the example of *The New Yorker*'s editorial team selecting a cover story, the publication now uses an unstructured machine learning program that is directly interfaced with its evaluation software (to select the cover story) and its layout system (to produce the cover). In this way, the editorial team is removed from both developing protocols and selecting actions.

When selecting a cover story, the unstructured machine learning program emphasizes an array of factors that it deems relevant including article quality, topic trendiness, and author reputation. However, depending on its optimization function(s), the technology could also select undesirable cover stories if it learns to value controversial authors with large online followings, language that generates online engagement by promoting conflict, or superficial trends that spur online interaction but lack the requisite depth and substance the periodical aspires to publish.

Automating technologies inextricably connect protocols and actions by establishing a direct causal linkage between the technology's self-developed protocols and self-selected actions. As a result, the protocols on which automating technologies select actions have the potential to vary substantially from those that humans would otherwise develop under identical conditions. Moreover, these protocols may rapidly change based on a host of situational factors that the technology can interpret and integrate into its protocols in real time. Despite their potential, it is important to note that automating technologies can also develop incomplete or flawed protocols that result in inferior action selection. This was evidenced when an unstructured machine learning program that was developed to differentiate between wolves and huskies. It correctly differentiated between the two species a vast majority of the time but made its determinations based not on the animals' unique attributes, but on a spurious correlation: it indicated "wolf" when the image contained snow (Ribeiro, Singh, & Guestrin, 2016). While benign in this context, this highlights how automating technologies, when left to their own devices, may develop suboptimal protocols that could result in undesirable outcomes. More generally, consideration of automating technologies unexpected and potentially detrimental effects require consideration.

In this section, we categorized forms of conjoined agency based on whether a technology in the human-nonhuman ensemble shifts the locus of agency away from humans in protocol development and/or action selection. We next discuss how these forms of conjoined agency impact a routine's change at a particular moment in time as well as its responsiveness over time.

CONJOINED AGENCY AND ROUTINE DYNAMICS

Given the importance of protocol development and action selection in the practice of organizational routines, we theorize that distinct forms of conjoined agency will differentially impact a routine's degree and predictability of change at a particular moment in time as well as its responsiveness to feedback over time.

Conjoined Agency and Degree of Routine Change

Degree of change reflects the amount by which a routine is altered in practice at a particular moment in time (Feldman & Pentland, 2003; Pentland & Feldman, 2007). Important here are a routine's protocols since they provide actors with guidelines for what to do. Since protocol development has reflected humans' intentionality, despite limitations and affordances from assisting technologies, protocol development has reflected the human shortcoming of myopic search (Cyert & March, 1963; Gavetti et al., 2012).

Myopic search describes humans' predisposition to privilege the short term at the expense of the long term, emphasize the "near neighborhood" rather than the larger picture, and focalize lessons garnered from successes rather than failures (Levinthal & March, 1993). This suggests humans are unlikely to deviate too far from established protocols in a routine's practice, thereby constraining the degree to which a routine can change at a moment in time. Yet, shifts in the locus of agency from humans to agentic technologies reduce (and even eliminate) the need for human involvement in protocol development in the human-nonhuman ensemble. Therefore, when compared against the baseline of conjoined agency with assisting technologies, other forms of conjoined agency impact the degree of a routine's change in distinct ways, bringing about routine change that human myopia may have otherwise inhibited.

Conjoined agency with arresting technologies generates protocols through a group-level consensus process where actors designated in the technology's code must collectively agree on a protocol for it to be enacted. These technologies do not develop protocols on their own since any amendment requires designated actors to reach consensus. This prevents ad-hoc, localized protocol development by individuals in a routine, thereby ensuring the technology's automatic action selection is based exclusively on its encoded protocols. However, since multiple human actors must still exercise intentionality in the development of protocols, human myopia continues to impact the protocols that are developed and subsequently enforced. As such, conjoined agency with arresting technologies will result in a low degree of routine change since protocol development requires group-level consensus and individual humans cannot deviate from the technology's encoded protocols in their practice of a routine at a particular moment in time since the technology's encoded protocols have exclusive authority over action selection.

Proposition 1a: Conjoined agency with arresting technologies reduces the degree of a routine's change when compared to conjoined agency with assisting technologies.

Conjoined agency with augmenting technologies makes available new protocols based on the technology's ability to observe patterns in its structured training data to best fit programmed objectives. These technologies are not bound by experience, considerations for existing protocols, nor a desire for consistency. This enables them to develop protocols that deviate from those that humans may otherwise develop and, in turn, expands the consideration set of potential actions from which humans can select. Yet, this technology's search capacity when developing protocols still faces constraints. Augmenting technologies can only search within their training data to develop protocols, prohibiting them from expanding beyond those bounds to use other self-identified data sources. Humans also select the training data used by augmenting technologies, likely imparting their own biases as to what constitutes pertinent data based on what information they would use to make similar determinations. This is apt to limit the breadth of protocols that may ensue from an augmenting technology. Finally, the suggestions put forth by augmenting technologies are still subject to human judgment and enactment. Therefore, while humans may follow a technology's recommendation, particularly if they believe the technology has a more sophisticated understanding of how to attain a desired objective (Dressel & Farid, 2018), they may also question a recommendation, particularly if they possess relevant expertise or status (Anthony, 2018; Faraj & Sproull, 2000). While these considerations impact whether a specific recommendation is enacted, in aggregate, conjoined agency with augmenting technologies will increase the degree of a routine's change at a particular moment in time.

Proposition 1b: Conjoined agency with augmenting technologies moderately increases the degree of a routine's change when compared to conjoined agency with assisting technologies.

Conjoined agency with automating technologies generates protocols based on the technology's ability to learn from self-selected unstructured data in real time. Uninhibited by myopia (like humans) or structured training data (like augmenting technologies), automating technologies continually interpret new information to update protocols in real time. Automating technologies do not rely on humans to select training data, but rather independently seek unstructured data to develop their own protocols. This enables a broader swath of information to be considered in protocol development than is the case with other forms of conjoined agency. Moreover, automating technologies are not limited by correlation-based pattern recognition, but instead have the capacity to develop protocols based on their own, often abstract, processes that may not resemble how humans would write steps to achieve a task. Over time, these internal logics continue to evolve as the technology learns from additional data points and data sources. For these reasons, automating technologies are likely to interpret and react to real-time changes in their environments; changes that are less likely to be perceived by actors, whether human or nonhuman, in other forms of conjoined agency. In aggregate, conjoined agency with automating technologies will result in a substantial degree of routine change at a particular moment in time since human myopia is removed from the routine's practice and the technology's protocols are continually updated as it learns from new data.

> *Proposition 1c: Conjoined agency with automating technologies highly increases the degree of a routine's change when compared to conjoined agency with assisting technologies.*

Conjoined Agency and Predictability of Routine Change

Predictability of change reflects the direction of a routine's variation relative to its expected change at a particular moment in time (Feldman, 2000, 2003; Pentland & Reuter, 1994). Important to this are the actions that actors select in a routine's practice (Goh & Pentland, 2019). In particular, actors are likely to select actions that align with their understanding of a routine and its objectives (Feldman, 2003). Since action selection has reflected humans' intentionality, despite limitations and affordances from assisting technologies, action selection has also reflected the human shortcoming of bounded rationality (March, 1978; Simon, 1947).

Bounded rationality describes how humans, who cannot realistically compute the expected utility of every possible action nor gather all the requisite information to do so due to limits in time, information availability, and capacity to process all available information, draw on biases and heuristics to select satisfactory rather than optimal actions (Kahneman, 2011). This suggests humans draw on a repertoire of generally understood actions that have been previously selected either by themselves or by others who practice a routine (Pentland & Reuter, 1994). Yet, shifts in the locus of agency from humans to agentic technologies reduce (and even eliminate) the need for human involvement in action selection within the human-nonhuman ensemble. Thus, when compared against the baseline of conjoined agency with assisting technologies, other forms of conjoined agency will impact the predictability of a routine's change in distinct ways, bringing about routine change that humans' bounded rationality may have otherwise prevented.

Conjoined agency with arresting technologies ensures the automatic selection of actions when certain conditions, as triggered by encoded data sources, are met. By preventing humans from selecting actions, arresting technologies stymie the notion that "routine operation is consistent with [humans'] routinely occurring laxity, slippage, rule-breaking, defiance, and even sabotage" (Nelson & Winter, 1982: 108) wherein humans' actions frequently diverge from a routine's established protocols. Since predefined data sources must be encoded to trigger an arresting technology's action selection, other actors—whether human or nonhuman—cannot select actions even in the presence of contingent factors that make other actions more desirable. This vastly increases a routine's predictability of change at a particular moment in time.

> *Proposition 2a: Conjoined agency with arresting technologies increases the predictability of a routine's change when compared to conjoined agency with assisting technologies.*

Conjoined agency with augmenting technologies provides recommendations for humans to consider and (possibly) select. Sometimes these recommended actions substantially differ from those that humans would otherwise derive on their own. Yet, in this form of conjoined agency, action selection remains the dominion of humans and, as a result, restricts potential variance in a routine's change. Augmenting technologies can make recommendations that fall within or outside the range of humans' previously selected actions. When recommendations fall within this range, and contingent factors are held constant, humans are likely to select the technology's recommended action. When recommendations fall outside this range, still holding contingent factors constant, humans are more likely to select an action that aligns with their prior experience even if it runs counter to the technology's recommendation. In this way, humans' anchoring biases are apt to provide them with a clear notion of the action they would select absent the technology (Kahneman, 2011). Yet, this assumes humans possess prior experience with a routine. If this is not the case, humans may follow the technology's recommendation if they had been questioning their own determination or had yet to select an action at all. Despite the fact that augmenting technologies broaden the range of possible actions from which humans can select, and likely lead to new actions being selected some of the time, humans are still apt to disregard recommendations that fall outside the range of known and accepted actions. For these reasons, in aggregate, conjoined agency with augmenting technologies decreases the predictability of a routine's change at a particular moment in time.

> *Proposition 2b: Conjoined agency with augmenting technologies moderately decreases the predictability of a routine's change when compared to conjoined agency with assisting technologies.*

Conjoined agency with automating technologies creates a direct link between action selection and the technology's self-developed protocols. It is this direct linkage that results in automating technologies selecting actions they deem most appropriate at a particular moment in time based on the information they have analyzed to date (and on which their protocols are based). This prevents deviations from the action(s) that the technology's protocols deem most appropriate. Unlike conjoined agency with arresting technologies where action selection is also inextricably linked to protocols, with automating technologies protocols are not held constant. Instead, automating technologies have the capacity to continually develop protocols aimed at achieving an objective and/or optimizing a set of conditions. Moreover, automating technologies can also craft entirely new ways to optimally complete a task (i.e., action selection) as they learn from newly available information. In aggregate, conjoined agency with automating technologies will substantially decrease the predictability of a routine at a particular moment in time since the technology is able to respond to information as it becomes available in real time, thereby freeing action selection from the constraints of humans' bounded rationality.

> *Proposition 2c: Conjoined agency with automating technologies highly decreases the predictability of a routine's change when compared to conjoined agency with assisting technologies.*

Conjoined Agency and Routine Responsiveness

Routine responsiveness reflects the ability of a routine to evolve or remain stable over time based on feedback such that a routine continues to achieve an organization's objectives (Gilbert, 2005; Knott, 2003). Important here are the mechanisms that constrain or enable both human and nonhuman actors from making structural changes to a routine if the routine fails to bring about its desired objectives. In other words, routine responsiveness directly addresses whether the routine is an apparatus for evolution or stability over time.

As previously argued, conjoined agency with assisting technologies allows humans in a routine's practice to alter protocols when new information becomes available and also consider a variety of contingencies when selecting an action. Here, humans have the capacity to assess the validity and reliability of inputs over time, allowing them to adjust a routine when its outcomes fall short of desired objectives (Feldman, 2000). Such adjustments occur at the individual level, and may take into account both rational performance metrics as well as individuals' social and/or political calculations (Pentland & Feldman, 2005). As such, the responsiveness of a routine in the presence of conjoined agency with assisting technologies is moderate since humans have the ability to change a routine though they are still limited by myopic search and bounded rationality. When compared against the baseline of conjoined agency with assisting technologies, other forms of conjoined agency will impact routine responsiveness in distinct ways.

As previously addressed, conjoined agency with arresting technologies inhibits humans from selecting actions that go against the technology's immutably encoded protocols. Arresting technologies are unable to learn from environmental changes (to adjust protocols) or interpret contingent factors that are not encoded into its protocols (to select different actions). This means an arresting technology cannot alter a routine on its own, but instead unwaveringly executes an existing routine. Furthermore, changes to an arresting technology's protocols are not governed by a single actor in a routine's practice, but instead require group-level consensus for protocol amendments to occur. As a result, over time, if the validity of a routine comes into question (e.g. due to a change in data patterns), a consensus must be reached among all actors who are designated in the technology's code. This is a high bar for adjustment since the designated actors must not only agree that there is cause to revisit the underlying protocols driving action selection, but must also agree on a new direction together. Only then can a new protocol be implemented. Further compounding the challenge of achieving consensus, focal actors not only consider performance criteria, but also contend with other factors such as actors' differing political calculations, social bargaining positions, and principal-agent concerns. Thus, a routine's responsiveness in the presence of conjoined agency with arresting technologies is minimal since it requires a group of focal actors to arrive at consensus on the routine's shift. Until this occurs, the technology will continue as designed with the impossibility for ad hoc human intervention.

Proposition 3a: Conjoined agency with arresting technologies highly decreases routine responsiveness when compared to conjoined agency with assisting technologies.

As previously discussed, conjoined agency with augmenting technologies provides humans with a set of protocols from which to select actions in the practice of a routine. In developing protocols, augmenting technologies are confined to established and structured training data, thereby restricting their ability to consider changes in present data or other external information sources. As such, if current data diverges from the technology's training data, an augmenting technology cannot respond with real-time protocol adjustments. However, since action selection is carried out by humans in this form of conjoined agency, humans may scrutinize the technology's recommendations to a greater extent if they appear to be suboptimal, or if inferior outcomes were realized when prior actions were selected based on the technology's recommendations. Both scenarios can result in humans reverting back to weighting their own understanding of a routine's objectives more heavily than the technology's protocols, at least until the technology's training data is updated. Thus, the responsiveness of a routine in the presence of conjoined agency with augmenting technologies is low since it requires the technology's training data to be reset. Until this occurs, the technology will continue to make recommendations based on outdated and/or suboptimal training data, and humans will increasingly select actions based on their own considerations as knowledge of the technology's shortcomings becomes more salient and diffused across actors in the routine's practice.

> *Proposition 3c: Conjoined agency with augmenting technologies moderately decreases routine responsiveness when compared to conjoined agency with assisting technologies.*

As addressed earlier, conjoined agency with automating technologies places protocol development and action selection into the technology's hands in the practice of a routine. Since automating technologies are able to learn from environmental conditions in real time, interpret a host of contingent factors as they occur, and then act, these technologies have autonomy in the practice of routines. As an automating technology becomes increasingly sophisticated through attaining and evaluating larger amounts of data, it will likely approach the analytical capabilities of a perfectly rational actor—a theoretical imposition long confined to economic models. This will enable a routine to be highly flexible and adaptable since the technology can feasibly optimize objectives without the limits of myopic search and bounded rationality. Thus, the responsiveness of a routine in the presence of conjoined agency with automating technologies is high since the technology can select actions based on multifaceted protocols that enable unencumbered adjustments to a routine when undesired outcomes occur.

> *Proposition 3d: Conjoined agency with automating technologies increases routine responsiveness when compared to conjoined agency with assisting technologies.*

DISCUSSION

To understand how emerging technologies are impacting contemporary organizations and their routines, it is necessary to explore the human-nonhuman ensemble in greater depth. In doing so, we categorize four forms of conjoined agency in which humans and technologies differentially share the capacity to exercise intentionality over protocol development and/or action selection in the practice of routines. The four forms of conjoined agency that we identify affect the degree and predictability of a routine's change at a particular moment in time as well as its responsiveness to feedback over time in new and distinct ways. Through our theorizing, we contribute to the literatures on organizational routines and technology in organizing, and also respond to calls for theory to address the changing nature of organizations and organizing (e.g., Faraj et al., 2018; Murray et al., 2019; von Krogh, 2018).

Organizational Routines

The tension of routines serving as a source of stability and an apparatus for evolution has been the impetus for much research that dives into the black box of routines (e.g., Feldman & Pentland, 2003; Pentland & Reuter, 1994). These studies have shown that routines change at a particular moment in time based on how humans enact them, and that routines respond to feedback over time as a result of humans making adjustments when suboptimal outcomes occur (Feldman, 2000; Howard-Grenville, 2005). We theorize that the distinct forms of conjoined agency present in contemporary organizations impact routine change and responsiveness in different ways. Specifically, where the locus of agency resides—with humans or technologies—in protocol development and/or action selection determines the degree and predictability of a routine's change at a particular moment in time. This diverges from our understanding of routine change when the locus of agency for each of these components rests squarely with humans (e.g., Dittrich & Seidl, 2018). Moreover, this makes salient the importance of treating protocol development and action selection as distinct routine components.

We also theorize that the form of conjoined agency present in a routine impacts the ability of a routine to respond to feedback, and the mechanisms through which the response occurs. At one extreme, a routine can be highly unresponsive when conjoined agency is formed with arresting technologies, requiring consensus among many actors before adjustments can occur. On the other extreme, a routine can be hyper-responsive when conjoined agency is formed with automating technologies, enabling adjustments based on the technology's real-time determinations. In the middle, a routine can have a limited level of responsiveness when conjoined agency is formed with augmenting technologies, requiring humans to contradict the technology's suggestions. Each of these forms of conjoined agency present mechanisms that facilitate a routine's responsiveness in unique ways when compared to conjoined agency with assisting technologies. As discussed below, this has direct implications on where different forms of conjoined agency are deployed in an organization.

Technology in Organizing

Our categorization of forms of conjoined agency is also important for organizational theorists more generally as it helps direct theory development around the act of organizing in contemporary organizations. Though this requires further inquiry, it is likely that where different forms of conjoined agency are deployed in an organization will enable (or inhibit) distinct capabilities (Sirmon, Hitt, & Ireland, 2007) and competitive advantages (Sirmon & Hitt, 2009). For instance, an organization may realize an advantage from using arresting technologies to ensure consistency in its supply chain handoffs, but negative repercussions from using the same technologies in more creative and exploratory efforts such as research and development where the desired outputs of an organizational subunit are difficult to fully specify in code *ex ante*. Moreover, jointly deploying agentic technologies may undergird a distinct capability. Just as arresting technologies can inhibit humans' action selection, arresting technologies can also be jointly deployed with automating technologies to safeguard against an automating technology's unwanted actions. In this way, the deployment of arresting technologies alongside automating technologies constitutes a new organizational design decision pertaining to control systems (Cardinal, Kreutzer & Miller, 2017).

To illustrate how various technologies influence organizational design decisions, allowing organizations to more effectively allocate tasks (Taylor, 1911), coordinate activities (Thompson, 1967), and control operations (Cardinal et al., 2017; Ouchi, 1977; Ouchi & Maguire, 1975), we focus on a prominent organizational design decision made possible by advances in information technology: crowdsourcing. Crowdsourcing assigns a task to an undefined network of people via an open call rather than allocate the task to employees or contract the task to a formal exchange partner (Afuah & Tucci, 2012; Bayus, 2013; Lifshitz-Assaf, 2018; Murray, Kotha, & Fisher, 2020; Piezunka & Dahlander, 2015, 2019; Tucci, Afuah, & Viscusi, 2017).

Information technology, as an assisting technology, has been monumental in facilitating crowdsourcing by enabling the flow of information from many actors regardless of their geographic location. Yet, the routines embedded in crowdsourcing continue to face numerous challenges that have yet to be fully addressed through conjoined agency with assisting technologies alone. As a result, this organizational design decision has yet to realize its full theoretical imperative.

Several routines are embedded in the act of crowdsourcing, three of which include: (1) formulating problems, (2) selecting and gatekeeping ideas, and (3) coordinating the transfer of solutions (Afuah, 2017). Each of these routines have led to organizational challenges when conjoined agency is exercised with assisting technologies alone. First, humans who are formulating a problem for the crowd often face challenges that include articulating the problem with language that potential solvers can easily understand, incorporating incentives that are likely to motivate potential solvers to submit solutions, and determining whether to use a tournament-based or collaboration-based model (Che & Gale, 2003; Liu, Yang, Adamic, & Chen, 2014; Ranade & Varshney, 2017; Wallin, von Krogh, & Sieg, 2017). Second, humans who are selecting and gatekeeping ideas often lack the capacity to thoroughly consider a high volume of suggestions due to limits in time and attention. Referred to as crowding, this can inhibit humans from recognizing the merit of ideas that are too distant or unfamiliar and, in turn, can lead to quality ideas being undervalued or overlooked altogether (Piezunka & Dahlander, 2015). Third, without formal contracts to protect parties to the exchange, solution providers risk that an organization will take and implement an idea without compensating them for their time and effort. This reflects a coordination challenge that arises due to a lack of trust between the parties (Ye & Kankanhalli, 2017). Each of these challenges can be affected by deploying forms of conjoined agency wherein agentic technologies exercise intentionality to varying degrees in the practice of these routines.

Technology as a problem formulator. The way in which a problem is formulated, which includes its articulation, incentive structure, and type of crowdsourcing model (e.g., competition or collaboration), has implications on the quality of solutions provided and whether solutions are even generated at all. For instance, if a problem is communicated in a way that is vague or difficult to comprehend, the organization may generate off-the-mark solutions. While each form of conjoined agency has the potential to impact the routine of problem formulation, here we focus on the impact of conjoined agency with automating technologies. Returning to *The New Yorker* example, in its effort to crowdsource articles, the publication aims to increase the submission of relevant articles and minimize uninteresting articles. An automating technology could analyze prior calls for submissions to develop an understanding of the communication styles and incentive structures that have corresponded with high-quality submissions in the past. The automating technology could even modularize problem formulation by first articulating a call for articles and then posting abstracts of the submissions it deems high quality to the periodical's online interface to facilitate a competition where readers rate the abstracts based on their level of interest in reading the full text versions. It could even weight readers' votes on a variety of criteria including the amount of time they spend on *The New Yorker*'s website and whether they subscribe to the publication. Going forward, the technology could adjust each subsequent call for submissions to ensure ongoing interest among potential readers.

Technology as a gatekeeper. If an organization receives unfamiliar or distant solutions, particularly when it is crowded with several submissions, humans in the routine may overlook such solutions' value and merit. Though each form of conjoined agency has the potential to impact the routine of idea selection, here we focus on the impact of conjoined agency with augmenting technologies. Returning to *The New Yorker*'s effort to crowdsource articles, the periodical also seeks to optimize its selection of submitted stories. An augmenting technology could make suggestions by drawing on a training data set that includes information on previously published stories, articles at comparable periodicals, and other relevant variables to create a set of guidelines as to which articles are most consistent with what has been successful in prior issues. Employing augmenting technology to evaluate submissions addresses a major crowdsourcing challenge of sorting through a deluge of submissions when time and attention limit humans' capacity to fully examine each one. Augmenting technologies address this by (1) giving low quality submissions low ratings to reduce the time and attention humans spend on them, and (2) surfacing more distant articles that humans may have otherwise disregarded (Piezunka & Dahlander, 2015). This not only allows humans to subsequently select articles recommended by the technology, but also leaves open the opportunity for humans to consider and recognize the value of articles that the technology did not recommend.

Technology as an implementor. In many instances of crowdsourcing, potential solution providers do not have formal contracts to ensure they are compensated for their efforts. This can lead them to withhold solutions due to a lack of trust in the organization. Though each form of conjoined agency has the potential to impact this routine, here we focus on conjoined agency with arresting technologies. To generate high-quality story submissions, publications must have processes in place to ensure contributors are compensated for their work. Since *The New Yorker* is a long-standing and reputable publication, this issue may be more salient for upstart organizations with less of a track record (e.g., rLoop and Steemit use blockchain-based payments for content contributors). If conjoined agency with arresting technologies is deployed in this routine, each submission could be digitally recorded on the company's immutable blockchain. Then, once it is selected by the company—whether by humans or by other technologies—the article's selection can be recorded on the blockchain as well, thereby triggering the company's smart contracts to automatically release payment to the contributing author. If compensation is also based on other variables such as word count, author's online following, and author's time, these data points can also be automatically recorded and interpreted by the company's smart contracts to discern the appropriate payment before its automatic execution. In total, the use of arresting technologies in this way substitutes for "trust" to encourage potential contributors' engagement with the firm's crowdsourcing practice as a whole.

As our consideration of crowdsourcing illustrates, different forms of conjoined agency have the potential to overcome ongoing challenges in firms' organizational design. And, while crowdsourcing is an organizational design decision rife for exploration, it is not alone. Many organizational design decisions, and the routines embedded within them, are set to be impacted.

Opportunities and Challenges for Future Research

A primary objective in writing this paper was to encourage scholars to pursue research that examines the impact of technologies that exercise intentionality within organizations. Next, we discuss three general topics that offer additional opportunities for promising future research—time, data, and complexity—and identify challenges that will accompany efforts to study forms of conjoined agency and their underlying technologies in organizational settings.

Time. Time is a critical consideration in our understanding of how forms of conjoined agency impact organizational routines. In our theorizing, we focused on time in two distinct ways. First, we addressed routine change at a particular moment in time. Second, we examined routine evolution in terms of its responsiveness to feedback over time. While change and responsiveness both address time, they do so after the technologies have been developed and deployed in an organization. Yet, understanding a technology's origin and design is also important. Indeed, the intention of the design may impact the (in)effective application of a technology. For instance, while the design of agentic technologies is currently originated from humans, understanding these dynamics may become even more essential as automating technologies, rather than humans, begin to develop other agentic technologies (e.g., arresting or augmenting) to accomplish organizational objectives. Pursuing this line of inquiry can further expound on our categorization of forms of conjoined agency and elaborate on the broader effects of these technologies within organizations.

Data. Data is also critical to our understanding of how forms of conjoined agency will impact organizations since, to varying degrees, agentic technologies have the capacity to evolve in their determinations based on the data they have available. Two key considerations here are data distributions and data dynamics. Non-normal data distributions may result in technologies making inferior determinations, particularly when contingent factors and outliers are not fully appreciated. Future research can attend to questions such as the optimal degree to which contingencies are encoded in arresting technologies' protocols, how outliers influence the decisions made by humans interfacing with augmenting technologies, and how automating technologies come to understand both contingent factors and outliers over time. Furthermore, it is important to recognize that data is not static, but instead is constantly evolving as events unfold. Future research can explore how flexibility may be coded into arresting technologies' protocols, how to overcome gaps between augmenting technologies' training data and diverging events in the present, and how to ensure automating technologies do not privilege current events at the expense of longer-term event histories.

Complexity. Complexity is also a key consideration in how and why various forms of conjoined agency are deployed in organizations. A long stream of academic inquiry has focused on how organizations coordinate complex, multifaceted tasks (Kellogg, Orlikowski, & Yates, 2006; Faraj & Xiao, 2006; Okhuysen & Bechky, 2009; Thompson, 1967). Herein, coordination describes a "temporally unfolding and contextualized process of input regulation and interaction articulation to realize a collective performance" (Faraj & Xiao, 2006: 1157). We have alluded to how distinct agentic technologies can be used to coordinate different organizational activities. Future research can specifically draw on Thompson's (1967) classic work on interdependence to understand whether and how agentic technologies serve as a coordination mechanism in contemporary organizations, and the suitability of distinct technologies to coordinate particular organizational activities that remain challenging for organizations to coordinate with available mechanisms. Research in this vein will shed greater light on what happens when an organization's agents are nonhuman rather than human, and resultingly, what types of activities can be coordinated within a firm's hierarchy versus the open market.

Challenges. We would be remiss not to acknowledge some of the challenges that scholars may face if they choose to pursue this line of research. Gathering large quantitative datasets of organizations deploying these technologies will likely be difficult at present since the use of these technologies has not yet thoroughly diffused despite use cases spanning industries, settings, and tasks. Notwithstanding the breadth of applications, there is also a lack of consensus around where in an organization to exercise different forms of conjoined agency (e.g., Orcutt, 2018). Even in industries ripe for disruption (e.g., banking, healthcare, insurance, etc.), forms of conjoined agency have been mobilized in diverse and sporadic ways both by incumbent firms and new entrants alike. Despite these dynamic conditions, as with any new phenomenon, scholars can begin by using rich qualitative methods, such as process studies, ethnographic fieldwork, and multiple-case research designs, to gather in-depth data on how forms of conjoined agency are affecting organizations. For those willing to pursue this line of inquiry, studies are likely to have significant implications for several theories of organization and strategy (Seong, Kim, & Szulanski, 2015).

CONCLUSION

Nelson and Winter, in their seminal text on routines, stated "Skills, organization, and technology are intimately intertwined in a functioning routine, and it is difficult to say exactly where one aspect ends and another begins" (1982: 104). Nearly four decades after its original publication, this sentiment not only endures, but rings ever clearer. While humans have alone been agentic, advanced technologies are claiming, to varying degrees, the capacity to exercise intentionality, thus leading to conjoined agency in the practice of organizational routines. This necessitates additional theorizing, rich empirical analyses, and philosophical conversations about the interface of humans and technologies in the organizations and societies of the present and the future. We hope our research takes one small step in developing this rich line of scholarly discourse and inquiry. To extrapolate from Feldman's intuition (2000: 627), the tried and true assertions of organizational theory hold "so long as human agents perform them."

REFERENCES

Afuah, A. 2017. Crowdsourcing: A primer and research framework. In C. L. Tucci, A. Afuah & G. Viscusi (Eds.), ***Creating and capturing value through crowdsourcing:*** 11–38. Oxford: Oxford University Press.

Afuah, A., & Tucci, C. L. 2012. Crowdsourcing as a solution to distant search. ***Academy of Management Review***, 37(3): 355–375.

Agrawal, A., Gans, J., & Goldfarb, A. 2018. ***Prediction machines: The simple economics of artificial intelligence***. Cambridge, UK: Harvard Business Press.

Anthony, C. 2018. To question or accept? How status differences influence responses to new epistemic technologies in knowledge work. ***Academy of Management Review***, 43(4): 661–679.

Aroles, J., & McLean, C. 2016. Rethinking stability and change in the study of organizational routines: Difference and repetition in a newspaper-printing factory. ***Organization Science,*** 27(3): 535–550.

Ashforth, B. E., & Fried, Y. 1988. The mindlessness of organizational behaviors. ***Human Relations***, 41(4): 305–329.

Bailey, D. E., Leonardi, P. M., & Barley, S. R. 2012. The lure of the virtual. ***Organization Science***, 23(5): 1485–1504.

Barley, S. R. 1986. Technology as an occasion for structuring: Evidence from observations of CT scanners and the social order of radiology departments. ***Administrative Science Quarterly***, 31(1): 78–108.

Bayus, B. L. 2013. Crowdsourcing new product ideas over time: An analysis of the Dell IdeaStorm community. ***Management Science***, 59(1): 226–244.

Beane, M. 2019. Shadow learning: Building robotic surgical skill when approved means fail. ***Administrative Science Quarterly***, 64(1): 87–123.

Beane, M., & Orlikowski, W. J. 2015. What difference does a robot make? The material enactment of distributed coordination. ***Organization Science***, 26(6): 1553–1573.

Berk, R. 2019. ***Machine learning risk assessments in criminal justice settings***. New York: Springer.

Berk, R., & Bleich, J. 2014. Forecasts of violence to inform sentencing decisions. ***Journal of Quantitative Criminology***, 30(1): 79–96.

Berk, R. A., Sorenson, S. B., & Barnes, G. 2016. Forecasting domestic violence: A machine learning approach to help inform arraignment decisions. ***Journal of Empirical Legal Studies***, 13(1): 94–115.

Boe-Lillegraven, 2019. Transferring routines across multiple boundaries: A flexible approach. In M. Feldman, L. D'Adderio, K. Dittrich & P. Jarzabkowski (Eds.), ***Routine dynamics in action: Replication and transformation:*** 31–53. Bingley, UK: Emerald Publishing Limited.

Boudreau, M. C., & Robey, D. 2005. Enacting integrated information technology: A human agency perspective. ***Organization Science,*** 16(1): 3–18.

Brayne, S. 2017. Big data surveillance: The case of policing. ***American Sociological Review***, 82(5): 977–1008.

Campbell, M., Hoane Jr, A. J., & Hsu, F. H. 2002. Deep Blue. ***Artificial Intelligence***, 134(1-2): 57–83.

Cardinal, L.B., Kreutzer, M., Miller, C.C. 2017. An aspirational view of the organizational control research: Re-invigorating empirical work to better meet the challenges of 21st century organizations. ***The Academy of Management Annals,*** 11(2): 559-592.

Casey, M., & Wong, P. 2017. Global supply chains are about to get better, thanks to blockchain. ***Harvard Business Review***. Accessed at https://hbr.org/2017/03/global-supply-chains-are-about-to-get-better-thanks-to-blockchain on April 14, 2019.
Che, Y. K., & Gale, I. 2003. Optimal design of research contests. ***American Economic Review***, 93(3): 646–671.
Cohen, M. D., & Bacdayan, P. 1994. Organizational routines are stored as procedural memory: Evidence from a laboratory study. ***Organization Science,*** 5(4): 554–568.
Cohendet, P. S., & Simon, L. O. 2016. Always playable: Recombining routines for creative efficiency at Ubisoft Montreal's video game studio. ***Organization Science***, 27(3): 614–632.
Cyert, R. M., & March, J. G. 1963. ***A behavioral theory of the firm***. Oxford: Blackwell.
D'Adderio, L. 2001. Crafting the virtual prototype: How firms integrate knowledge and capabilities across organisational boundaries. ***Research Policy***, 30(9): 1409–1424.
D'Adderio, L. 2008. The performativity of routines: Theorising the influence of artefacts and distributed agencies on routines dynamics. ***Research Policy***, 37(5): 769–789.
D'Adderio, L. 2010. Artifacts at the centre of routines: Performing the material turn in routines theory. ***Journal of Institutional Economics***, 6: 1–34.
D'Adderio, L. 2014. The replication dilemma unravelled: How organizations enact multiple goals in routine transfer. ***Organization Science***, 25(5): 1325–1350.
DeSanctis, G., & Poole, M. S. 1994. Capturing the complexity in advanced technology use: Adaptive structuration theory. ***Organization Science***, *5*(2): 121–147.
Dittrich, K., Guérard, S., & Seidl, D. 2016. Talking about routines: The role of reflective talk in routine change. ***Organization Science,*** 27(3): 678–697.
Dittrich, K., & Seidl, D. 2018. Emerging intentionality in routine dynamics: A pragmatist view. ***Academy of Management Journal***, 6*1*(1): 111–138.
Dressel, J., & Farid, H. 2018. The accuracy, fairness, and limits of predicting recidivism. ***Science Advances***, 4(1): eaao5580.
DuPont, Q. 2017. Experiments in algorithmic governance: A history and ethnography of "The DAO," a failed decentralized autonomous organization. In ***Bitcoin and beyond***: 157–177. New York: Routledge.
Edmondson, A. C., Bohmer, R. M., & Pisano, G. P. 2001. Disrupted routines: Team learning and new technology implementation in hospitals. ***Administrative Science Quarterly***, 46: 685–716.
Emirbayer, M., & Mische, A. 1998. What is agency? ***American Journal of Sociology***, 103: 962–1023.
Faraj, S., Pachidi, S., & Sayegh, K. 2018. Working and organizing in the age of the learning algorithm. ***Information and Organization***, 28(1): 62-70.
Faraj, S., & Sproull, L. 2000. Coordinating expertise in software development teams. ***Management Science***, 46(12): 1554–1568.
Faraj, S., & Xiao, Y. 2006. Coordination in fast-response organizations. ***Management Science***, *52*(8): 1155–1169.
Feldman, M. S. 2000. Organizational routines as a source of continuous change. ***Organization Science***, 11(6): 611–629.
Feldman, M. S. 2003. Reconceptualizing organizational routines as a source of flexibility and change. ***Administrative Science Quarterly***, 48(1): 94–118.
Feldman, M. S., & Pentland, B. T. 2003. Reconceptualizing organizational routines as a source of flexibility and change. ***Administrative Science Quarterly,*** 48(1): 94–118.

Ferguson, A. G. 2017. ***The rise of big data policing: Surveillance, race, and the future of law enforcement***. New York: NYU Press.

Gavetti, G., Greve, H. R., Levinthal, D. A., & Ocasio, W. 2012. The behavioral theory of the firm: Assessment and prospects. ***The Academy of Management Annals,*** 6(1): 1-40.

Gersick, C., & Hackman, R. 1990. Habitual routines in task-performing groups. ***Organizational Behavior and Human Decision Processes***, 47: 65–97.

Giddens, A. 1984. ***The constitution of society: Outline of the theory of structure.*** Berkeley: University of California Press.

Gilbert, C. G. 2005. Unbundling the structure of inertia: Resource versus routine rigidity. ***Academy of Management Journal***, 48(5): 741–763.

Glaser, V. L. 2017. Design performances: How organizations inscribe artifacts to change routines. ***Academy of Management Journal***, 60(6): 2126–2154.

Goh, K. T., & Pentland, B. T. 2019. From actions to paths to patterning: Toward a dynamic theory of patterning in routines. ***Academy of Management Journal***, Forthcoming.

Greenfield, R. & Griffin, R. 2018. Artificial intelligence is coming for hiring, and it might not be that bad. ***Bloomberg.*** Accessed at https://www.bloomberg.com/news/articles/2018-08-08/artificial-intelligence-is-coming-for-hiring-and-it-might-not-be-that-bad on April 4, 2019.

Grodal, S., Nelson, A. J., & Siino, R. M. 2015. Help-seeking and help-giving as an organizational routine: Continual engagement in innovative work. ***Academy of Management Journal***, 58(1): 136–168.

Hassabis, D. 2017. Artificial Intelligence: Chess match of the century. ***Nature***, 544(7651): 413.

Hassabis, D., Kumaran, D., Summerfield, C., & Botvinick, M. 2017. Neuroscience-inspired artificial intelligence. ***Neuron***, 95(2): 245–258.

Howard-Grenville, J. A. 2005. The persistence of flexible organizational routines: The role of agency and organizational context. ***Organization Science***, 16(6): 618–636.

Huq, A. Z. 2019. Racial equity in algorithmic criminal justice. ***Duke Law Journal***, 68.

Jarvenpaa, S. L., Rao, V. S., & Huber, G. P. 1988. Computer support for meetings of groups working on unstructured problems: A field experiment. ***MIS Quarterly***, 12(4): 645–666.

Joh, E. E. 2016. The new surveillance discretion: Automated suspicion, big data, and policing. ***Harvard Law & Policy Review***, 10: 15.

Jordan, M. I., & Mitchell, T. M. 2015. Machine learning: Trends, perspectives, and prospects. ***Science,*** 349(6245): 255–260.

Kahneman, D. 2011. ***Thinking, fast and slow***. New York: Macmillan.

Kaplan, S. 2011. Strategy and PowerPoint: An inquiry into the epistemic culture and machinery of strategy making. ***Organization Science***, 22(2): 320–346.

Kellogg, K. C., Orlikowski, W. J., & Yates, J. 2006. Life in the trading zone: Structuring coordination across boundaries in postbureaucratic organizations. ***Organization Science***, 17(1): 22–44.

Kho, J., Spee, A., & Gillespie, N. 2019. Enacting relational expertise to change professional routines in technology-mediated service settings. In M. Feldman, L. D'Adderio, K. Dittrich & P. Jarzabkowski (Eds.), ***Routine dynamics in action: Replication and transformation:*** 191–213. Bingley, UK: Emerald Publishing Limited.

Knott, A. M. 2003. The organizational routines factor market paradox. ***Strategic Management Journal***, 24(10): 929–943.

Lapointe, L., & Rivard, S. 2005. A Multilevel Model of Resistance to Information Technology Implementation. ***MIS Quarterly*** 29(3): 461–491.

Leonardi, P. M. 2007. Activating the informational capabilities of information technology for organizational change. ***Organization Science***, 18(5): 813–831.
Leonardi, P. M. 2011. When flexible routines meet flexible technologies: Affordance, constraint, and the imbrication of human and material agencies. ***MIS Quarterly***, 35(1): 147–167.
Leonardi, P. M. 2013. When does technology use enable network change in organizations? A comparative study of feature use and shared affordances. ***MIS Quarterly***, 37(3): 749–775.
Leonardi, P. M., & Barley, S. R. 2008. Materiality and change: Challenges to building better theory about technology and organizing. ***Information and Organization***, 18(3): 159–176.
Levinthal, D. A., & March, J. G. 1993. The myopia of learning. ***Strategic Management Journal***, 14(S2): 95–112.
Lifshitz-Assaf, H. 2018. Dismantling knowledge boundaries at NASA: The critical role of professional identity in open innovation. ***Administrative Science Quarterly***, 63(4): 746–782.
Liu, T. X., Yang, J., Adamic, L. A., & Chen, Y. 2014. Crowdsourcing with all-pay auctions: A field experiment on Taskcn. ***Management Science***, 60(8): 2020–2037.
March, J. G. 1978. Bounded rationality, ambiguity, and the engineering of choice. ***The Bell Journal of Economics***, 587–608.
March, J. G., & Simon, H. A. 1958. ***Organizations***. Oxford: Blackwell.
Mittal, N., Hans, S., & Kuder, D. 2019. AI-fueled organizations. ***Deloitte Insights.*** Accessed at https://www2.deloitte.com/insights/us/en/focus/tech-trends/2019/driving-ai-potential-organizations.html on March 11, 2019.
Murray, A., Kotha, S., Fisher, G. 2020. Community-based resource mobilization: How entrepreneurs acquire resources from distributed non-professionals via crowdfunding. ***Organization Science***, Forthcoming.
Murray, A., Kuban, S., Josefy, M., & Anderson, J. 2019. Contracting in the smart era: The implications of blockchain and decentralized autonomous organizations for contracting and corporate governance. ***Academy of Management Perspectives***, Forthcoming.
Nelson, R. R., & Winter, S. 1982. ***An evolutionary theory of economic change.*** Cambridge, MA: Belknap Press/Harvard University Press.
Okhuysen, G. A., & Bechky, B. A. 2009. Coordination in organizations: An integrative perspective. ***The Academy of Management Annals***, 3(1): 463–502.
Orcutt, M. 2018. Blockahin smart contracts are finally good for something in the real world. ***MIT Technology Review.*** Accessed at https://www.technologyreview.com/s/612443/ blockchain-smart-contracts-can-finally-have-a-real-world-impact/ on April 14, 2019.
Orlikowski, W. J., & Scott, S. V. 2008. Sociomateriality: Challenging the separation of technology, work and organization. ***The Academy of Management Annals***, 2(1): 433–474.
Ouchi, W. G. 1977. Relationship between organizational structure and organizational control. ***Administrative Science Quarterly,*** 22: 95–113.
Ouchi, W. G., & Maguire, M. A. 1975. Organizational control: Two functions. ***Administrative Science Quarterly,*** 20: 559–569.
Parmigiani, A., & Howard-Grenville, J. A. 2011. Routines revisited: Exploring the capabilities and practice perspectives. ***Academy of Management Annals***, 5(1): 413–453.
Pentland, B. T., & Feldman, M. S. 2005. Organizational routines as a unit of analysis. ***Industrial and Corporate Change***, 14(5): 3–815.
Pentland, B. T., & Feldman, M.S. 2007. Narrative networks: Patterns of technology and organization. ***Organization Science***, 18(5): 781–795.

Pentland, B. T., & Feldman, M. S. 2008. Designing routines: On the folly of designing artifacts, while hoping for patterns of action. ***Information and Organization***, 18(4): 235–250.
Pentland, B. T., Hærem, T., & Hillison, D. 2011. The (n)ever-changing world: Stability and change in organizational routines. ***Organization Science,*** 22(6): 1369–1383.
Pentland, B. T., & Rueter, H. H. 1994. Organizational routines as grammars of action. ***Administrative Science Quarterly,*** 39(3): 484–510.
Piezunka, H., & Dahlander, L. 2015. Distant search, narrow attention: How crowding alters organizations' filtering of suggestions in crowdsourcing. ***Academy of Management Journal,*** 58(3): 856–880.
Piezunka, H., & Dahlander, L. 2019. Idea rejected, tie formed: Organizations' feedback on crowdsourced ideas. ***Academy of Management Journal***, 62(2): 503–530.
Ranade, G. V., & Varshney, L. R. 2017. The role of information patterns in designing crowdsourcing contests. In C. L. Tucci, A. Afuah & G. Viscusi (Eds.), ***Creating and capturing value through crowdsourcing:*** 154–180. Oxford: Oxford University Press.
Ribeiro, M. T., Singh, S., & Guestrin, C. 2016, August. Why should I trust you? Explaining the predictions of any classifier. In ***Proceedings of the 22nd ACM SIGKDD international conference on knowledge discovery and data mining*** (pp. 1135-1144). ACM.
Reynaud, B. 2005. The void at the heart of rules: routines in the context of rule-following. The case of the Paris Metro Workshop. ***Industrial and Corporate Change***, 14(5): 847–871.
Sanyal, S. 2018. How is AI revolutionizing elderly care. ***Forbes.*** Accessed at https://www.forbes.com/sites/shourjyasanyal/2018/10/31/how-is-ai-revolutionizing-elderly-care/#2c531554e07d on April 4, 2019.
Seong, S., Kim, Y., & Szulanski, G. 2015. Leadership, innovation, and strategic change: A conversation with Michael Tushman. ***Journal of Management Inquiry***, 24(4): 370-381.
Silver, D., Huang, A., Maddison, C., Guez, A., Sifre, L., van den Driessche, G., Schrittwieser, J., Antonoflou, I., Panneershelvam, V., Lanctot, M., Dieleman, S., Grewe, D., Nham, J., Kalchbrenner, N., Sutskever, I., Lillicrap, T., Leach, M., Kavukcuoglu, K., Graepel, T., Hassabis, D. 2016. Mastering the game of Go with deep neural networks and tree search. ***Nature,*** 529(7587): 484–489.
Silver, D., Hubert, T., Schrittwieser, J., Antonoglou, I., Lai, M., Guez, A., Lanctot, M., Sifre, L., Kumaran, D., Graepel, T., Lillicrap, T., Simonyan, K., & Hassabis, D., 2018. A general reinforcement learning algorithm that masters chess, shogi, and Go through self-play. ***Science***, 362(6419): 1140–1144.
Silver, D., Schrittwieser, J., Simonyan, K., Antonoglou, I., Huang, A., Guez, A., Hubert, T., Baker, L., Lai, M., Bolton, A., Chen, Y., Lillicrap, T., Hui, F., Sifre, L., van den Driessche, G., Graepel, T., Hassabis, D. 2017. Mastering the game of Go without human knowledge. ***Nature,*** 550(7676): 354.
Simon, H. A. 1947. ***Administrative behavior***. New York: Free Press.
Simon, H. A. 1955. A behavioral model of rational choice. ***Quarterly Journal of Economics***, 69(1): 99–118.
Sirmon, D.G., & Hitt, M.A. 2009. Contingencies within dynamic managerial capabilities: Interdependent effects of resource investment and deployment on firm performance. ***Strategic Management Journal***, 30(13): 1375–1394.
Sirmon, D.G., Hitt, M.A., & Ireland, R.D. 2007. Managing firm resources in dynamic environments to create value: Looking inside the black box. ***Academy of Management Review***, 32(1): 273-–292.

Spee, P., Jarzabkowski, P., & Smets, M. 2016. The influence of routine interdependence and skillful accomplishment on the coordination of standardizing and customizing. ***Organization Science,*** 27(3): 759–781.

Tapscott, A., & Tapscott, D. 2017. How blockchain is changing finance. ***Harvard Business Review***. Accessed at https://hbr.org/2017/03/how-blockchain-is-changing-finance on April 14, 2019.

Taylor, F. W. 1911 ***The principles of scientific management***. New York: Harper & Bros.

Thompson, J. D. 1967. ***Organizations in action***. New York: McGraw-Hill.

Tucci, C. L., Afuah, A., & Viscusi, G. 2017. ***Creating and Capturing Value through Crowdsourcing***. Oxford: Oxford University Press.

Turner, S. F., & Rindova, V. P. 2012. A balancing act: How organizations pursue consistency in routine functioning in the face of ongoing change. ***Organization Science,*** 23(1): 24–46.

Turner, S. F., & Rindova, V. P. 2018. Watching the clock: Action timing, patterning, and routine performance. ***Academy of Management Journal***, 61(4): 1253–1280.

Tyre, M. J., & Orlikowski, W. J. 1994. Windows of opportunity: Temporal patterns of technological adaptation in organizations. ***Organization Science***, 5(1): 98–118.

Volkoff, O., Strong, D. M., & Elmes, M. B. 2007. Technological embeddedness and organizational change. ***Organization Science,*** 18(5): 832–848.

von Krogh, G. 2018. Artificial Intelligence in organizations: New opportunities for phenomenon-based theorizing. ***Academy of Management Discoveries,*** 4(4): 404–409.

Wallin, M. W., von Krogh, G., & Sieg, J. H. 2017. A problem in the making: How firms formulate sharable problems for open innovation contests. In C. L. Tucci, A. Afuah & G. Viscusi (Eds.), ***Creating and capturing value through crowdsourcing:*** 127–153. Oxford: Oxford University Press.

Werbach, K. 2018. ***The Blockchain and the New Architecture of Trust***. Cambridge, MA: MIT Press.

Ye, H. J., & Kankanhalli, A. 2017. Solvers' participation in crowdsourcing platforms: Examining the impacts of trust, and benefit and cost factors. ***The Journal of Strategic Information Systems***, 26(2): 101–117.

FIGURE 1: Typology of Forms of Conjoined Agency

Locus of Agency in Action Selection	Locus of Agency in Protocol Development: Human	Locus of Agency in Protocol Development: Technology
Human	**Conjoined Agency with Assisting Technologies**	**Conjoined Agency with Augmenting Technologies**
Technology	**Conjoined Agency with Arresting Technologies**	**Conjoined Agency with Automating Technologies**