Here, Let Me Do It: Task Takeover Hurts Team Performance

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Here, Let Me Do It:

Task Takeover Hurts Team Performance

An Honors Thesis presented

by

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TASK TAKEOVER HURTS TEAM PERORMANCE

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Dedication

For Adam Mastroianni and Daniel Gilbert, for being my mentors and believing in me.

TASK TAKEOVER HURTS TEAM PERORMANCE

Table of Contents

Abstract

Takeover dilemmas are situations in which one person can take over a task that is being performed by another person. For example, a project manager can take over and assume control of the marketing report when his subordinates are too slow. Despite their prevalence in everyday life, takeover dilemmas have never been studied before to the best of the author's knowledge. To investigate takeover dilemmas, I first investigated whether taking over impairs a team's performance, and then I attempted to answer why. Drawing from literature from various fields, I hypothesized that taking over may impair a team's performance. This impairment is because people who take over must spend time climbing a steep learning curve before they reach the same skill level as the person they displaced (learning costs), and people who take over have to spend time assuming control (switching costs). To test this prediction, I devised an online maze task that allowed me to measure the performance of *the same teams* when they did and did not experience a takeover. Results support both hypotheses and show that people seem to underestimate both switching costs and learning costs, and therefore, when they take over, they make their team worse off. After discussing the real-world implication, this study proposes numerous routes to further investigate this new area of research.

Key Words: Overconfidence, Time Perception, Freeriding, Learning Curve, Mental Simulations

TASK TAKEOVER HURTS TEAM PERORMANCE

Introduction

Every day, people engage in tasks that involve a possible takeover. For example, a project manager can take over and assume control of the marketing report when his subordinates are too slow; an anxious roommate could wrest the key from his friend and open the apartment door himself in order to turn the kitchen stove off; and a passenger could tell the driver to pull over and drive the car herself if her friend has been driving too slow on their way to the airport. In each of these cases, the two people have a common goal, and the person who is not performing the task faces a dilemma: They can either wait and let the person who is currently doing the task finish it, or they can take over and complete the task themselves. These tasks will be termed *takeover dilemmas*, and despite their daily prevalence, they have never been studied before to the best of the author's knowledge.

Takeover dilemmas have several defining traits. First, takeover dilemmas involve at least two people who share a common goal, such as completing a company project or getting to the airport. Each person's individual outcome is tied to the team's outcome. Second, only one person can advance the team's cause at any time. Whether it is opening a locked door or completing a class project, only one person can be making active progress on the team's goal at any particular moment in time. Third, the person who is not currently advancing the team's cause must decide whether and when to take over and complete the task himself or herself. These criteria characterize a wide range of ordinary phenomena ranging from changing drivers on a road trip to taking over for a fatigued colleague on a project.

While these takeover situations are common in everyday life, it is unclear how a person's decision affects the team's performance. For example, a person who takes over may expedite the

team's performance, or they may impede it. If a takeover impedes a team's performance, then this raises the question of why the person chose to take over in the first place. The central question of this thesis is: Does the decision to take over generally help or hurt a team's performance—and if it hurts, then why do people do it?

Insights from Other Fields: Preliminary Evidence that People Will Take Over

Although humans are generally exceptional at learning through imitation and observation (e.g. Hermann et al., 2007; Schaik & Burkart, 2011; Dean et al., 2012; etc.), they may be less capable in scenarios similar to those in takeover dilemmas. For example, research shows that people become more confident in their own abilities when they watch someone else complete a task, but then when they try to complete the task themselves, they perform just as poorly as people who did not watch at all (Kardas & O'Brien, 2018). People gain confidence from watching others perform, but they do not necessarily gain competence. Confidence, however, strongly predicts how likely people are to engage in a task: The more confident people are, the more likely they are to engage in a task regardless of their level of competence (Bandura, 1977). Because people who face takeover dilemmas are watching their teammate complete a task, they may become more confident – but not necessarily more competent. As a result, they may decide to take over even though doing so will not improve their team's performance.

People may also take over because they have unrealistic expectations about how long a performance will and should take. People naturally become frustrated when tasks take longer than expected (Morewedge, Kassam, Hsee, & Caruso, 2009; Tsai & Zhao, 2011), but they also underestimate how long tasks will take (Buehler, Griffin, & Ross, 1994; Kassam, Epley, &

Gilbert, N.D.). Together, these facts suggest that people may become impatient when they see teammates "taking too long," and they may decide to execute a takeover.

Finally, people may take over simply because there is a norm against "free-riding," which may be defined as benefiting from a team effort without contributing to it. Most people go out of their way to avoid free-riding (Fischbacher, Gächter, & Fehr, 2001), and people may sometimes worry that they will be accused of free-riding if they do not execute a takeover. A student who is working on a team assignment, for example, may fear that she will be seen as free-riding if her partner is struggling to complete a section of the team's essay and she does not take over, so she may take over and complete the remainder of the essays herself in order to eliminate this concern.

Taking Over Could Be Costly: The Price of the Learning Curve

Even though people may have many motivations to takeover, task takeover can nonetheless be costly for two reasons. First, takeovers may produce *switching costs*, which is the time lost due to the mechanics of switching control (Becker & Murphy, 1992). For example, if a person is struggling to open a door with a key, a friend who decides to take over must take a moment to get his own key out of his pocket, must move into position in front of the door, and so on. All of this takes time, which is the very thing the takeover was meant to save. Second, many tasks require some initial learning in which performance is poor and slow, and therefore takeovers can produce *learning costs* (Becker & Murphy, 1992). For example, if a person is struggling to assemble a new chair from Ikea, a friend who decides to take over must take a moment to read the instructions and figure out which tools are best suited to the task. All of this also takes time.

The learning costs of takeovers are especially striking because they may occur even if person who takes over is inherently more skilled than his or her teammate. Most tasks have a

learning curve, whether it be figuring out how to compose a jargon-filled report or pick a lock. A

person who has been struggling with such a task for some time has probably accumulated a

reasonable amount of knowledge and experience, and even if a teammate with greater innate

aptitude for the task takes over, the teammate will have to "start from scratch." For example, a

supervisor with superior verbal skills who takes over the production of a jargon-filled report will

still need to spend some time learning the jargon, just as an especially dexterous onlooker will

have to take a moment learning the mechanics of a lock. Both the onlooker and the supervisor may

be more naturally skilled than the person who is currently doing the task, but they will still have to

climb a steep learning curve in order to reach the same skill level as that person. Several

theoretical learning curves appear in Figure 1.

Skill	Task Performance
The person who is taking over is **just as skilled** as the person they displaced	
The person who is taking over is **a little more skilled** than the person they displaced	
The person who is taking over is **a lot more skilled** than the person they displaced	
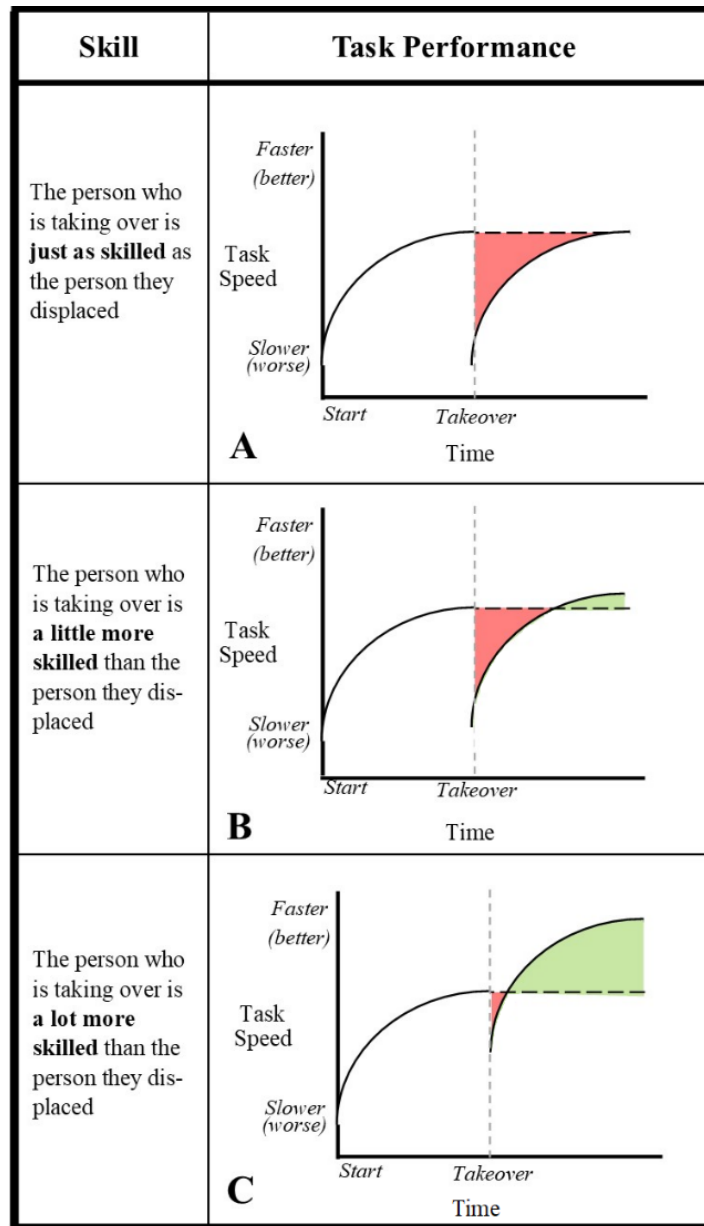
Figure 1: Theoretical Learning Curves. The person who is initially completing task is represented by a dark line until the point of the takeover. After the takeover, their task speed becomes the dashed line, as it represents what would have happened if they had never been displaced. The dark line after the takeover represents the task speed of the person who took over. Slope of the line indicates learning: A positive slope indicates the person is learning how to perform the task more efficiently, while a zero slope indicates consistent performance and no learning. The area under the curve represents task progress; it is mathematically derived by multiplying speed (task progress divided by time) by time. Thus, green shaded areas represent how much the team *gained* from the takeover and red shaded areas represent how much the team *lost* from the takeover. **A** shows that, even if two people are equally skilled, taking over will hurt the team's performance. **B** shows that, if the person taking over is slightly more skilled, then a takeover will still hurt the team's performance, as the costs of taking over (red area) is greater than the benefits (green area). **C** show that if the person taking over is dramatically more skilled, then the benefits of the takeover (green area) will be greater than the costs (red area).

As Figure 1 shows, when the person who takes over is far more skilled than the person he or she displaces, the takeover will indeed help the team's performance. But when the person who takes over is just as skilled as the person they displace, or only slightly more skilled than the person they displace, the takeover will hurt the team's performance because any benefits due to superior skill will be offset by learning costs.

Faulty Simulations: Why People May Take Over Despite the Costs

Most tasks have switching and learning costs. However, people may not anticipate these costs when they contemplate taking over because they are generally poor at simulating their own performances (Kassam et al., N.D.; Buehler et al., 1994). When people contemplate taking over, they must mentally simulate their own performance and then compare their simulated performance to their partner's actual performance. In other words, they must compare how well their partner *is* doing to how well they can *imagine* themselves doing. The problem with simulations is that they often leave out critical details like unanticipated obstacles that can hinder performance. For example, commuters who plan out their commutes might be late to work simply because they didn't anticipate running into traffic, or graduate students might underestimate the amount of time it will take to create R code simply because they didn't expect to run into a glitch.

Given that people's mental simulations routinely leave out unanticipated obstacles, people may underestimate the effects of unanticipated obstacles in takeover dilemmas. For example, when the project manager takes over a marketing report, he probably doesn't anticipate all the little frictions that will slow him down, and this faulty simulation may give him unwarranted confidence that taking over would be in the team's best interest. Or, when the concerned team member takes over a section of the term paper, she probably does not anticipate that the person she

displaces has already completed a lot of research, and now, she will have to start learning from scratch and will overall make the team's performance worse. In short, when people are contemplating a takeover, I predict that they will fail to consider the switching costs and learning costs that normally offset performance benefits, and that as such, people will choose to take over even when doing so hurts their team's performance.

Experimental Synthesis

In summary, people may take over for a variety of reasons. Whether it is the need to reduce free-riding, impatience, or feeling confident regardless of competence (Fischbacher et al., 2001; Morewedge et al., 2009; Kardas & O'Brien, 2018), people have many reasons to take over and complete a task themselves. People, however, will only act on these reasons and take over if they think that they can perform at least as well as their teammate. They reach this conclusion by comparing their simulated performance to the actual performance of their teammate, but their simulations may leave out unanticipated switching and learning costs. These costs may be so great that the takeover offsets any performance benefits and therefore hurt the team's overall performance. Thus, I predict the following:

- H_1: Takeovers, on average, will hurt a team's overall performance.
- H_2: This will happen in part because switching and learning costs offset performance benefits.

It is impossible to test the second of these hypotheses in real-world takeover dilemmas because once a person takes over, it is impossible to know how their team would have performed if the takeover had not occurred. To overcome this problem in the laboratory, I created an online task called *the maze task*. This task involves using a computer mouse to move a square through a
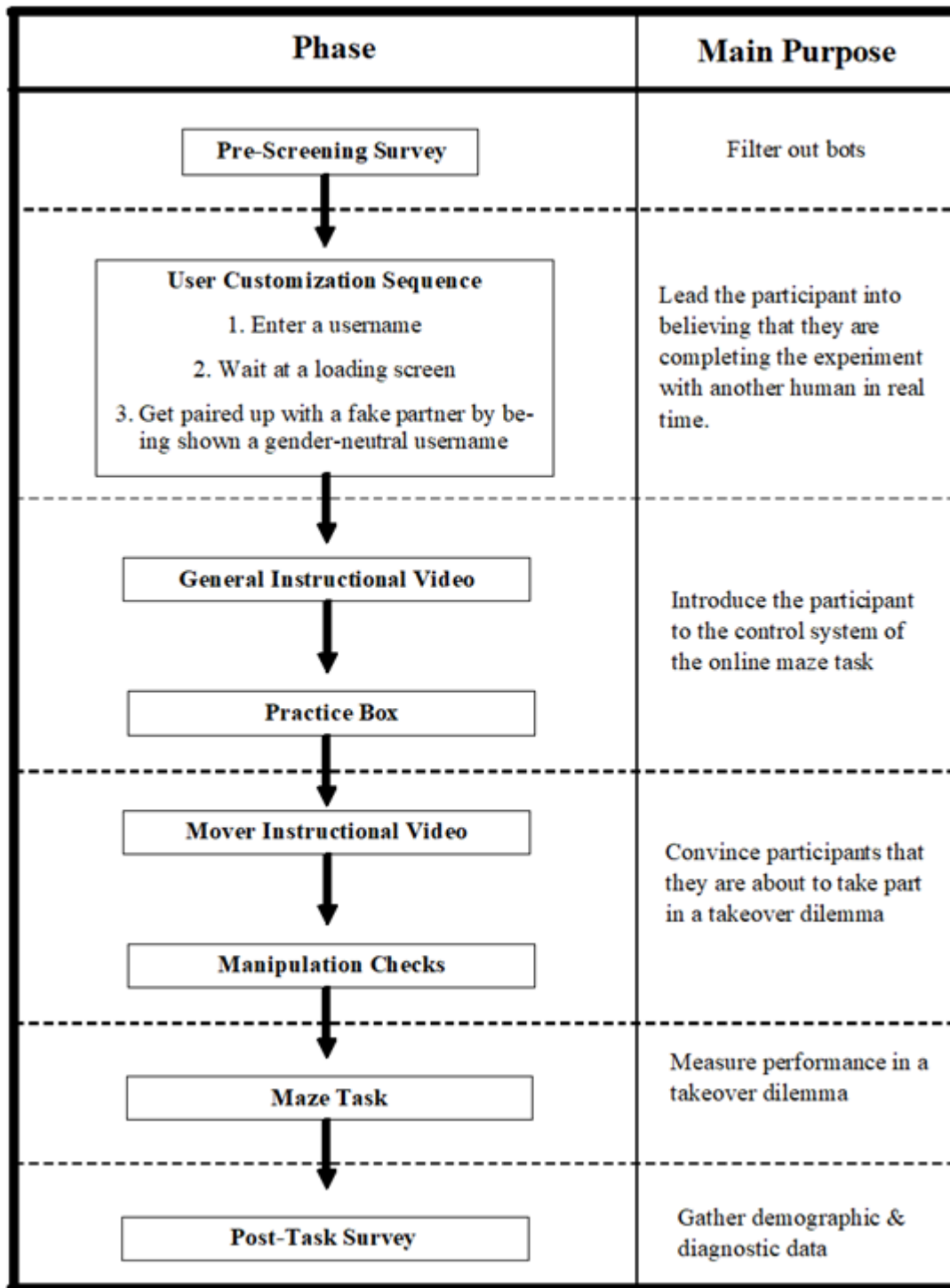
maze. In Part 1, participants (whom I call *the prime movers)* completed the maze. They were told

that they were members of a team and that the other member could take over if he/she wished, but

in fact, there was no other team member and all prime movers were allowed to complete the task

themselves. This served as my measure of how well a "team" performed in the absence of a

takeover. In Part 2, a new group of participants (whom I call *the monitors*) watched a computer

simulation of the movements of a prime mover from Part 1 but were told that they were watching

another participant complete the maze in real time. They were also told that they were on a team

with the prime mover whose performance they were watching. These monitors could initiate a

takeover and complete the maze themselves at any point. This procedure allowed me to compare

(a) the performance of a team in which there was no takeover (from Part 1) with (b) the

performance of *the same team* in which there may have been a takeover (from Part 2).

Experiment 1, Part 1

A brief visualization of the experiment can be found in Figure 2. A more detailed

visualization, as well as a URL that allows the reader to experience the paradigm, appears in

Appendix A.

Phase	Main Purpose
Pre-Screening Survey	Filter out bots
User Customization Sequence 1. Enter a username 2. Wait at a loading screen 3. Get paired up with a fake partner by being shown a gender-neutral username	Lead the participant into believing that they are completing the experiment with another human in real time.
General Instructional Video	Introduce the participant to the control system of the online maze task
Practice Box	
Mover Instructional Video	Convince participants that they are about to take part in a takeover dilemma
Manipulation Checks	
Maze Task	Measure performance in a takeover dilemma
Post-Task Survey	Gather demographic & diagnostic data

Figure 2: Visual Summary of Experiment 1, Part 1. Each box represents a phase of the experiment. Arrows designate going from one phase of the experiment to the other. Although this diagram only depicts Part 1, Part 2 uses virtually the same experimental flow.

Method

Pre-Screening. Participants were recruited on Amazon Mechanical Turk (mTurk). Before participants could complete the study, they underwent a brief screening to ensure they spoke English, were human, and that their internet browser could handle the online maze task. The full pre-screening can be found in Appendix F.

Sample. A sample of 50 participants (28% female, 72% male; age: M = 34.92 years, SD = 10.22) who passed the pre-screening were recruited. Sample size was based on the methodology described in part two. Hereinafter, I will refer to these participants as prime movers.

User Customization Sequence. Prior to beginning the maze, prime movers underwent a customization sequence. In it, they entered a username and waited at a loading screen. Afterwards, they were told that they were paired up with a partner, when in reality they were just shown a fake gender-neutral username. The purpose of this sequence was to ensure prime movers believed they were on the same team as another human who was completing the experiment with them in real time.

General Instructional Video & Maze Control System. Prime movers watched a general instructional video to introduce them to the control system of the online maze task. In the video, prime movers were told that they will soon be required to move a blue square, but this was not be as easy as it sounds. Specifically, prime movers were taught that they can move the square by holding down their mouse, and the square would always move in the opposite direction of the mouse. The video also informed prime movers that if the square hit a wall of the maze, it would be "stunned," which meant that the square could not be moved for a period of 2 seconds. I designed

the movement system this way because I wanted it to be equally novel for all prime movers, and I also wanted it to be challenging to learn. The general instructional video appears in Appendix C.

Practice Box. After receiving instructions on the control system, prime movers were given time to familiarize themselves with the unusual "reverse movement" of the mouse. Prime movers were therefore allowed to move their square around a white "practice box" for as long as they wished.

Prime Mover Instructional Video. After prime movers spent whatever amount of time they wished on the practice box, prime movers were shown an instructional video for the upcoming maze task in order to convince them that they were about to begin a takeover situation. A link to the video and a transcript of the video appear in Appendix D. Prime movers were informed that they were on a team with the same participant with whom they had been paired earlier, and that this teammate would be monitoring their performance the entire time. Additionally, they were told that their teammate was allowed to press a button at any time to take control of the square and complete the maze. Prime movers were also told that they would be paid the same bonus as their teammate, and that the faster the team completed the maze, the more they would be paid. Although prime movers believed that they were being monitored by a teammate, in reality there was no teammate.

Manipulation Checks. After the instructional video, prime movers answered manipulation checks to ensure that they correctly identified their role, their teammate's role, and that they understood that their teammate could initiate a one-time takeover and complete the maze himself or herself. Prime movers were not be allowed to proceed until they had answered each question correctly. The Manipulation Check questions appear in Appendix G.

Maze Task. After the manipulation checks, prime movers completed the maze. The maze itself was designed to maximize novelty while being uniformly difficult (see Figure 3). Furthermore, because it was possible that the interior of the maze was more or less difficult than the exterior of the maze, the direction of travel within the maze was counterbalanced across participants so that half the prime movers started from the center and moved to the edge while the remaining prime movers started from the edge and moved to the center. Finally, all prime movers' mouse movements were recorded by the computer so that they could be simulated in Part 2.

Maze Bonus. The team's bonus started at $2.00 and then decreased by $0.01 per second as soon as the maze task loaded. This created an incentive for the prime mover to complete the maze as quickly as possible. Prime movers were told that they would be paid the same bonus as their teammate. If the bonus dropped to $0, the task was terminated, and the prime mover automatically moved onto the next phase of the experiment.

Figure 3: Online Maze Task. Participants controlled the blue square and moved it to the finish flag. Half the participants started from the center and moved toward the edge, and the remaining half started from the edge and moved toward the center. The bonus started at $2.00.

Metrics. As prime movers completed the maze, the computer recorded their *completion time, progress*, and *speed* as well as their movements. Completion time was the amount of time prime movers took to complete the maze, in seconds. Progress was not measured in terms of pixels or inches, but in terms of "checkpoints" which were 126 markers that were evenly spaced throughout the maze. The more checkpoints prime movers passed, the further along in the maze they were and the greater their progress. Speed was calculated as the number of checkpoints passed divided by total time. Full details of these metrics appear in Appendix B.

Post-Task Survey. Once the prime movers completed the maze task, they completed a post-task survey. The survey contained basic demographic and diagnostic questions to ensure there were no technical glitches and that they believed their partner was real. The survey also asked various exploratory questions related to what prime movers thought of their teammate and the threat of the takeover. The complete list of questions appears in Appendix H.

Results

Descriptive Statistics. All fifty prime movers successfully completed the maze, and their performance was successfully recorded. Prime movers took anywhere from 44 seconds to 200 seconds to complete the maze (completion time: $M = 99.52$, $SD = 37.66$), and their overall speeds ranged from .38 to 1.89 checkpoints per second (speed: $M = 0.99$, $SD = 0.36$).

Experiment 1, Part 2

Method

Pre-Screening & Sample. A sample of 225 participants (42.59% female, 57.41% male; age: $M = 34.71$ years, $SD = 9.44$) who passed the pre-screening were recruited from Amazon

mechanical Turk (mTurk). The pre-screening was the same as the pre-screening in part 1. Participants in Part 2 will hereinafter be referred to as monitors. Because one prime mover was paired up with multiple monitors, the data was nested, and traditional power analyses could not be used. Sample size was therefore determined by consulting prior laboratory studies that used a similar nested methodology (Levari et al., 2018). The sample size was capable of detecting a small effect size and ensured that each prime mover could be paired with up to 5 different monitors.

User Customization Sequence, General Instructional Video, Practice Box, and Maze Control System. These phases were the same unmodified phases that the prime movers completed in part 1. All monitors completed them.

Monitor Instructional Video. After completing the practice box, monitors watched an instructional video to convince them that they will soon participate in a takeover dilemma. Monitors were told that they would begin by watching the prime mover complete the online maze task in real time, and that at any point they could initiate a one-time takeover and complete the maze themselves. The instructions also emphasized that they and the prime mover would be paid as a team. A link to the video and a transcript of the video appear in Appendix E.

Manipulation Checks. Monitors were given the same set of manipulation checks as the prime movers, which appears in Appendix G. The correct answers, however, were changed so that they reflect the monitor's role. Monitors must acknowledge that they will be watching their partner move the square through the maze and that they could take over at any point.

Maze Task. After passing the manipulation checks, monitors watched a computer simulation of a prime mover's performance. If they chose to initiate a takeover, the simulation was instantly discontinued, and the monitor was given control of the square.

Metrics. In addition to the metrics computed in Part 1, the timing of the takeover was recorded if it occurred.

Post-Task Survey. The same post-task survey was used to ask the same demographic and diagnostic questions, ensuring that there were no undetected technical glitches and that participants thought that they were paired up with another human. The survey, however, was modified in order to ask why the monitors took over or did not take over, as well as ask whether they thought their takeover decision helped or hurt their team's performance.

Results

Data Exclusions. Nine monitors were excluded due to a variety of technical glitches. Thirty-seven monitors were excluded because I was able to determine that they were looking at another tab of their browser during the experiment. Thirty-six monitors were excluded because in the post-task survey, they explicitly stated that they believed their teammate was a robot or a computer recording. This left 143 monitors in the data set.

Descriptive Statistics. The majority of monitors initiated a takeover (took over: 63%, $n = 90$; did not take over: 37%, $n = 53$). Monitors who took over waited from 1.74 seconds to 118.84 seconds before taking over (timing of takeover: $M = 29.06$, $SD = 27.88$). All teams in Part 2 took from 36 seconds to 200 seconds to complete the maze (completion time: $M = 103.9$, $SD = 39.27$) and had an overall speed that ranged from 0.05 to 3.8 checkpoints per second (speed: $M = 0.98$, $SD = 0.57$).

Test of H_1: Did taking over hurt the team's performance? In order to gauge a team's performance, team completion time was used. Because a prime mover was paired with several

monitors, a single prime mover's completion time was nested within multiple team completion times. To control for this nested data, I used a linear mixed effects model that was fitted in R using the *nlme* package. Whether the monitor took over was the binary independent variable, and the team's completion time was the dependent variable. The model included the independent variable as a fixed effect as well as an intercept for each prime mover as random effects.

The analysis revealed a significant effect of taking over on group completion time, $b = 22.55$, $SE = 6.68$, 95% confidence interval (CI) = [9.30, 35.81], $t(97) = 3.38$, $p = .001$. Teams with monitors who took over ($M = 112.60$, 95% CI = [103.50, 121.70]) performed significantly worse than teams with monitors who did not to take over ($M = 88.60$, 95% CI = [81.35, 95.36]). (See top and middle rows of Figure 4). Of course, this does not mean that taking over caused the teams to be worse off. It could well be that monitors only took over from prime movers who were
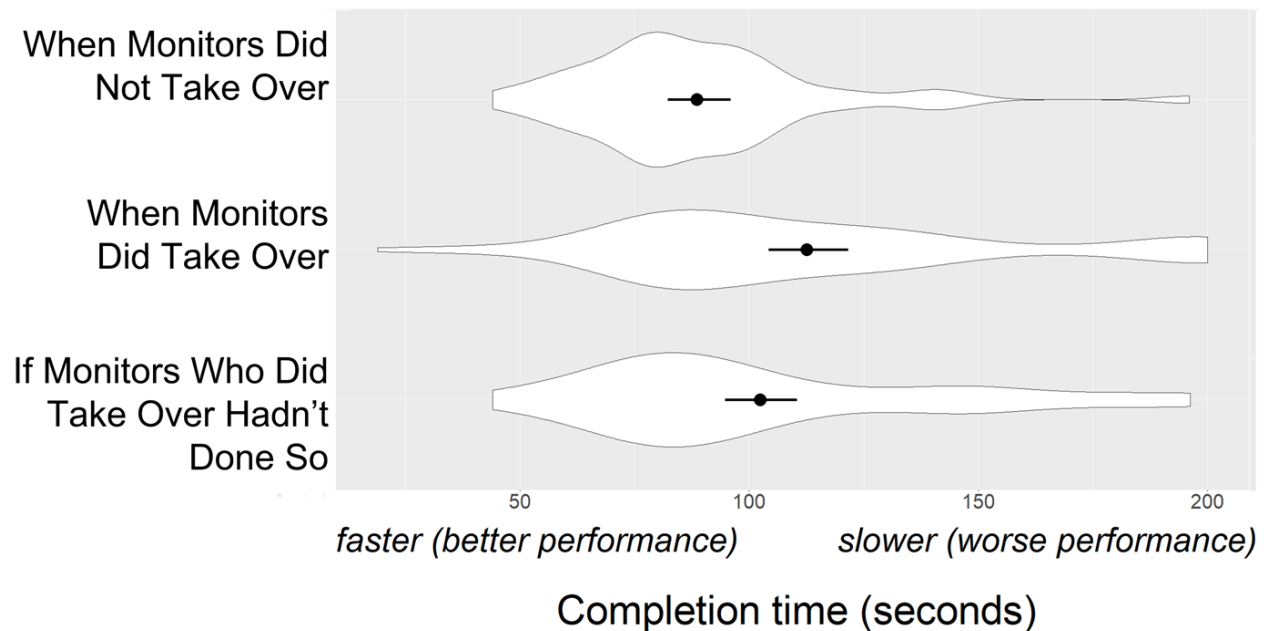
Figure 4: Average Completion Times by Status, with Violin Plots. Error bars represent 95% confidence intervals. Violin plots illustrate distribution.

performing poorly, and that the poor performance of the prime mover was responsible for the team's long completion time. To test whether a prime mover's performance predicted whether the monitor took over, a binomial logistic regression was conducted, with the independent variable being the prime mover's uninterrupted completion time and the binary dependent variable being whether the monitor took over. The analysis revealed a significant effect, $b = .013$, $SE = .006$, $p = .027$, 95% confidence interval (CI) = [.002, .024], such that prime movers who experienced a takeover ($M = 102.39$, 95% CI = [94.26, 110.52]) were indeed performing more poorly than prime movers who did not experience a takeover ($M = 88.60$, 95% CI = [81.35, 95.36]) (See top and bottom rows of Figure 4). In other words, monitors were more likely to take over when their teammate was performing poorly. This suggests that monitors were actively monitoring their teammate's performance, and that their decision to take over was indeed an attempt to help their team.

To gauge the impact of the monitor's takeover decision on the team's performance, a metric called "effect of takeover" was calculated. Effect of takeover was computed by subtracting a team's completion time from Part 1 (when the team consisted entirely of the prime mover) from the team's completion time in Part 2 (when the team consisted of the prime mover and a monitor who took over). A positive number indicates that the team performed more poorly in Part 2 than in Part 1 or, more simply, that the team's performance suffered after the monitor took over. A one-sample t-test revealed that this number was significantly greater than zero, $M = 10.19$, $SE = 5.01$, 95% confidence interval (CI) = [.36, 20.02], $t(89) = 2.03$, $p = .045$. (See bottom and middle rows of Figure 4). Monitors who took over, on average, hurt their team's performance.

TASK TAKEOVER HURTS TEAM PERORMANCE

In summary, monitors tended to take over for poorly performing prime movers, but they made their team performance even worse than it would have been if they had simply allowed their poorly performing teammate to continue. H_1 was therefore supported: Taking over tends to hurt team performance.

Test of H_2: Does takeover hurt a team's overall performance in part because switching and learning costs offset performance benefits? To measure learning costs, each monitor's speed can be compared to the speed of his/her displaced partner at every checkpoint after the takeover. If monitors were initially a lot slower than their displaced partner and then became faster, then this finding would suggest that the monitors spent time learning the task and thus suffered from learning costs.
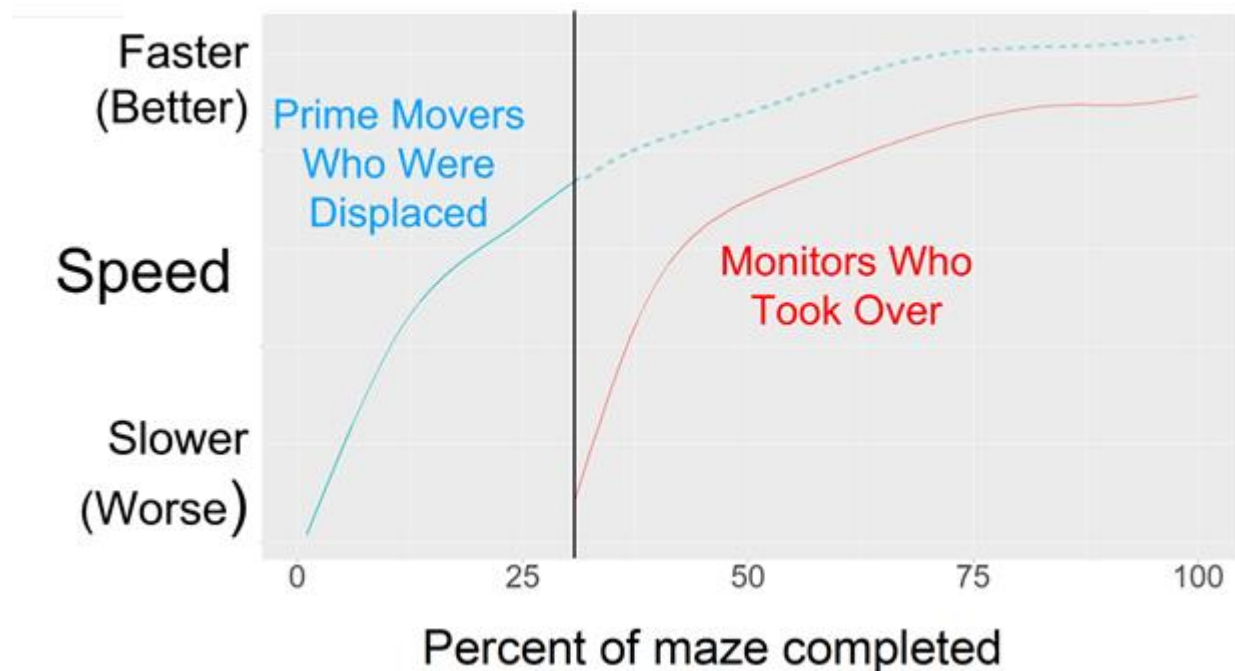
Figure 5: Illustration of Displaced Mover & Monitor Speeds Throughout Maze. Black line indicates the average position of the takeover. The blue prime mover line becomes dashed after the takeover in order to illustrate how fast the average prime mover would have gone if the takeover had never occurred.

TASK TAKEOVER HURTS TEAM PERORMANCE

To illustrate speed throughout the maze, the prime mover's and monitor's average speeds were plotted against "percent of the maze completed" in Figure 5 using a Loess regression for smoothing. "Percent of maze completed" simply shows how much of the maze each participant completed in percent. This metric was calculated by dividing the participant's current checkpoint by the total number of checkpoints in the maze, multiplied by 100.

On average, when monitors took over, their partners had completed roughly 30% of the maze. To aid interpretation of this illustration, the average monitor performance was horizontally transformed to reflect the average position of the takeover via the expression $30+.7f(x)$, where $f(x)$ returned the monitor's position at x percent of the maze. The purpose of this transformation was to better depict how the average monitor performed on the maze. Furthermore, the blue prime mover line becomes dashed after the takeover in order to represent how fast the average prime mover would have gone if the takeover had never occurred.

As Figure 5 shows, monitors who took over initially learned the task faster than the prime movers whom they displaced, as their speed increased at a much faster rate both with and without the transformation. Maybe the monitors learned something by watching the prime mover, or maybe they were just naturally more talented. But like most tasks, the online maze paradigm had a steep learning curve—everyone performed poorly at first and then improved over time. Even though monitors learned quicker, the monitors would have been better off if they had just allowed their teammate to continue: Their teammate had already learned the task, accelerated, and reached a stable speed, and the monitor, who started off as a beginner, disrupted the prime mover's progress in order to learn the task himself/herself. By taking over and undergoing a learning period, the monitor thus incurred learning costs and hurt the team's performance.

To more concretely illustrate learning costs, I subtracted the monitor's speed from their displaced prime mover's speed at every checkpoint after the takeover. A positive speed differences indicates that the monitor was slower than his/her displaced partner, while negative numbers indicate that the monitor was faster than his/her displaced partner. Each takeover, however, occurred during a different point of the maze: Some occurred early on and some occurred much later. To account for this position difference, I standardized position through the metric "percent of maze completed after the takeover" so that 0 represents the position of the takeover and 100 represents the finish line. This standardization allowed me to take the average speed difference at every given percent for all mover-monitor teams. Thus, the mean speed difference was plotted for each given percent using a Loess regression for smoothing in figure 6.
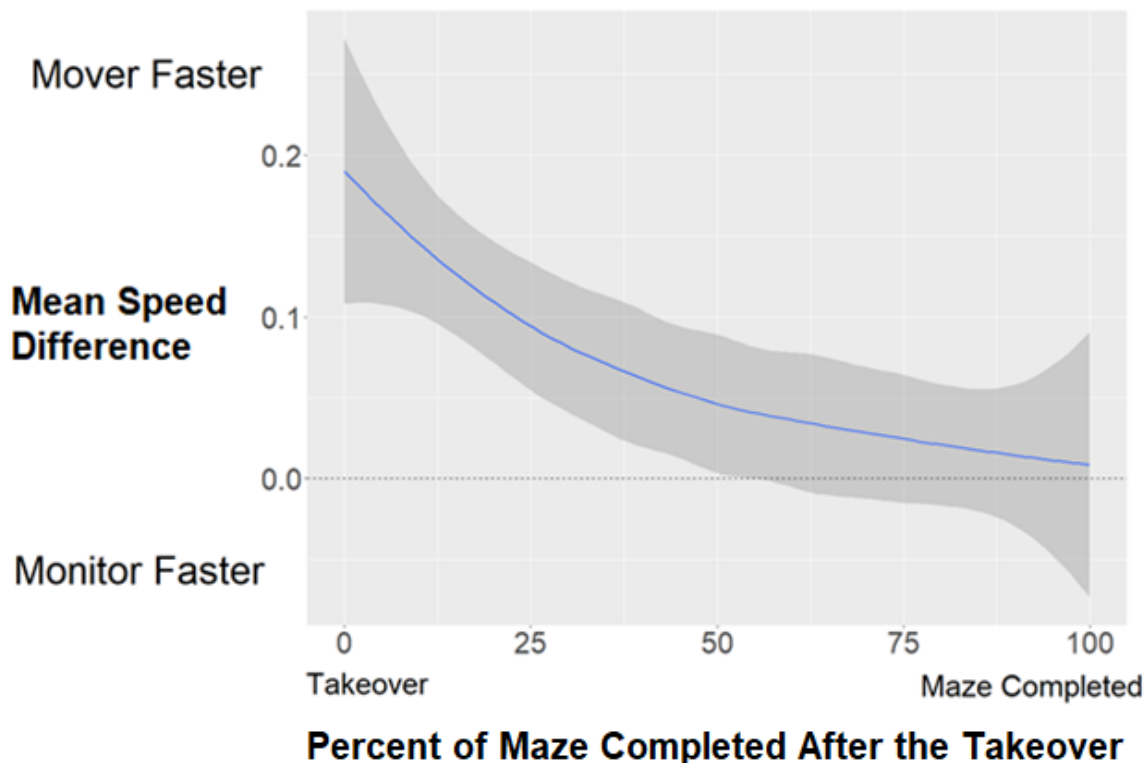
Figure 6: Post-Takeover Speed Differences. Mean speed difference was the average difference between prime mover and monitor speed. Positive values indicate that the prime mover was faster, negative values indicate that the monitor was faster. On the x-axis, 0 indicates the position of the takeover and 100 indicates the finish line. Shading indicates standard error.

On average, the monitors were much slower than the prime movers immediately after the takeover. However, as soon as the monitors took over, they rapidly learned and got faster until they were roughly half way done with their section of the maze. At this point, the monitors became approximately as fast as their partner whom they displaced. Because it took monitors quite a bit of time to reach this speed, however, their performance did not compensate for the time it took them to learn the task. In other words, because the monitors were slower than their partners for half of their performance, they hurt their team until they were roughly half way done with their section of the maze, and then after that, they were not able to compensate for the amount of time they spent learning the task and reaching their partner's speed. Thus, H_2 was supported: There are, in fact, learning costs to taking over.

To test for switching costs, I calculated the amount of time it took from the moment the monitors took over to the time they began moving their square, in seconds. Greater values indicate that it took the monitors longer to switch roles while a value of near 0 indicates that the monitor began progressing through the maze shortly after the takeover. A one-sample t-test revealed that this number was significantly greater than 0, $M = 1.87$, $SE = 0.14$, 95% confidence interval (CI) = [1.60, 2.15], $t(89) = 13.48$, $p < .001$. Monitors who took over also hurt their team because they spent a significant amount time mechanically switching roles rather than progressing through the maze. Thus, monitors suffered costs from manually switching roles (switching costs) and from going at a slower speed then the speed their partner would have gone at if they had never taken over (learning costs). Thus, H_2 was fully supported: There are both learning and switching costs to taking over.

Discussion

My study was the first of its kind to empirically examine how people resolve takeover dilemmas. I found that most monitors took over, but that takeover tended to hurt their team's performance. The reason for this was twofold. First, there were switching costs associated with monitors transitioning from watching the simulation to moving the square themselves. Secondly, this task, like most tasks, had a steep learning curve, and therefore the monitor's ability did not compensate for the time he or she had to spend learning the task. This study shows that takeover can be costly and that people underestimate that cost when they decide to take over.

Real-World Implications & Recommendations

This research offers evidence of a consequential problem with our decision-making process: We fail to adequately calculate or consider learning and switching costs, and as a result, our decisions to take over sometimes make our teams worse off. Our company would have been better off if we hadn't been so confident and taken over that report; our roommate would have been better off if we hadn't stepped in and tried to open our locked apartment door ourselves; and we would have gotten to our destination faster if we hadn't been so impatient with our partner's driving and demanded that we drive the car ourselves. We often feel so confident that we can do a task better than others, and yet, the current results show that our confidence is often misplaced and that our decision to take over makes everyone, including ourselves, worse off.

This misplaced confidence, however, is not necessarily inevitable. The reason why we take over when we shouldn't is that we don't consider learning or switching costs, which suggests that if we were to consider those costs, our decisions would be improved. For example, a company could redefine its product management training module so that, before supervisors decide to take

over from their specialized subordinates, they will understand that they will face a steep learning curve and high switching costs before they can make progress. Furthermore, next time we see someone trying to pick a locked door or work on their section of our team's essay, we can resist our urge to take over by consciously thinking of switching costs, as well as the learning curve that the person has faced—and that we will face if we decide to intervene. While this sort of debiasing technique has not yet been tested with regard to takeover dilemmas, it has been tested in other domains and has been shown to alleviate other biases that are due to faulty simulations such as the planning fallacy (Buehler et al., 1994).

Psychological and Economical Implications & Recommendations

In addition to real-world implications, this finding has implications for other areas of psychology. For example, social learning can be defined as learning by observing or mimicking another person's behavior (Bandura & Walters, 1977), and many authors argue that humans are great at social learning without discussing many limitations (e.g. Hermann et al., 2007; van Schaik & Burkart, 2011; Dean et al., 2012). It would be worthwhile for these authors, as well as for others within this subfield, to consider more carefully the limitations of our ability to learn. For example, if we become confident but not competent at watching someone perform a task (Kardas & O'Brien, 2018), and if this confidence urges us to take over and make everyone worse off, then these findings suggest that there is a critical flaw with our social learning process. It would therefore be informative to investigate why social learning is ineffective in contexts like takeover tasks.

My findings also expand the economics literature, particularly to Becker & Murphy's (1992) theoretical learning curve and switching costs idea (both of which were originally termed

"coordination costs") because, to the best of my knowledge, my research is the first time that a theoretical learning curve has been constructed using experimental data. It would be helpful to apply microeconomic and mathematical models to determine when taking over will be optimal, as well as to devise other learning curves and measure implications on task takeover. Similar to other economics-based findings like diminishing marginal productivity, this research could be powerfully used for business recommendations.

Major Limitations & Future Directions

It is important to note that these studies do not show that taking over must necessarily make a team worse off. The experiment did not require monitors to take over, and therefore monitors self-selected into those who took over and those who did not. Although we were able to determine what would have happened if monitors who did take over hadn't, we do not know what would have happened if monitors who did not take over had. It is possible that if all monitors had been required to take over at some point, the takeover could have produced a net benefit because the monitors who never took over could have been the most skilled at the task. On the other hand, these present studies are externally valid inasmuch as monitors in the real world are seldom forced to take over and are instead allowed to do so at their own discretion.

Although these studies suggest a reason why monitors took over when they should not have, it does not firmly establish that mechanism. Specifically, while it is plausible that the faulty simulation mechanism is why monitors did not anticipate learning costs, there could be other mechanisms behind this decision. Furthermore, this study did not investigate the different types of learning curves, as well as whether the logarithmic learning curve in this experiment is representative of the learning curves in the real world. For example, even though logarithmic and

linear learning curves would produce the same results using this paradigm, real-world tasks may have a different type of learning curve that may produce a different relationship. Additionally, the steepness of the learning curve plays a role in the online maze task where, if the learning curve was steeper and the task became harder, the effects of the takeover would be even greater. Conversely, if the learning curve was not steep at all, then the learning costs of the takeover might be so small that they become negligible. It is unknown how steep the learning curves are in the real world, so future research ought to investigate how learning curve types and steepness influence takeover optimality.

Finally, these experiments used takeover dilemmas in which a monitor was allowed to execute a single irreversible takeover, but real-world takeover tasks may involve multiple takeovers by and of multiple people. For example, if multiple family members are watching someone play a single-player videogame, they can take over for a while and then switch back, and the person playing the videogame can even request a takeover. It would be informative to investigate how well people do in more complex takeover dilemmas. For example, in a situation with multiple team members, it would not be surprising to see people constantly switching roles and potentially accumulating even more costs. It would also be interesting to examine situations in which the person who was displaced has the option of taking over from the person who displaced him or her.

Conclusion

Whether it is a supervisor assuming control of a marketing report, an anxious passenger becoming the driver on a road trip, or a young kid helping a struggling peer put on a shoe, takeover dilemmas are present in everyday life. The current studies suggest that most people take

over when given the opportunity, but they may not anticipate the steep costs. First, people may underestimate how much time it takes to mechanically assuming control of the task (switching costs). Secondly, people may not anticipate that most tasks have a learning curve, and their ability may not compensate for the time they spend learning the task (learning costs). Taking over can thus be costly and people may underestimate these costs when they decide to take over.

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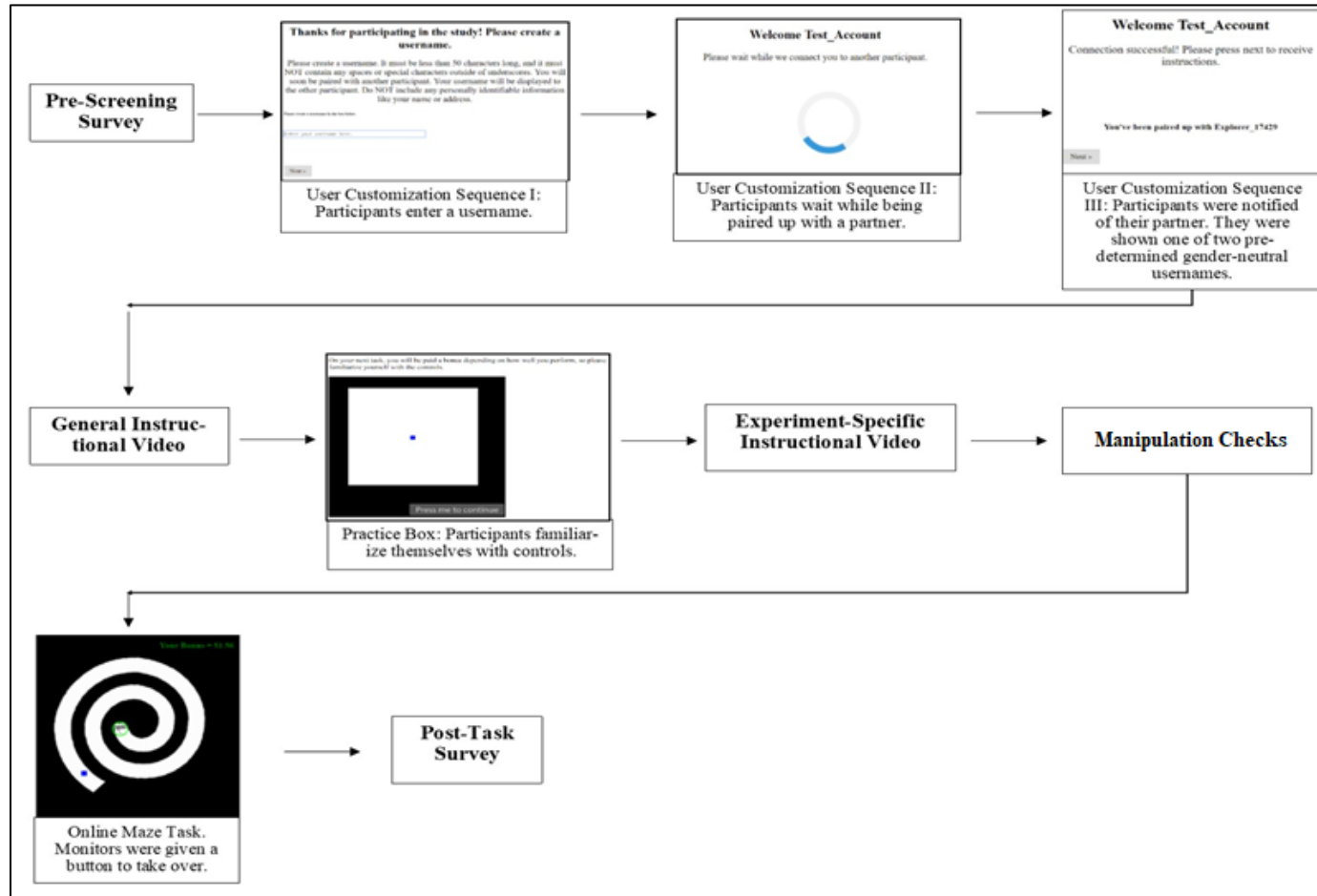
TASK TAKEOVER HURTS TEAM PERORMANCE

Appendix A: Online Maze Task

I.   **The online maze task can be accessed via the following URL:**

https://www.gilbertlab.net/files/Maze_v3.0/user_init/user_selection.html

II.   **Experimental Design: Flow Chart of Major Events**

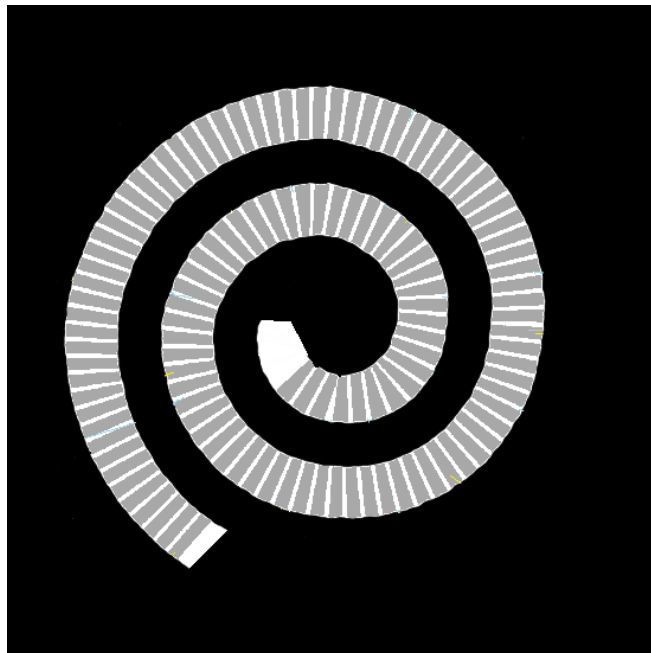TASK TAKEOVER HURTS TEAM PERORMANCE

Appendix B: Maze Metrics

I. Table of Metrics

Metric Name	Purpose	Unit	Calculation
Completion Time	Quantify participants' maze performance	Seconds	N/A
Timing of Takeover	Quantify when each monitor took over, if they took over at all.	Seconds	N/A
Progress	Measure where each participant is on the maze at any given point	Checkpoints	N/A
Speed	Measure each participant's skill level as they progress through the maze	Checkpoints per second	$\dfrac{\Delta Checkpoints}{\Delta Time}$

II. Maze with Darkened Checkpoints. Checkpoints are otherwise invisible to the human eye and were darkened to show positions.

Appendix C: General Instructional Video

I.   **The general instructional video can be found via the following URL:**

https://www.gilbertlab.net/files/Maze_v3.0/user_init/Before_Practice.mp4

II.   **Script**

Thanks for participating in this study. I'm going to quickly explain what you'll be doing. Make sure you watch this video all the way through or you won't be able to complete the study. In today's study, you and your partner will move a little blue square through a maze using your mouse. What makes this a bit tricky is that your mouse will move in a special way. Specifically, instead of moving towards the place you click, the blue square will always move away from the place you click. Let me show you what I mean.

If you click below the blue square, it will move up instead of down. If you click to the left of the square, it will move to the right. If you move to the bottom-left of the square, it will go up and right. See what I mean? By the way, it doesn't matter how far or close you click. For example, I can click really close to the square and it will move exactly the same as if I click very far away.

OK. Now here is the really important thing to know. Any time the little blue square hits the wall of the maze, it will turn bright red and freeze for a few seconds. You can't move when it is frozen. You just have to wait for it to unfreeze. After your square unfreezes, it turns blue again, and you can start moving it again. On the next maze, there is a practice box, where you can try all this out and get a feeling for how it works. Once you feel like you're familiar with the way the square moves, just press the continue button and I'll give you some more instructions.

Appendix D: Prime Mover Instructional Video

I.   The prime-mover instructional video can be found via the following URL:

https://www.gilbertlab.net/files/Maze_v3.0/main/Mover_Regular.mp4

II.   Script

So here's how today's study is going to work. You and your partner are a team, and your job is to move the little blue square through the maze as quickly as you can. The quicker you get the blue square to the end of the maze, where the flag is, the more bonus money you and your partner will be paid. You can see your starting bonus at the top-right corner of the screen. As time goes on, the bonus will decrease. You and your partner are a team, so you will both be paid the amount that's on the screen at the moment you finish the maze.

So what do I mean when I say you are a team? Only one of you can move the little blue square at any time. We're going to start by letting you move it while your partner watches. If at any point your partner wants to take over, then they just have to press the switch button that they have on their screen, and as soon as they do, they will be able to move the blue square as you watch. Only your partner has the switch button, so only they can decide whether or not to switch.

But there's one important rule. Your team can only switch once. So if at any point while you are moving the square, if your partner decides to take over, then your partner will finish the maze for your team. Your team can't press the switch button twice, so once it has been pushed, there is no switching back.

So let me show you how this works. I'm moving the square. At any point, my partner can press the switch button and now they are moving the square. We can only switch once, so my partner will move the square for the rest of the maze. And that's all. Thanks for listening and good luck.

Appendix E: Monitor Instructional Video

I.   The prime-mover instructional video can be found via the following URL:

https://www.gilbertlab.net/files/Maze_v3.0/main/Monitor_Regular.mp4

II.   Script

So here's how today's study is going to work. You and your partner are a team, and your job is to move the little blue square through the maze as quickly as you can. The quicker you get the blue square to the end of the maze, where the flag is, the more bonus money you and your partner will be paid. You can see your starting bonus at the top-right corner of the screen. As time goes on, the bonus will decrease. You and your partner are a team, so you will both be paid the amount that's on the screen at the moment you finish the maze.

So what do I mean when I say you are a team? Only one of you can move the little blue square at any time. We're going to start by letting your partner move it while you watch. If at any point you want to take over, then you just have to press the switch button that you have on your screen, and as soon as you do, you will be able to move the blue square while your partner watches. Only your have the switch button, so only you can decide whether or not to switch.

But there's one important rule. Your team can only switch once. So if at any point while your partner is moving the square, you decide to take over, then you will finish the maze for your team. Your team can't press the switch button twice, so once it has been pushed, there is no switching back.

So let me show you how this works. My partner is moving the square. At any point, I can press the switch button and now I'm moving the square. We can only switch once, I will move the square for the rest of the maze. And that's all. Thanks for listening and good luck.

Appendix F: Pre-Screening Survey

[This mobile device block was only shown to participants who attempted to complete the experiment on a phone or tablet, which is not supported by the online maze task. Participants who received this block were not allowed to proceed further unless they switch devices.]

To take part in this study, you must complete this experiment on a computer. Please exit the survey now or retake the survey on a desktop computer.

Thanks for participating! In order to complete the survey, you must live in the United States and be fluent in English. Please answer the questions below.

In which of these grades are students about 4 or 5 years old?

○ Kindergarten

○ Third grade

○ Fifth Grade

○ Seventh Grade

○ Ninth Grade

Which of these is NOT associated with Halloween?

○ Costumes

○ Pumpkins

○ Trick-or-treating

○ Eating turkey

○ Ghosts

Which of these is an American zip code?

○ 7TX 4LZ

○ 14 Monroe Avenue

○ 02138

○ 19

○ 112

[Participants must have answered 'kindergarten', 'eating turkey', and '02138' respectively. Failure to answer these questions resulted in participants not being allowed to proceed in the study, as not being from the US would interfere with the US-dollar-based bonus metric.]

End of Block: US-Based Test

Start of Block: Video Test

Thank you, you are eligible to complete this study. Before we begin, we want to make sure the survey is working on your computer. Please make sure that your sound is unmuted, and answer the questions on the next page.

Page Break

TASK TAKEOVER HURTS TEAM PERORMANCE

[A demo video was displayed. The video contained two squares moving back and forth, with a piano playing in the background, to test both video quality and audio]

What do you hear in this recording?

○ A voice saying "Test"

○ A voice saying "One two three"

○ A voice saying "A B C"

○ A piano

○ A drum

○ Nothing

How many moving boxes do you see?

○ 1

○ 2

○ 3

○ 4

○ There are no moving boxes

What is the color of the background?

○ Gray

○ Orange

○ Yellow

○ Purple

○ None of the above

[Participants must have answered 'A piano', '2', and 'gray' respectively. Failure to do so prevented participants from proceeding further in the study because a computer that cannot display video or audio will prevent the instructional videos from running correctly.]

End of Block: Video Test

Start of Block: Redirect

Once you click the next button, you will be redirected to another webpage. Once you begin, please **do NOT hit the back button or your results will not be recorded**.

Additionally, please make your window full-screen. There will be further instructions on the next screen.

End of Block: Redirect

Appendix G: Manipulation Checks

[For all questions, if participants did not provide the correct answer, they were told the correct answer and were shown the question again. Participants were not allowed to proceed until they answered all three questions correctly. Furthermore, participants answered questions by selecting a radio button rather than a letter; letters were added to improve clarity.]

1) What were you instructed to do at the start of the maze?
   A. I will move the square through the maze.
   B. I will watch my partner move the square through the maze
   C. Neither. I was never told what I would do
   D. I am not sure.

[Correct answer: (a) if prime mover, (b) if monitor]

2) Who can press the SWITCH BUTTON?
   A. Only me
   B. Only my partner
   C. Both of us
   D. I am not sure

[Correct answer: (b) if prime mover, (a) if monitor.]

3) How many times can the SWITCH BUTTON be pressed?
   A. Only once. If we switch, we cannot switch back
   B. Twice
   C. As many times as we want
   D. I am not sure.

[Correct answer: (a) for both prime mover and monitor]

Appendix H: Post-Task Survey

Thank you for completing the maze. We have some additional questions for you.

Page Break

[Participants were only shown the following block if they are monitors who took over for their partner]

During the task, you and your partner switched roles.

How much do you think the total team performance (and your bonus amount) was improved or harmed because your and your partner switched roles?

- ○ -5   (Switching hurt our performance a lot)

- ○ -4

- ○ -3

- ○ -2

- ○ -1

- ○ 0 (Switching did not affect our performance)

- ○ 1

- ○ 2

- ○ 3

- ○ 4

- ○ 5 (Switching helped our performance a lot)

TASK TAKEOVER HURTS TEAM PERORMANCE

Do you think that you and your partner switched roles at the right time?

○ Yes, I think the switch happened at the right time

○ No, I think the switch should have happened later

○ No, I think the switch should have happened earlier

[All participants who were not monitors who took over were shown this block]

During the task, you and your partner did not switch roles.

How much do you think the total team performance (and your bonus amount) was improved or harmed because you and your partner did not switch roles?

○ -5 (Not switching hurt our performance a lot)

○ -4

○ -3

○ -2

○ -1

○ 0 (Not switching did not affect our performance)

○ 1

○ 2

○ 3

○ 4

○ 5 (Not switching helped our performance a lot)

TASK TAKEOVER HURTS TEAM PERORMANCE

[For the rest of the survey, all participants were shown all blocks]

To maximize the cash bonus, do you think that you and your partner should have switched roles, or not?

○ Yes, we should have switched roles

○ No, we should not have switched roles

Page Break ───────────────────────────────

How much do you like your partner?

○ 1 (not very much)

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7 (very much)

Page Break ───────────────────────────────

Why do you think the switch *[occurred/did not occur]*?

_____

_____

_____

_____

_____

Page Break —

During the maze task, how often did you think about whether or not a switch would or should happen?

○ Never

○ Some of the time

○ About half the time

○ Most of the time

○ The entire time

Page Break —

Compared to **most people**, how skilled do you think your partner is at the maze task?

○ They are less skilled than most people

○ They are about as skilled as most people

○ They are more skilled than most people

Page Break —

Compared to **you**, how skilled do you think your partner is at the maze task?

○ They are less skilled than me

○ They are about as skilled as me

○ They are more skilled than me

TASK TAKEOVER HURTS TEAM PERORMANCE

Compared to **most people**, how skilled do you think you are at the maze task?

◯ I am less skilled than most people

◯ I am about as skilled as most people

◯ I am more skilled than most people

You and your partner completed the maze in *[Participant's completion time was pasted here]* seconds. How many seconds do you think the average person takes to complete the maze?

_____

You and your partner completed the maze in *[Participant's completion time was pasted here]* seconds. How many seconds do you think it would have taken you to complete the maze without your partner?

_____

End of Block: Switch and task questions

Start of Block: Demographics

Today you moved a square through a maze. Have you ever used or played maze games similar to this before?

◯ Yes

◯ No

◯ Sort of

◯ I'm not sure

TASK TAKEOVER HURTS TEAM PERORMANCE

What is your gender?

◯ Male

◯ Female

◯ Other

What is your age? (Please enter a whole number.)

_____

Are you right or left handed?

◯ Right handed

◯ Left handed

How would you rate your comprehension of the English language?

◯ Very Poor

◯ Poor

◯ Fair

◯ Good

◯ Very Good

TASK TAKEOVER HURTS TEAM PERORMANCE

What type of computer mouse are you using?

○ Standard mouse - I have a typical mouse that's either wireless or plugged into the computer.

○ Touchpad - I'm using a touchpad or trackpad

○ Other (please specify): _____

Page Break ————————————————————————

What do you think this study was about?

_____

_____

_____

_____

_____

Page Break ————————————————————————

Was it possible to earn a cash bonus in this experiment?

○ Yes, the bonus was based on how well my partner and I did at the task

○ Yes, the bonus was awarded randomly

○ No, a bonus was not mentioned at all

○ I'm not sure

Page Break ————————————————————————

TASK TAKEOVER HURTS TEAM PERORMANCE

Did anything seem suspicious or unusual about this study?

_____

_____

_____

_____

_____

Were there any technical problems with the study?

_____

Finally, if you have any other comments about the study, please let us know here:

_____

_____

_____

_____

_____

End of Block: Demographics