

Remote work mindsets predict emotions and productivity in home office: A longitudinal study of knowledge workers during the Covid-19 pandemic

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Millions of employees across the globe, including a large proportion of knowledge workers, transitioned to remote work during the COVID-19 pandemic. As remote work continues to characterize work post-crisis, it is imperative to understand how employees adjust to remote work. The current research explores the extent to which knowledge workers hold a *fixed mindset* about remote work (e.g., that a person either is or is not suited to remote work and this cannot be changed) and tested how this mindset shaped well-being during coronavirus-related lockdown. In a longitudinal five-week study of 113 knowledge workers transitioning to remote work, we find that knowledge workers who endorsed a more fixed mindset about remote work experienced more negative and less positive emotion during remote work. The increased negative emotion prompted by fixed mindsets was associated with lesser perceived productivity among these knowledge workers in subsequent weeks. We conclude that understanding how fundamental beliefs (e.g., beliefs about the learnability of remote work) affect employee experiences can help create a brighter future as technology further enables remote work. Encouraging employees to view remote work as a skill that can be learned and developed could help people thrive in the new world of work.

Keywords: remote work, telecommuting, emotion, employee well-being, productivity, mindsets

1. Introduction

Over the past decades, developments in information and communication technologies have enabled more and more employees to work from locations other than the office (Stiles & Smart, 2020; ter Hoeven & van Zoonen, 2015) in what has come to be interchangeably called remote work, telecommuting, or distributed work (Allen et al., 2015). This trend has attracted much scholarly attention, in particular the question of how remote work can be implemented in optimal ways for employees and organizations (Golden, 2009; Messenger & Gschwind, 2016; Shin et al., 2000). A new urgency was brought to the study of remote work when the COVID-19 pandemic prompted

organizations across the world to shift their workforce unexpectedly and rapidly to home office (Hickman & Saad, 2020). In light of the crisis, many organizations are planning to increase the amount of remote work available to employees, including “tech giants” such as Twitter that have now announced employees can work remotely forever if they desire (British Broadcasting Corporation, 2020; Dwoskin, 2020). Accordingly, scholars and practitioners alike predict that in the aftermath of the global crisis, remote work will be part of the “new normal” (EY Belgium, 2020; DeArmas, 2020; Leonardi, 2020; Lueck, 2020), prompting a call for more research on factors that increase employee well-being and productivity when working in remote environments and using technology to work remotely (Dwivedi et al., 2020).

An increase in remote work would have a strong impact on the careers of knowledge workers, given that knowledge-intensive jobs tend to be especially well-suited to remote work (Desilver, 2020). For example, computer and mathematical occupations have a high share of tasks that can be done from home, as do jobs in the information and communication industry (e.g., software developers and publishers can both complete an estimated 89% of their tasks at home) (Adams-Prassl et al., 2020). Many knowledge workers expect that remote work will increase in their industry in the future (Slack, 2020). Indeed, the shift toward remote work during the COVID-19 crisis was particularly pronounced among knowledge workers, with over one quarter of all knowledge workers in the U.S. (amounting to over 16 million people) estimated to have shifted to remote work in the first weeks after the pandemic was officially declared (Slack, 2020). Helping knowledge workers to transition effectively to remote work is thus an important goal in a future that involves increased remote work.

In particular, how transitions to remote work affect productivity has long been a practical interest for organizations contemplating increased remote work (Karnowski & White, 2002). Productivity during remote work has also been a key theoretical interest for a variety of academic fields, including human-computer interaction (Olson & Olson, 2000), computer science and engineering (Ruth & Chaudhry, 2008; Turetken et al., 2011), information systems (Neufeld & Fang, 2005), management (Choudhury et al., 2020; Staples et al., 1999), psychology (Allen et al., 2015), economics (Bloom et al., 2015), and more. This dovetails with a long-standing research interest in factors that predict knowledge worker productivity both more generally (Davenport et al., 2002) and during remote work specifically (Davis, 2002) that has manifested across several fields. Research has often highlighted remote work’s promise, largely suggesting that

allowing employees to engage in it increases productivity and performance (Bloom et al., 2015; Gajendran & Harrison, 2007). Given these findings, increasing remote work post-pandemic may seem like a boon, particularly for knowledge workers whose jobs are well-suited to it.

Yet other research suggests that this bright future of remote work is not a given. While some employees adjust readily to remote work, others struggle with the transition (Felstead & Henseke, 2017). Thus, for the future of remote work, it is critical to consider factors that shape whether employees can maintain productivity and well-being in the switch to remote work. Past research has found that psychological factors, such as employees' positive or negative attitudes toward remote work, influence productivity during remote work (Neufeld & Fang, 2005; Staples et al., 1999). This literature has not yet considered how more fundamental beliefs about the nature of remote work affect responses to remote work opportunities. Yet much research in psychology suggests that beliefs about whether an ability is learnable or set in stone shape how people cope with challenges (e.g., Dweck, 2006). This literature indicates that employees' beliefs about remote work's learnability should play an important role in employee adjustment. The pandemic presents an ideal opportunity to investigate such beliefs about remote work and their role in adjustment, as many individuals were forced to switch to home office rather than opting in to it. Accordingly, the pandemic is a situation in which people who hold beliefs that would normally discourage them from voluntarily taking on remote work would nevertheless begin remote work and the challenges that such individuals face can be examined.

In the current research, we draw on theories of lay beliefs about personal attributes (Dweck, 1999) to identify a new predictor of employee adjustment to remote work and its effects on productivity: employees' fundamental beliefs – or *mindsets* – about the nature of remote work. We propose that employees differ in the extent to which they believe that there is a kind of person who is well-suited to working remotely and that someone simply either is or is not that kind of person. We theorize that employees who endorse this mindset, rather than viewing remote work as a skill that a person can learn and develop, will struggle more with remote work. Specifically, we hypothesize that endorsing this mindset will prompt employees to experience adverse emotions during remote work that ultimately undermine productivity. We test our theory among knowledge workers adjusting to remote work during the COVID-19 pandemic and find general support.

Our research adds an important nuance to the literature on remote work and productivity (Gajendran & Harrison, 2007; Neufeld & Fang, 2005), illustrating that the level of productivity a remote worker ultimately experiences is influenced by this person's individual mindsets about remote work. As such, it identifies a new attribute of knowledge workers who are most likely to perform at a high level in home office and identifies who may need additional support. In addition, our research makes contributions to the literature on telecommuting (Allen et al., 2015), as well as new ways of working more broadly (Ruosetla & Lönnqvist, 2013), by demonstrating that mindsets about the nature of remote work in general (in this case, its learnability) shape adjustment to it. Our research thus highlights the importance of considering subjective barriers to productivity (e.g., employees' beliefs) as technologies change the nature and structure of work. Our research can also inform the design and development of future technologies for remote work, such that these technologies facilitate adaptive mindsets (e.g., O'Rourke, Haimovitz, Ballwebber, Dweck, & Popović, 2014) to foster better remote work experiences. Finally, we extend literature on mindsets about personal characteristics and skills (Dweck, 2006) to the domain of technology-enabled remote work, demonstrating that mindsets about a specific skill's malleability shape meaningful outcomes in that domain over and above mindsets about other related attributes.

Generally, our research suggests that the future of remote work should involve careful consideration of the psychological factors that shape remote worker experiences. Understanding beliefs about remote work and their role in adjustment can inform how to structure remote work and support employees to maximize employee well-being and productivity. Doing so can help to ensure that technological advancements that enable employees to work from anywhere result in benefits for employees and organizations alike.

2. Related work

Previous research has posed the question of whether remote work enhances or undermines productivity in general. In addition, research has explored potential moderators of this relationship, and has identified some psychological, social, and environmental factors that shape whether employees adapt to remote work effectively. Our research draws on theories of mindsets about personal characteristics to propose a new psychological factor that will shape adjustment to remote work: whether people

hold the fundamental belief that remote work is a skill that can be learned and developed, or whether they instead believe that remote work is simply something to which some people are more well-suited than others and this cannot be changed. We hypothesize that fundamental beliefs about the learnability of remote work relate to the emotions that knowledge workers experience while working remotely, and accordingly shape their perceived productivity during remote work.

2.1. Remote work and productivity gains

Productivity has been defined as the effectiveness with which workers apply their abilities to complete work within a given time frame (Ruch, 1994), or in other words, the quality of the work produced over the time taken to produce it. In light of the greater flexibility, and the lack of structure and oversight, that is inherent to remote work, a common concern has been whether remote workers achieve the same level of individual productivity as employees in the traditional office. Managers frequently worry that employees who work remotely will be less productive, either because they shirk their duties (Barrero et al., 2020) or because they struggle with a lack of supervision, distractions, social isolation, and other issues (Kurland & Egan, 1999; Larson et al., 2020).

However, contrary to these concerns, research largely seems to suggest that remote work enhances individual productivity and performance (Boell et al., 2013; Halford, 2005; Vega et al., 2015). For example, a study of patent examiners who were allowed to work remotely from any geographic location found that employees who were allowed this flexibility increased work output by 4.4% without their work suffering any loss in quality (Choudhury et al., 2020). Another study found that Chinese call center workers increased their productivity by 13% when allowed to work remotely (Bloom et al., 2015), and a similar study with employees at U.S. call centers showed productivity gains of 8% to 10% (Emanuel & Harrington, 2020). A study in an Italian organization in the multi-utility sector found that employees who were allowed to work without constraints on location or time showed higher productivity in terms of the number of dossiers processed (Angelici & Profeta, 2020).

In addition to these studies showing benefits of remote work for employees' objective productivity, some studies show that people report feeling more productive when they work remotely (Bailey & Kurland, 2002; Barrero et

al., 2020; Martin & MacDonnell, 2012; Staples et al., 1999). For example, in a qualitative, quasi-experimental study of IBM employees, those employees who were arbitrarily assigned to switch to remote work reported higher levels of productivity than those who remained in office (Hill et al., 1998). However, some other research has found that remote work does not affect perceived performance (Gajendran & Harrison, 2007).

When it comes to performance assessed by others rather than the employees themselves, research shows that remote work enhances individual performance. One such study showed that employees who worked remotely were rated higher by supervisors in terms of their job performance, dedication to work, and supportiveness of other employees, and that the frequency of remote work (i.e., hours spent working remotely per week) was similarly predictive of these three facets of performance (Gajendran et al., 2015). Indeed, a meta-analysis of 46 studies of remote work in natural settings and involving over 12,000 employees showed benefits of remote work on both supervisor-rated performance and objectively measured job performance, as well as showing that remote work has positive impacts on other important factors such as perceived autonomy, job satisfaction, performance, turnover intent, and work-related stress (Gajendran & Harrison, 2007). Along similar lines, a meta-analysis of 39 studies of over 4,000 employees found that employees who were allowed greater control over their work schedules, and thus the kind of flexibility that often comes along with remote work, were more productive (Baltes et al., 1999).

Thus, in general, remote work seems to benefit both subjective and objective productivity for individual employees. In fact, one of the top reasons that organizations who implement remote work policies state for having adopted such policies is that these policies increase productivity (Karnowski & White, 2002). Similarly, one reason why employees report wanting to work remotely is because they believe that it increases their productivity (OWLLabs, 2019; Shockley & Allen, 2012). At first glance, the future of remote work thus seems bright, as one that will bring increased productivity for individuals.

2.2. Predictors of remote work ability

Despite its potential benefits for productivity, remote work can bring with it a wide variety of personal challenges for individuals, such as blurry boundaries between home

and work life, reduced support and feedback, feelings of isolation, and struggling to detach from work (Boell et al., 2013; Charalampous et al., 2019; Ciolfi et al., 2020; Eddleston & Mulki, 2017; Sardeshmukh et al., 2012). And research suggests that employees are not equally adept at maintaining productivity in the light of these challenges. For example, in contrast to the research finding increased productivity among patent examiners who work remotely (Choudhury et al., 2020), other research has found that patent examiners who transition to remote work struggle with procrastination (Frakes & Wasserman, 2016). Recent research during the COVID-19 pandemic found that productivity decreased for a substantial minority (38%) of employees (Wu & Chen, 2020), and other research found that according to most supervisors (65%), their employees' productivity decreased during this time period (Bartik et al., 2020). Further, in the study that found increased productivity among call center workers in China, the researchers found that allowing employees to self-select into remote work (or not) nearly doubled productivity gains, as those who performed badly during remote work returned to the office (Bloom et al., 2015). This suggests that only some individuals gain productivity during remote work and indicates that there are a variety of factors that influence who adapts to remote work and who instead struggles with this transition.

To ensure that adopting remote work brings benefits, it is important to understand which factors predict a successful transition to remote work and which factors might undermine it. Previous research has found that a variety of factors predict whether workers are effective at working remotely, such as personality (O'Neill, Hambley, & Chatellier, 2014), characteristics of work groups (Olson & Olson, 2000), the available technology (Karis et al., 2016), and the nature of the work and tasks involved (Turetken et al., 2011). Much of the previous research on predictors of individuals' remote work adjustment has focused on how social and environmental factors, rather than psychological factors, shape adjustment to remote work (Allen et al., 2015; Bailey & Kurland, 2002; Raghuram et al., 2001; Wang & Haggerty, 2011). Studies of psychological factors have generally focused on stable individual differences such as personality and motivational factors (Biron et al., 2020; Clark et al., 2012; O'Neill, Hambley, & Chatellier, 2014) or individuals' skills and abilities (Wang & Haggerty, 2011). Here we examine a different psychological factor – people's fundamental beliefs about the learnability of remote work – and explore how these basic beliefs shape remote work adjustment.

2.2.1. *Psychological predictors of remote work ability*

Past research has identified some individual differences that play a role in adjustment to remote work. Some research studied demographic differences such as gender (Allen et al., 2013; Gajendran & Harrison, 2007; Neufeld & Fang, 2005) or family and marital status (Lim & Teo, 2000; Neufeld & Fang, 2005). Other research has focused on personality and motivational traits that are predictive of adjustment to remote work. For example, there is some evidence that employees with certain personalities (e.g., more agreeable and less neurotic based on the Big Five personality traits) have more positive attitudes toward remote work (Clark et al., 2012). Employees with higher emotional stability also seem to cope best with the higher autonomy remote work often entails, and thus show higher levels of well-being during remote work (Perry et al., 2018). Trait optimism predicts self-reported adjustment to remote work (Biron et al., 2020). More sociable employees report lower performance during remote work, and employees who are high in need for autonomy report higher performance (O'Neill et al., 2009). Traits such as honesty have been found to predict higher engagement and less “cyberslacking” (i.e., putting off work through Internet-based distractions) (O'Neill, Hambley, & Bercovich, 2014; O'Neill, Hambley, & Chatellier, 2014). Thus, personal characteristics seem to influence whether employees adjust well to or struggle with remote work.

Relatedly, research has studied individual differences in skills that predict adjustment to remote work. Possessing the competencies necessary for work in a virtual setting predicts employees' perceived performance (Wang & Haggerty, 2011). Self-regulatory skills, such as employees' tendency to engage in planning and structuring behaviors (e.g., goal setting, creating an appropriate work environment) are predictive of less stress and less work-family conflict during remote work (Lapierre & Allen, 2012; Raghuram & Wiesenfeld, 2004). On the flip side, being prone to procrastination undermines self-reported performance and is related to increased cyberslacking during remote work (O'Neill et al., 2009; O'Neill, Hambley, & Chatellier, 2014). A recent study of remote workers during the COVID-19 pandemic found that employees who were more proactive at coping with challenges (e.g., being a “take charge” kind of person in the face of obstacles) predicted being more future-oriented, which in turn predicted higher perceived productivity during remote work (Chang et al., 2020). Thus, individual

differences in personal skills and abilities shape remote work ability much like personality traits and other individual qualities.

A smaller body of research has explored how an individual's attitudes and beliefs shape remote work adjustment. One study explored general attitudes toward remote work and found that holding more positive attitudes toward remote work (e.g., feeling that remote work has mostly advantages) predicted increased perceived productivity during remote work, whereas holding more negative attitudes toward remote work (e.g., feeling that it causes complications and difficulties) is predictive of lower perceived productivity (Neufeld & Fang, 2005). Another series of studies explored employees' beliefs about their own abilities at remote work and examined how these self-oriented beliefs shaped remote work outcomes. These studies found that employees with higher self-efficacy about their ability to complete tasks that are necessary to work effectively in a remote environment showed better adjustment to remote work, including greater perceived productivity, remote work effectiveness, job satisfaction, and ability to cope with challenges (Raghuram et al., 2003; Staples et al., 1999). Employees with higher self-efficacy about remote work tended to be those who had more previous experience with remote work, relevant training (e.g., IT skills), and less anxiety about working with computers (Staples et al., 1999).

Thus, an individual's personal characteristics and their beliefs about their own abilities can predict how they respond to opportunities to work remotely. But while some research has documented how general positive or negative attitudes toward remote work, and how beliefs about the self, shape remote work effectiveness, absent from this past research are studies that pinpoint more fundamental beliefs about the nature of remote work, such as whether it can be learned or not, and their impact on remote work outcomes. Our research tests this possibility.

2.3. Fixed and growth mindsets about abilities

Our research explores fundamental beliefs about the nature of remote work: namely, the extent to which people view remote work as a skill that anyone can learn and develop, versus viewing it as something unchangeable and to which people are simply well-suited or poorly-suited. We propose that the extent to

which knowledge workers view remote work as something that cannot be learned and developed will shape their adjustment to remote work.

This proposition is supported by a large psychological literature on the influence of specific mindsets about personal qualities. This literature suggests that the extent to which individuals believe that a personal quality such as intelligence, personality, and shyness can be changed or developed (a *growth mindset*), rather than a quality that is set in stone (a *fixed mindset*), predicts motivation and performance in a wide variety of contexts (Dweck, 1999). For example, students who endorse the view intelligence as an unchangeable, fixed quality of which a person either has a little or a lot to a greater extent tend to earn lower grades than students who view intelligence as malleable quality (Blackwell et al., 2007). Past research suggests that people's mindsets fall along a continuum from endorsing a more fixed view to a more growth view, and thus researchers frequently treat mindsets as a continuous variable rather than a dichotomous one (e.g., Howe & Dweck, 2016).

Research has documented that a person's mindset about a specific ability shapes a person's outcomes in that domain, such that individuals who hold more fixed mindsets about an ability tend to respond more poorly to setbacks in that domain and thus perform worse over time relative to individuals who hold more growth mindsets about an ability. For example, holding a more fixed mindset about specific knowledge areas and skills (e.g., ability in math and biology) predicts outcomes in that domain, such as dropout from certain majors and course grades (Dai & Cromley, 2014; Good et al., 2012). Research indicates that mindsets are domain-specific; that is, mindsets about specific abilities (e.g., mindsets about programming aptitude among computer science students) predict outcomes in that domain over and above more general mindsets (e.g., mindsets about intelligence among computer science students) (Scott & Ghinea, 2014).

Thus, we propose that the extent to which a person holds a fixed mindset about remote work – viewing it as an unchangeable ability that people either have or do not have – will affect whether people adjust to remote work and important outcomes such as productivity. The current study explores whether fixed and growth mindsets about the learnability of remote work in general shape the transition to remote work, and whether mindsets about remote work do so over and above other mindsets about intelligence.

2.4. Mindsets about abilities and emotion

Why would mindsets about whether remote work is a skill that can be learned or not relate to an individual's productivity during remote work? We propose that holding a more fixed mindset about remote work will lead individuals to experience more negative emotion and less positive emotion during remote work. In turn, we expect that experiencing negative emotion will undermine productivity while experiencing positive emotion will bolster it.

Past research on mindsets suggests that a fixed mindset undermines individuals' motivation and performance by shaping how individuals interpret the challenges they face (Keating & Heslin, 2015). Individuals who hold a fixed mindset about a personal quality – such as the skill to work remotely – tend to interpret challenges that arise as a sign that they lack this desirable quality, and this makes setbacks personally distressing. For example, when individuals who hold a fixed mindset about intelligence fail a test, these individuals are more likely to see this setback as reflecting poorly on their self (e.g., as a sign that they are not smart), and accordingly, individuals with more fixed mindsets feel more upset by these setbacks (Heslin & VandeWalle, 2011; Nussbaum & Dweck, 2008). Failures prompt greater negative emotion directed toward the self (e.g., shame, disappointment) for those who hold a fixed mindset because these failures are linked to something immutable about “who they are” as a person (Howe & Dweck, 2016). Thus, individuals who hold fixed mindsets about remote work may see any struggles that naturally arise in the transition to remote work (e.g., difficulty concentrating, feelings of loneliness) as a sign that they are the kind of person who is simply not suited for remote work, and accordingly may tend to feel greater frustration, guilt, or anxiety during remote work.

Likewise, holding a more fixed mindset about remote work could minimize the positive emotion that employees experience during remote work. Individuals with a more fixed mindset about remote work may readily lose enthusiasm and excitement about their work when facing everyday challenges, as they may tend to interpret these challenges as a sign that they are simply not good at remote work and accordingly become less energized by remote work (Dweck, 1999).

2.5. Emotions and productivity

Past research supports our proposition that the emotions employees experience during remote work should be consequential for employees' productivity during remote work. Emotions at work predict a wide range of work-relevant outcomes, from motivation to creativity to absences and turnover (Ashkanasy & Dorris, 2017; Menges & Kilduff, 2015). Emotions also predict work performance. Generally in the workplace, negative emotions have detrimental effects on work performance (Barsade & Gibson, 2007; Kiefer, 2005), while positive emotions increase work performance (Staw et al., 1994; Wright et al., 2007). Building on this literature, we suggest that the route through which fixed mindsets about remote work undermine productivity is by increasing negative emotions and decreasing positive emotions during remote work.

For individuals with more fixed mindsets, experiencing negative emotion (e.g., feeling frustrated) or lacking positive emotion (e.g., feeling little excitement) could be particularly debilitating for productivity, as these emotional patterns may reinforce the idea that one is simply not suited to remote work, making individuals unwilling to invest further effort into their work and thereby strengthening feelings of unproductivity. Thus, we expected that knowledge workers who endorse a more fixed mindset would experience reduced productivity because of their heightened negative and lessened positive emotions during remote work.

3. A longitudinal study of knowledge workers' mindsets about remote work and their impact during the COVID-19 pandemic

To determine whether fundamental beliefs about the learnability of remote work affect knowledge workers' emotions and productivity, we took advantage of the opportunity to study transitions to remote work as many knowledge workers transitioned to remote work because of the COVID-19 pandemic. Although remote work was already quite prevalent before the pandemic, with surveys suggesting that around 50% of the global workforce engaged in remote work for at least half of each workweek (International Workplace Group, 2019), the number of remote workers quickly accumulated during mandatory lockdowns across the globe. For instance, the number of adults working remotely doubled in the United States from mid-March to April in 2020 (Jones, 2020).

The pandemic thus presented a unique chance to study factors that shape adjustment to remote work as employees were forced to rapidly adapt to this way of working. Based on the literature reviewed above, we make the following hypotheses about individuals' mindsets about remote work and their relationship to negative emotion, positive emotion, and productivity during remote work.

3.1. Hypotheses

3.1.1. Mindsets about remote work and negative emotion

- H1: Knowledge workers who hold a more fixed mindset about remote work experience more negative emotion while working remotely.

3.1.2. Mindsets about remote work and positive emotion

- H2: Knowledge workers who hold a more fixed mindset about remote work experience less positive emotion while working remotely.

3.1.3. Emotions during remote work and productivity

- H3: Knowledge workers who hold a more fixed mindset about remote work will feel less productive during remote work because of the increased negative and decreased positive emotion that they experience during remote work.

3.2. Method

3.2.1. Procedure

Participants were recruited through announcements (e.g., on LinkedIn, relevant Facebook groups) that invited anyone who was currently working remotely in Switzerland because of the COVID-19 pandemic to participate in a five-week study about remote work. In a baseline survey during the first week, participants completed mindset measures, demographics, employment information, and relevant control variables (e.g., personality, segmentation). This baseline survey took approximately 10 minutes to complete.

Then, participants completed weekly surveys for the following three weeks containing similar questions (hereafter labeled as Weeks 1-3 to reflect the fact that these identical surveys were fielded over the span of three weeks). Each weekly survey took approximately 5 minutes to complete. All of the surveys were distributed online via e-mail and administered through the Qualtrics platform. Recruitment began on April 16th, 2020. The first weekly survey was fielded via email on Friday, April 24th, the second on Thursday, April 30th (given that Friday, May 1st was a holiday in Switzerland), the third on Friday, May 8th. A final survey in the fifth week of the study that included additional questions was administered on Friday, May 15th. This survey took approximately 10 minutes to complete. Participants were sent up to three daily reminders through the Monday following administration of each weekly survey. We conducted weekly surveys so that we could track participants' adjustment to remote work over a longer-term time period during the pandemic, while avoiding overburdening participants. This follows approaches used in other longitudinal research on mindsets and emotions (e.g., Schroeder, Callahan, Gornik, & Moser, 2019; Tamir, John, Srivastava, & Gross, 2007).

Incentives for participating in the survey included that 1 Swiss franc was donated to the World Health Organization's COVID-19 relief fund for each survey that was completed, and that any participant who completed the full study was entered in a lottery to receive a gift card and had the option to receive personalized feedback about their survey responses.

3.2.3. Measures

3.2.3.1. *Mindsets about remote work and intelligence.* In the baseline survey, participants completed two measures that assessed the extent to which participants held fixed mindsets about remote work and intelligence. As in past research, mindsets were treated as a continuous variable (e.g., Howe & Dweck, 2016).

To measure mindsets about remote work, we adapted Dweck's (1999) scale, e.g., "You are either the kind of person who is good at working remotely or not and you can't really do much to change it," (3 items, $\alpha=0.87$, 1=*strongly disagree*, 6=*strongly agree*). Higher scores on this scale indicated greater agreement with a fixed view of remote work.

To test whether domain-specific mindsets about remote work are uniquely predictive of outcomes in home office, compared to other potentially relevant and

previously established mindsets, we also included Dweck's (1999) scale used to measure fixed mindsets about intelligence, e.g., "Your intelligence is something about you that you can't change very much," (3 items, $\alpha=0.90$, 1=*strongly disagree*, 6=*strongly agree*). Higher scores on this scale indicated greater agreement with a fixed view of intelligence.

3.2.3.2. *Positive and negative emotion during remote work.* To capture participants' emotions during remote work, in each weekly survey, participants answered the question: "How often did you feel the following emotions while working over the last week?" (1=never, 5=very often). Based on the short form of the positive and negative affect scale (Mackinnon et al., 1999), participants reported positive emotions (enthusiastic, excited, inspired, determined, alert, 5 items) and negative emotions (irritable, anxious, guilty, upset, frustrated, 5 items). Cronbach's alpha was calculated to assess the reliability of these scales (acceptable values range from 0.70-0.95). Values indicated high reliability (for positive emotions, $\alpha_{\text{Week1}}=0.81$, $\alpha_{\text{Week2}}=0.83$, $\alpha_{\text{Week3}}=0.83$; for negative emotions, $\alpha_{\text{Week1}}=0.84$, $\alpha_{\text{Week2}}=0.83$, $\alpha_{\text{Week3}}=0.83$).

3.2.3.3. *Perceived productivity during remote work.* We measured participants' perceptions of their productivity during remote work through two items in each weekly survey, "How productive or unproductive were you over the past week?" (1=very unproductive, 7=very productive) and "What percentage of your work goals would you say you accomplished over the last week?" (0-100%). These items are adapted from those used to measure perceived productivity through self-reports in past research (e.g., Meyer, Barton, Murphy, Zimmermann, & Friz, 2017). These two items were showed moderate to strong correlations with one another in each of the weekly surveys ($r_{\text{Week1}}=0.45$, $p<0.001$, $r_{\text{Week2}}=0.63$, $p<0.001$, $r_{\text{Week3}}=0.65$, $p<0.001$). Since these items varied in their ranges, we scaled them by subtracting the mean of the variable and dividing by the standard deviation of the variable for each variable before creating an average score. Higher numbers indicate greater perceived productivity.

3.2.3.4. *Control variables.* We included a variety of control variables in the baseline survey that we theorized could be predictive of participants' emotions and productivity during remote work.

Demographics and work environment. Along with participant age and gender, we measured other predictors that could shape work experiences during the pandemic, including participants' employment status (i.e., part- or full-time), participants' income, participants' level in their organization's hierarchy, the number of adults and children with whom participants lived, and whether participants had a dedicated space for work in their home or not.

Personality. We measured the "Big Five" personality traits to account for differences in participants' personalities. As in previous research (Goldberg, 1992; Grant et al., 2011), participants rated their own personality traits using ten items for each of the Big Five personality traits on a scale from 1=strongly disagree to 7=strongly agree. Cronbach's alpha is provided in parentheses and the scales showed acceptable levels of reliability. The openness to experience scale included adjectives such as "imaginative," "intellectual," and "shallow" (reverse scored) ($\alpha=0.72$), the conscientiousness scale included adjectives such as "organized," "dependable," and "careless" (reverse scored) ($\alpha=0.82$), the agreeableness scale included adjectives such as "considerate," "helpful," and "cold" (reverse scored) ($\alpha=0.81$), the extraversion scale included adjectives such as "talkative," "energetic," and "reserved" (reverse scored) ($\alpha=0.89$), and the neuroticism scale included adjectives such as "moody," "high-strung," and "unemotional" (reverse scored) ($\alpha=0.79$).

Segmentation. Since participants' preference for separation between work and home life could affect their experiences with remote work, in the baseline survey, we assessed segmentation as measured in past research (Rothbard et al., 2005). Participants were asked "How important is each of the following job characteristics to you personally?" and rated their agreement with statements like "Not being required to work while at home" and "Being able to forget work while I am at home" on a scale from 1=very unimportant to 7=very important (4 items). Reliability was high for this scale ($\alpha=0.86$).

Motivation. In the baseline survey, we measured participants' sources of motivation for their work as another factor that could predict adjustment to remote

work. Based on scales used in previous research, including extrinsic motivation, intrinsic motivation, prosocial motivation, and family motivation (Amabile et al., 1994; Grant, 2008; Menges et al., 2017), participants were asked, “Why are you motivated to do your work?” and rated their agreement with various reasons from 1=strongly disagree to 7=strongly agree. Cronbach’s alpha is provided in parentheses and indicated acceptable levels of reliability. The extrinsic motivation scale included statements such as “Because of the money I earn with it” and “Because of the recognition I get from others” (5 items, $\alpha=0.70$), the intrinsic motivation scale included statements such as “Because I enjoy the work itself” and “Because it’s fun” (4 items, $\alpha=0.88$), the prosocial motivation scale included statements such as “Because I want to have a positive impact on others” and “Because I care about benefitting others through my work” (4 items, $\alpha=0.92$), and the family motivation scale included statements such as “Because I care about supporting my family” and “Because I want to help my family” (5 items, $\alpha=0.95$).

3.4. Results

Means, standard deviations, and correlations are presented in Table 1. [*Insert Table 1 about here.*] Given the large number of control variables assessed in the study and to prevent overfitting the model, we performed stepwise model selection using backward elimination to reduce the number of control variables in the models. Results from models using a reduced number of control variables are presented below; however, we note that directions of coefficients and patterns of significance were unchanged when analyses were re-conducted using models with all control variables included.

3.4.1. Participants

One hundred and thirteen knowledge workers employed in Switzerland participated in the study (68.1% women, 31.9% men, 0% non-binary, $M_{Age}=36.82$, $SD=8.85$). The most prevalent industries represented in our sample were Education (15.0% of participants) followed by Software & IT (12.4%), Research (11.5%), Consulting (9.7%), Health, Biotechnology, and Pharmaceuticals (6.2%), Banking & Investment Management (6.2%), Civic & Social (5.3%), and Insurance (4.4%). Most participants were employed full-time (74.3%) and the remaining were employed part-time (25.7%). Students were not included in the study unless they were also working a job alongside their studies.

Eighty-seven participants completed the full study, providing data at each of the timepoints.

3.4.2. *Mindsets about remote work*

3.4.2.1. *Mindsets about remote work and mindsets about intelligence.* We explored the relationship of mindsets about remote work with mindsets about intelligence to determine whether these mindsets are best thought of as separate, domain-specific constructs (Scott & Ghinea, 2014). Mindsets about remote work were weakly positively correlated with mindsets about intelligence, $r(111)=0.20$, $p=0.032$. People who tended to endorse fixed mindsets about remote work thus showed a slight tendency to also agree that intelligence cannot be changed. Thus, people who tended to agree more that remote work cannot be learned and developed also slightly tended to agree that intelligence cannot be changed.

We tested whether mindsets about remote work were distinguishable from mindsets about intelligence more broadly. We conducted a confirmatory factor analysis using maximum likelihood estimation to test whether a model of the data in which these two mindsets were considered separately was a better fit than a model in which these two variables were loaded onto the same factor. The model in which both variables were loaded onto the same factor was a poor fit for the data, with a Tucker-Lewis Index (TLI) of 0.31, a Comparative Fit Index (CFI) of 0.58, and a root mean square error of approximation (RMSEA) of .431, 90% confidence interval (CI): [0.380, 0.485]. The model in which the variables were loaded onto separate factors was a more acceptable fit for the data, with a TLI of 0.94, a CFI of 0.97, and a RMSEA of .124, 90% confidence interval (CI): [0.063, 0.187]. The two-factor model fit the data significantly better than a single-factor solution ($\chi^2(1)=176.34$, $p<0.001$). Thus, mindsets about remote work appeared to be distinct from mindsets about intelligence.

3.4.2.1. *Predictors of mindsets about remote work.* We assessed the relationship of the control variables with mindsets about remote work and mindsets about intelligence. In two linear regressions, we predicted mindsets about remote work, and mindsets about intelligence respectively, with the control variables identified through model selection. One significant predictor of mindsets about remote work was age, such that older participants tended to have more fixed mindsets about remote work than younger

participants, $B=0.02$, 95% confidence interval (CI): [0.00, 0.05], $SE=0.01$, $t(82)=2.06$, $p=0.043$. Further, family motivation was a significant predictor, such that people who reported being more motivated in their job because it benefits their family tended to have less fixed mindsets about remote work, $B=-0.20$, 95% CI: [-0.33, -0.07], $SE=0.06$, $t(82)=-3.15$, $p=0.002$. No other control variables reached significance as predictors. See Table 2 for unstandardized regression coefficients and information about other predictors. [*Insert Table 2 about here.*]

Significant predictors of mindsets about intelligence differed from those of remote work. The only significant predictors were intrinsic motivation, such that people who reported being more motivated in their job because it is interesting and fun reported less fixed mindsets about intelligence, $B=-0.37$, 95% CI: [-0.60, -0.15], $SE=0.11$, $t(82)=-3.30$, $p=0.001$, and extrinsic motivation, such that people who reported being more motivated in their job because of external rewards tended to have more fixed mindsets about remote work, $B=0.29$, 95% CI: [0.10, 0.47], $SE=0.09$, $t(82)=3.07$, $p=0.003$. These findings are aligned with past research on mindsets about intelligence that suggests that fixed mindsets undermine intrinsic motivation (e.g., Haimovitz, Wormington, & Corpus, 2011) and orient people towards performance goals such as being recognized for high performance or outperforming others (e.g., DeBacker, Heddy, Kershen, Crowson, Looney & Goldman, 2018).

3.4.3. *Mindsets and emotions during remote work*

We tested how mindsets about remote work predicted knowledge workers' emotional well-being during remote work. Since measures of positive and negative emotion were collected over the course of three weeks, we time lagged the variables of positive and negative emotion so that we tested how positive and negative emotions in Week 1 predicted productivity in Week 2, and how positive and negative emotions in Week 2 predicted productivity in Week 3, controlling for same-week positive and negative emotion. This allows us to test whether positive and negative emotions seemed to have a subsequent effect on productivity in following weeks.

To test Hypotheses 1 and 2, we estimated two mixed-effects linear models in which we predicted the extent to which participants felt either positive or negative emotions while working with a variable indicating participants' mindsets about remote work, controlling for the timepoint at which data were collected and the control variables identified through model selection. Our model included a random intercept for

each participant to account for repeated measures across participants. In these models, we included 87 participants who completed all of the weekly measures in the study and omitted participants who had missing data for one or more of the weeks. However, patterns of results and levels of significance are the same when all available data from the 113 participants are retained in the analyses.

Knowledge workers' mindsets about the learnability of remote work predicted the levels of positive and negative emotion they experienced while adjusting to remote work during the pandemic. Knowledge workers who endorsed a more fixed mindset about remote work experienced more negative emotion during remote work, $B=0.20$, 95% CI: [0.03, 0.37], $SE=0.09$, $t(82)=2.28$, $p=0.025$, supporting Hypothesis 1. See Table 3 for unstandardized regression coefficients. Knowledge workers who endorsed a more fixed mindset about remote work also experienced less positive emotion during remote work, $B=-0.21$, 95% CI: [-0.37, -0.06], $SE=0.08$, $t(83)=-2.72$, $p=0.008$, supporting Hypothesis 2. [*Insert Table 3 about here.*]

Notably, mindsets about intelligence did not predict knowledge workers' outcomes in the same way when we substituted mindsets about intelligence for mindsets about remote work in our linear models. The extent to which knowledge workers endorsed a fixed mindset about intelligence did not predict the extent to which they experienced negative emotion during remote work, $B=-0.06$, 95% CI: [-0.18, 0.07], $SE=0.07$, $t(82)=-0.84$, $p=0.402$, or the extent to which they experienced positive emotion during remote work, $B=0.06$, 95% CI: [-0.06, 0.18], $SE=0.06$, $t(83)=0.94$, $p=0.349$. This suggests that effects were specific to mindsets about remote work rather than mindsets about other traits more broadly (see Figure 1). [*Insert Figure 1 about here.*]

Examining the control variables, predictors of negative emotion included the number of children in one's household, such that having more children heightened reports of negative emotion experienced during remote work, and family motivation, such that being driven to work because it benefit's one's family also heightened negative emotion. These results suggest that family ties may be associated with more challenges in the shift to remote work, perhaps as family and work life collided in home office. In addition, knowledge workers with higher levels of the personality trait neuroticism reported more negative emotion, in line with past research (McNiel & Fleeson, 2006). No other control variables reached significance as predictors of negative emotion. Further, negative emotion during remote work tended to decrease over the

course of the study, suggesting that knowledge workers felt less negative as their experience with remote work increased over time. Predictors of positive emotion included intrinsic motivation, such that higher levels of intrinsic motivation predicted more positive emotion, in line with research associating intrinsic motivation with positivity (Vandercammen, Hofmans, & Theuns, 2014); in contrast, higher levels of family motivation predicted lower positive emotion. No other control variables reached significance as predictors of positive emotion. Knowledge workers' level of positive emotion did not decrease or increase over the course of the study. See Table 3 for regression coefficients.

3.4.4. *Mindsets and productivity during remote work*

Finally, we tested whether the differences in positive and negative emotion prompted by more fixed mindsets about remote work affected how knowledge workers gauged their productivity during remote work. In a mixed-effect linear model, we predicted knowledge workers' perceived productivity in weeks 2 and 3 with the variable indicating mindsets about remote work, time-lagged and same-week positive and negative emotion, and the control variables. When excluding the emotion variables, mindsets about remote work predicted marginally significantly decreased productivity in subsequent weeks, $B=-0.19$, 95% CI: [-0.37, -0.01], $SE=0.10$, $t(80)=-1.97$, $p=0.052$, and this effect was reduced when controlling for positive and negative emotions, $B=0.03$, 95% CI: [-0.10, 0.15], $SE=0.07$, $t(80)=0.37$, $p=0.710$.

Knowledge workers experiencing more negative emotion in the previous week predicted lower productivity in the subsequent week, $B=-0.23$, 95% CI: [-0.44, -0.02], $SE=0.11$, $t(147)=-2.11$, $p=0.037$, over and above the extent to which experiencing negative emotion in the same week predicted decreased productivity that same week, $B=-0.33$, 95% CI: [-0.53, -0.11], $SE=0.11$, $t(152)=-2.97$, $p=0.003$. However, the extent to which knowledge workers experienced positive emotion in the previous week did not predict productivity in the subsequent week, $B=-0.10$, 95% CI: [-0.30, 0.09], $SE=0.10$, $t(159)=-1.01$, $p=0.316$; experiencing more positive emotion in the same week did predict increased productivity that same week, $B=0.52$, 95% CI: [0.33, 0.71], $SE=0.10$, $t(154)=5.10$, $p<0.001$. The only control variable that significantly predicted productivity was intrinsic motivation, such that employees with higher levels of intrinsic motivation reported lower productivity.

To test Hypothesis 3, we conducted a mediation analysis to examine whether more fixed mindsets about remote work may have reduced participants' productivity because these mindsets increased negative emotion or decreased positive emotion during remote work. We did so by creating a 95% confidence interval for the indirect effect of mindsets on productivity through increased negative emotion using bootstrapping with 5,000 samples. This confidence interval did not include zero: [-0.12, -0.003], supporting our mediational hypothesis. We then created a 95% confidence interval for the indirect effect of mindsets on productivity through decreased positive emotion using bootstrapping with 5,000 samples and it did include zero: [-0.02, 0.08], thus suggesting that fixed mindsets about remote work mainly decreased productivity in subsequent weeks because these mindsets prompted increase negative emotion in prior weeks, rather than because these mindsets reduced positive emotion in prior weeks (Figure 2). *[Insert Figure 2 about here.]*

4. General discussion

Our research shows in a sample of knowledge workers that fundamental beliefs about the nature of remote work, as captured in workers' mindsets about whether remote work is an ability that can be learned or that people simply possess or not, shape emotions and ultimately perceived productivity during remote work. During the COVID-19 pandemic, knowledge workers who were required to rapidly adjust to remote work fared better when they held the mindset that remote work is a skill that can be learned and developed, rather than something that is set in stone. Knowledge workers who agreed that people simply either are or are not the kind of person who can work remotely tended to feel more negative and less positive emotion during the course of remote work. Further, the increased negative emotion that employees with this mindset experienced undermined their productivity in subsequent weeks, while positive emotion predicted same-week productivity.

More generally, our research illustrates the promise of studying intrapersonal and psychological factors, such as beliefs and attitudes, to understanding adjustment to remote work and factors such as remote worker productivity. Alongside investigating personality and skills, as well as structural and relational factors, that shape remote work, it is important to get inside people's heads in order to predict how they will react to and adjust to remote work. A successful future of remote work thus involves

unpacking employees' beliefs about remote work and working to rectify any maladaptive beliefs that may exist.

4.1. Theoretical contributions

As technologies have developed, more and more workers have been afforded the opportunity to work remotely with flexibility in time and location (Davis, 2002). Researchers in human-computer interaction have long been interested in the consequences of increased remote work, including how workers' productivity is affected when employees use technologies to work outside of traditional office settings (e.g., Ciolfi & de Carvalho, 2014; Jarrahi & Thompson, 2017; York & Pendharkar, 2004). Our research contributes to this literature by shedding light on psychosocial factors that shape productivity when workers switch to home office. Our research suggests that even when remote workers have objectively similar remote work environments at home, their productivity could nonetheless be affected in dissimilar ways depending on their mindsets about remote work. Thus, our research highlights how scholars of remote work can benefit from studying subjective barriers to productivity (e.g., attitudes, beliefs, mindsets) as well as more objective and/or technical barriers (e.g., work environments, challenges in setting up or using technology, Neufeld & Fang, 2005; Szameitat, Rummel, Szameitat, & Sterr, 2009). Researchers in human-computer interaction and other disciplines may gain a better understanding of when remote work relates to increased or decreased productivity from considering how employees' attitudes, beliefs, and mindsets about remote work, and the technology that is used during it, shape productivity.

Our research also adds a new perspective to research on the psychological factors that predict employees' individual adjustment during remote work. Thus far, studies that have identified individual differences that predict adjustment to remote work have focused largely on relatively stable individual differences, such as personality traits or differences in motivations (Biron et al., 2020; O'Neill et al., 2009; O'Neill, Hambley, & Bercovich, 2014). Some research has focused on people's actual skills or abilities (Wang & Haggerty, 2011) or their beliefs about their own skills (Raghuram et al., 2003; Staples et al., 1999). The current study makes a novel contribution to this literature by highlighting mindsets about the fundamental nature of remote work as a new kind of individual difference that predicts adjustment. It suggests that it is not only people's beliefs about themselves, but their beliefs about the nature of

remote work more broadly, such as whether it can be learned or not, that shape transitions to remote work. This can spark new lines of research focused on understanding other critical attitudes and beliefs that influence whether employees are set on an upward or downward trajectory when they switch to remote work.

More broadly, our research illustrates the importance of psychological insights when technology enables new ways of working (Ruosetla & Lönnqvist, 2013). It highlights that increased opportunities to work in new and different ways will not inevitably result in increased well-being and productivity, but rather may do so more for some than others. It thus encourages researchers to think about when and for whom changes to ways of working bring the most benefits, and how these benefits might be increased for others. This contributes a new understanding to a puzzle raised in past research on the link between remote work and productivity. While some studies have shown that remote work bolsters employees' productivity (Bloom et al., 2015; Choudhury et al., 2020), others have found adverse effects (Frakes & Wasserman, 2016; Wu & Chen, 2020). This inconsistency could result from the fact that there were other factors at play, perhaps psychological, social, and/or environmental, that ultimately determined whether these increased opportunities for remote work benefitted organizations and when they instead backfired. Accordingly, our research suggests that it will be the most fruitful for researchers interested in the link between new ways of working and productivity to consider a more nuanced view of this link and to investigate factors that serve as moderators to this link. Specifically, our research suggests that workers' ability to embrace changes in the nature and structure of work may depend on their mindsets about these changes. This insight could be applied when studying how other new ways of working shape productivity and other work outcomes in a variety of settings (e.g., examining how mindsets shape workers' experiences in coworking spaces, Spinuzzi, Bodrožić, Scaratii, & Ivaldi, 2018; examining how mindsets shape the outcomes of increased human-machine collaboration, Hinds et al., 2004). As technology affords increased work flexibility and introduces new work practices in the future, understanding the various beliefs that help people to embrace these opportunities and how adaptive beliefs can be fostered among everyone can contribute to a brighter future of work.

Our research also applies insights from past research in psychology to the domain of technology-enabled remote work, and in doing so adds to the literature on fixed and growth mindsets and their influence across various domains of life (Dweck,

2006). We show that specific mindsets about remote work's learnability are distinguishable from more general mindsets about intelligence and predict employee well-being and productivity during remote work in ways that more general mindsets about intelligence do not. Our research thus provides evidence for the domain-specificity of mindsets, corroborating previous studies, which for instance have found that mindsets about a specific technical skill (programming) were distinct from mindsets about intelligence (Scott & Ghinea, 2014). Accordingly, our research also suggests that interventions that target building a growth mindset in one broader domain (e.g., intelligence) may not improve outcomes when it comes in specific contexts (e.g., remote work). To help employees adjust to changes in the workplace driven by technology, interventions may need to target mindsets that are specific to the particular context. Thus, our research highlights fixed and growth mindsets about aspects of new ways of working and technology use (e.g., about specific technological skills and abilities, Lee, Heeter, Magerko, & Medler, 2012) as an important point for future study.

4.2. Practical implications

Practically, our research allows managers, organizations, developers of remote-work software, and other societal actors with a stake in remote work to better understand how knowledge workers will fare in the transition to remote work. Our research pinpoints mindsets about remote work as an important factor that should be kept in mind both by organizations that are entertaining the idea of increased remote work in the wake of the pandemic, as well as organizations that plan to return to office work and yet may face future challenges (e.g., future pandemics or other crises) that prompt them to shift their workforce to remote work. Assessing mindsets about remote work can help organizations to identify individuals who may be in need of additional support during the transition to remote work as well as to develop strategies for helping remote workers to maintain well-being and productivity.

First, by identifying a new psychological characteristic that predicts employee adjustment to remote work, this research can help organizations to predict which employees may struggle more as they adjust to remote work. Organizations could identify employees with more fixed mindsets about remote work and take steps to offer these employees additional support to ensure that they are able to function well in home office. For example, supervisors could be nudged to check in with employees who might particularly struggle. Further, technologies that are used during remote work

could be designed to support employees' remote work learning and progress in either implicit or explicit ways. For instance, researchers have suggested that tracking and reflecting on one's own productivity could help to enhance it (White, Liang, & Clarke, 2019). Drawing on this, technologies could provide remote workers with more fixed mindsets with data that visualizes their remote work productivity and/or provide feedback to aid those who are struggling to remain productive during remote work, such as identifying factors correlated with productivity and pointing workers toward helpful strategies.

Second, by assessing remote work mindsets, organizations might also be able to anticipate who is more eager to choose remote work. If organizations offer employees the opportunity to work remotely for their job (a trend anticipated to increase in light of the pandemic), certain employees, such as those with less fixed mindsets about remote work, seem more likely to opt for this than others. Future research should explore whether this effect emerges and has positive or negative consequences for organizations offering remote work opportunities and how beliefs about different aspects of remote work (e.g., technology used during remote work) affect who chooses to work remotely.

However, it is important to note that if organizations assess employee mindsets about remote work, there is the potential for misuse of such data. For instance, perhaps actors in organizations would unfairly disadvantage employees who hold more fixed mindsets about remote work (e.g., firing employees who hold more fixed mindsets, giving more desirable work assignments to employees who hold more growth mindsets, promoting employees who hold more growth mindsets). Deciding to use data for decision-making in this way would reflect a misunderstanding about the nature of mindsets. Research suggests that rather than being a dichotomous trait (i.e., individuals either have a fixed or a growth mindset), mindsets can shift as a result of experience or situational triggers, even for individuals who chronically endorse more fixed or more growth mindsets about an ability (Murphy & Reeves, 2019). Thus, rather than selecting or evaluating employees on the basis of mindsets about remote work, organizations might aim to shape remote work mindsets in a more positive direction.

Along these lines, our research pinpoints mindsets about remote work as a potentially fruitful point for intervention when organizations transition employees to remote work. For example, organizations could take steps to instill a growth mindset in employees before these employees transition to remote work in order to facilitate adjustment. Organizations could equip employees beginning remote work with

information that depicts it as a skill that can be learned (e.g., recommending practical strategies that facilitate remote work) and/or ask employees to engage in activities that facilitate a growth mindset about remote work (e.g., asking employees to reflect each week on what they learned about working remotely). Activities to facilitate a growth mindset about remote work could be incorporated into the very technologies that enable remote work. For example, research suggests that technologies such as conversational agents can facilitate structured dialogues on topics relevant to productivity to increase it (e.g., Williams, Kaur, Mark, Thompson, Iqbal, & Teevan, 2018). Drawing on this, remote work platforms could encourage remote workers to reflect on the factors that affect their remote work productivity and devise strategies for improving their remote work ability (e.g., via a daily “virtual commute” that asks individuals to reflect on factors that shaped their ability to work remotely at the end of each day and make a plan for the next).

Building on this, from a design perspective, software providers might consider ways in which the tools of remote work can embody or encourage a growth mindset. Technologies could incorporate feedback, assessments, tutorials and other means to facilitate a growth mindset in users in order to make remote workers’ experience with the software more positive and to increase their perceived productivity. For example, research has found that online modules can be used to teach growth mindsets about abilities such as intelligence (e.g., Yeager et al., 2016), and similar modules on the topic of remote work could be built into orientations to remote work softwares. Or, messages that facilitate a growth mindset could be incorporated into the software (e.g., reminders stating that remote work is a learnable skill) (Williams, Paunesku, Haley, & Sohl-Dickstein, 2013). In addition, some research has found that educational games can teach growth mindsets by adopting incentive structures that promote growth mindset behavior, such as encouraging users to try new strategies and consider puzzles from a fresh perspective by awarding points for clearing a game board (O’Rourke, Haimovitz, Ballwebber, Dweck, & Popović, 2014). Drawing on this, remote work software could nudge individuals to try out effective remote-work strategies, such as encouraging users to test out taking breaks at opportune moments (Kaur, Williams, McDuff, Czerwinski, Teevan, & Iqbal, 2020). Software providers might consider the way in which technologies, particularly those used in remote work, might shift mindsets about remote work for the better and/or encourage behaviors associated with a growth mindset, and

organizations might opt to select technologies that contribute toward a growth mindset about remote work in their design.

4.3. Limitations and future research

While the current research was conducted under extreme circumstances, as knowledge workers began remote work in a global crisis, the findings could extend to knowledge workers and other employees who are shifting to remote work for a variety of reasons. How mindsets about remote work predict outcomes under more mundane circumstances, e.g., as organizations change policies to allow for increased remote work outside of the context of a global pandemic, should be examined in future research. In addition, future research could explore the role of mindsets among people that are hired into fully-remote positions from the outset rather than people who switch to remote work. This question is particularly relevant for industries like software development, where all-remote work opportunities are increasingly feasible.

We examined knowledge workers in this research, as knowledge workers constitute a large proportion of employees who are able to work remotely (Adams-Prassl et al., 2020). However, as technology continues to develop, remote work may be enabled for more and more employees from occupations beyond knowledge work. Accordingly, future research should examine how mindsets about remote work shape adjustment in other types of work. The effects observed in this study could perhaps be amplified in other occupations where remote work is as of yet a rarity and an unfamiliar concept. The particular tools that enable remote work in other occupations could also be designed to foster optimal mindsets about remote work.

This study was conducted over the course of five weeks as knowledge workers shifted to remote work, but it is an open question how these effects would play out over a longer time frame. For example, it is unclear from the current study whether the effects of mindsets about remote work on emotions and productivity would diminish or strengthen over time. Perhaps as employees adjust to remote work over the course of several months, employees who initially held fixed mindsets about remote work would have more positive experiences than expected and the mindset would lose its potency. On the contrary, employees who have more fixed mindsets about remote work could enter a vicious cycle in which mindsets lead people to have more negative experiences while adjusting to remote work, which reinforces a fixed mindset about remote work. Thus, over time, individuals with more fixed mindsets about remote work could be

placed on a downward trajectory in which effects exacerbate over time. Future studies with a longer time scale could help to address these and other important questions. For example, certain features of technologies might exacerbate or help to alleviate the initial impact of mindsets on productivity over time.

It should be noted that each weekly survey asked participants to recall their positive and negative emotions, as well as their productivity, over the course of the past week. This allowed us to track how participants' experiences may have changed as the pandemic continued over several weeks, without risking demanding excessive time from participants and associated survey fatigue (Porter, Whitcomb, & Weitzer, 2004). However, given that participants were asked to reflect on their past emotions, participants' reported emotions are subject to biases that exist in the recall of emotions (Levine & Safer, 2002). For example, particularly salient emotional experiences (e.g., a hostile conversation with a co-worker, an unexpected promotion) or more recent emotional experiences (e.g., the most recent task an employee was working on) may be weighed most heavily in the recall of emotions, leading participants to overestimate the extent to which they felt these emotions (Kahneman, 2000). The same biases may also have affected participants' recollections of their productivity. These cautionary notes notwithstanding, research does suggest that recollections of the intensity of experienced emotions are fairly accurate (e.g., showing correlations of $r=.50$ or higher) (Levine & Safer, 2002). In addition, we note that participants were instructed to recall the emotions that they felt while working over the past week, and cuing participants to focus on emotions at work may have helped to focus participants' reports on work-relevant emotions rather than emotions associated with extraneous events.

In the current study, we measured perceived productivity, which is often predictive of actual performance (Baruch, 1996). This allowed us to compare productivity across a variety of remote workers working at different organizations. However, it is an open question whether mindsets about remote work are predictive of job performance. Future studies that complement these findings by examining measures of objective productivity (e.g., quality or quantity of work produced) and/or supervisor perceptions of productivity and performance would also be beneficial. Technologies could also track objective productivity to shed further insight. Further, it should be noted that although the questions about productivity were similar to those used in other research on perceived productivity (e.g., Meyer et al., 2017), these questions were not validated and were selected for their brevity and simplicity.

Finally, research is needed to examine interventions to change a fixed mindset about remote work. Past research suggests that mindsets about a wide variety of attributes (e.g., intelligence, personality) are malleable and can be shifted, for instance by presenting people with evidence that these attributes can be changed and developed over time (Dweck & Yeager, 2019; Howe & Dweck, 2016; Wilson & Buttrick, 2016; Yeager & Dweck, 2012). Could encouraging employees who have a more fixed mindset about remote work to endorse more of a growth mindset forestall some of the negative effects observed in the current study? If so, then these interventions could be incorporated into employee experiences to improve work. Past research has suggested that prompting people to reflect on their behavior through self-monitoring can facilitate behavior change (Meyer et al., 2017), so developing tools that encourage people to reflect on what they learn about remote work could potentially help to strengthen growth mindsets.

5. Conclusions

Given the growing body of evidence suggesting that remote work enhances productivity, the future of remote work might seem bright. But our research identifies an important caveat: to transition successfully to remote work, employees need to believe that remote work is a skill anyone can acquire, rather than something for which certain kinds of people are either well or poorly-suited. Accordingly, to ensure this brighter future, organizations should consider how employee mindsets affect adjustment to remote work. Remote work may be readily embraced by employees who believe people can develop what it takes to work remotely, but risks disadvantaging those who view remote work as an immutable skill. Organizations that adopt strategies to cultivate adaptive mindsets among their employees, including growth mindsets about remote work, may help employees to thrive both in times of crisis and times of greater stability. And as technologies used in remote work become increasingly integral and sophisticated, as does their role in supporting the mindset necessary to ensure the success of remote work itself.

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Table 1. Means, standard deviations, and correlations between the study measures.

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8
<i>Between-level variables</i>										
1. Remote work mindsets	2.34	0.90								
2. Intelligence mindsets	2.96	1.20	0.24*							
3. Age	36.68	8.93	0.06	-0.01						
4. Gender	0.69	0.47	-0.02	-0.09	0.02					
5. Extraversion	4.49	1.09	-0.05	-0.06	-0.15	0.23*				
6. Agreeableness	5.83	0.60	0.02	0.06	0.13 ⁺	0.09	0.21 ⁺			
7. Conscientiousness	5.48	0.78	0.09	0.09	0.16	0.05	-0.09	0.10		
8. Neuroticism	3.84	0.93	-0.07	0.03	-0.11	0.28**	0.25*	0.22*	-0.13	
9. Openness to experience	5.05	0.73	-0.07	-0.18 ⁺	0.03	0.20 ⁺	-0.07	0.27*	-0.12	0.08
10. Work segmentation	4.10	1.49	0.10	0.09	-0.16	-0.15	0.31**	-0.08	0.02	-0.06
11. Children in household	0.57	0.95	-0.07	0.08	0.35***	-0.03	0.04	0.07	-0.11	0.12
12. Adults in household	1.94	0.58	-0.02	-0.18	0.06	-0.02	0.14	0.05	-0.01	-0.02
13. Have dedicated office space	0.54	0.50	-0.13	-0.06	0.13	-0.07	0.07	-0.10	-0.14	-0.11
14. Employment	0.23	0.42	-0.00	0.19 ⁺	-0.05	0.10	-0.25**	-0.17*	0.23*	0.25**
15. Education	5.91	0.84	0.03	-0.30***	-0.06	0.07	-0.06	0.10	0.11	0.08
16. Job hierarchy	1.91	1.36	-0.06	0.12	0.45***	-0.08	0.01	0.06	-0.06	-0.10
17. Income	3.80	1.76	0.04	0.12	0.37***	-0.40***	-0.17	-0.18	0.00	-0.21*
18. Prosocial motivation	5.32	1.14	-0.06	-0.10	0.28**	0.18	0.00	0.15	-0.01	0.09
19. Intrinsic motivation	5.56	1.05	-0.16	-0.33**	0.18 ⁺	0.19 ⁺	0.18 ⁺	0.07	0.22*	-0.16
20. Extrinsic motivation	4.32	1.24	-0.11	0.31**	-0.06	-0.23*	-0.04	-0.10	0.02	0.00
21. Family motivation	4.40	1.62	-0.24*	-0.05	0.45***	-0.12	-0.11	0.04	-0.05	-0.21 ⁺
<i>Within-level variables</i>										
1. Lagged negative emotion	2.40	0.88								
2. Lagged positive emotion	3.24	0.76	-0.16							
3. Same week negative emotion	2.33	0.86	-0.40***	-0.00						
4. Same week positive emotion	3.22	0.77	0.12	-0.38***	-0.29**					
5. Lagged productivity	0.01	0.92	0.06	-0.22*	-0.22*	0.34**				
6. Same week productivity	0.03	0.88	0.07	0.30**	-0.05	-0.09	-0.58***			
7. Measurement week	1.50	0.50	-0.25*	-0.04	-0.01	-0.02	-0.06	0.03	-0.12***	0.02

Note. $N_{\text{Between}}=87$ participants, $N_{\text{Within}}=174$ observations. + indicates $p < .10$, * indicates $p < .05$, ** indicates $p < .01$. M and SD are used to represent mean and standard deviation, respectively. Column numbers correspond to the variables as numbered in each row in the far left column (e.g., for the between-level variables, column 1 displays the correlations between remote work mindsets and the other between-level variables, and for within-level variables, column 1 displays the correlations between lagged negative emotion and the other within-level variables). Gender was coded as men 0, women as 1. Employment was coded as full-time 0, part-time 1. Education was coded as primary school 1, secondary school 2, apprenticeship 3, *matura* (high school) 4, bachelor degree 5, masters degree 6, and doctoral degree 7. Income was coded as less than 30,000CHF 1, 30,000-59,999CHF 2, 60,000-89,999CHF 3, 90,000-119,999CHF 4, 120,000-149,999CHF 5, 150,000-179,999CHF 6, More than 180,000CHF 7. Job hierarchy was coded as staff 1, management 2, middle management 3, senior management 4, CEO/owner 5. For the within-subject variables, we report repeated measures correlation coefficients (Bland & Altman, 1995) calculated using the *rmcorr* package (Bakdash & Marusich, 2018) in *R*, thus taking into account the fact that there were multiple measurements of these variables per participant.

Table 1, continued

Variable	9	10	11	12	13	14	15	16	17	18
<i>Between-level variables</i>										
9. Openness to experience										
10. Work segmentation	-0.21*									
11. Children in household	-0.17	-0.03								
12. Adults in household	0.12	-0.08	0.15							
13. Have dedicated office space	-0.26*	-0.13	0.05	0.23*						
14. Employment	-0.16	-0.15	0.28**	-0.09	0.01					
15. Education	-0.17	0.13	0.17	-0.15	-0.05	-0.07				
16. Job hierarchy	0.05	-0.20 ⁺	0.26*	0.16	0.01	-0.04	-0.10			
17. Income	-0.28**	0.23*	0.26*	0.06	0.08	-0.36***	0.15	0.24*		
18. Prosocial motivation	0.21*	-0.18	-0.02	-0.04	0.00	0.02	-0.01	0.14	-0.20 ⁺	
19. Intrinsic motivation	0.18 ⁺	-0.31**	-0.04	-0.01	-0.03	-0.06	-0.10	0.14	-0.16	0.45***
20. Extrinsic motivation	-0.20 ⁺	0.03	0.13	-0.12	-0.04	-0.07	0.12	-0.07	0.36***	-0.14
21. Family motivation	-0.11	0.07	0.37***	0.16	0.14	-0.20 ⁺	0.07	0.35***	0.31**	0.10

Note. $N_{\text{Between}}=87$ participants, $N_{\text{Within}}=174$ observations. ⁺ indicates $p < .10$, * indicates $p < .05$, ** indicates $p < .01$. *M* and *SD* are used to represent mean and standard deviation, respectively. Column numbers correspond to the variables as numbered in each row in the far left column (e.g., for the between-level variables, column 1 displays the correlations between remote work mindsets and the other between-level variables, and for within-level variables, column 1 displays the correlations between lagged negative emotion and the other within-level variables). Gender was coded as men 0, women as 1. Employment was coded as full-time 0, part-time 1. Education was coded as primary school 1, secondary school 2, apprenticeship 3, *matura* (high school) 4, bachelor degree 5, masters degree 6, and doctoral degree 7. Income was coded as less than 30,000CHF 1, 30,000-59,999CHF 2, 60,000-89,999CHF 3, 90,000-119,999CHF 4, 120,000-149,999CHF 5, 150,000-179,999CHF 6, More than 180,000CHF 7. Job hierarchy was coded as staff 1, management 2, middle management 3, senior management 4, CEO/owner 5. For the within-subject variables, we report repeated measures correlation coefficients (Bland & Altman, 1995) calculated using the *rmcorr* package (Bakdash & Marusich, 2018) in *R*, thus taking into account the fact that there were multiple measurements of these variables per participant.

Table 2. Unstandardized regression coefficients predicting employees' mindsets about remote work and mindsets about intelligence.

<i>Dependent variable</i>	Mindsets about remote work	Mindsets about intelligence
<i>Predictors</i>		
1. Age	0.02* [0.00, 0.05] (0.01)	
2. Neuroticism	-0.14 [-0.34, 0.06] (0.10)	
3. Intrinsic motivation	-0.18+ [-0.36, 0.00] (0.09)	-0.37** [-0.60, -0.15] (0.11)
4. Family motivation	-0.20** [-0.33, -0.07] (0.06)	
5. Employment	(0.15)	0.49+ [-0.06, 1.04] (0.27)
6. Conscientiousness		0.21 [-0.09, 0.52] (0.15)
7. Extrinsic motivation		0.29** [0.10, 0.47] (0.09)
Intercept	3.88*** [2.33, 5.43] (0.78)	2.51* [0.47, 4.55] (1.03)
Adjusted R^2	0.10	0.21
N	87	87

Note. + indicates $p < 0.10$, * indicates $p < 0.05$, ** indicates $p < 0.01$, *** indicates $p < 0.001$. 95% confidence intervals for regression coefficients are reported in brackets below each coefficient, and standard errors for regression coefficients are reported below each unstandardized regression coefficient in parentheses. Employment was coded as full-time 0, part-time 1.

Table 3. Unstandardized regression coefficients predicting employees' positive and negative emotions and felt productivity during remote work.

<i>Dependent variable</i>	Positive emotions (Weeks 1 and 2)	Negative emotions (Weeks 1 and 2)	Productivity (Weeks 2 and 3)
<i>Key predictors</i>			
1. Mindsets about remote work	-0.21** [-0.37, -0.06] (0.08)	0.20* [0.03, 0.37] (0.09)	0.03 [-0.10, 0.15] (0.07)
2. Lagged negative emotion	-	-	-0.23* [-0.44, -0.02] (0.11)
3. Lagged positive emotion	-	-	-0.10 [-0.30, 0.09] (0.10)
4. Same week negative emotion	-	-	-0.33** [-0.53, -0.11] (0.11)
5. Same week positive emotion	-	-	0.52*** [0.33, 0.71] (0.10)
<i>Within-level controls</i>			
1. Measurement week	-0.02 [-0.13, 0.09] (0.06)	-0.13* [-0.24, -0.02] (0.05)	-0.08 [-0.26, 0.10] (0.09)
<i>Between-level controls</i>			
1. Intrinsic motivation	0.25*** [0.13, 0.38] (0.07)		-0.14* [-0.26, -0.03] (0.06)
2. Family motivation	-0.09* [-0.17, -0.00] (0.04)	0.15* [0.05, 0.26] (0.05)	-0.01 [-0.09, 0.06] (0.04)
3. Neuroticism		0.36*** [0.19, 0.53] (0.09)	0.06 [-0.07, 0.18] (0.07)
4. Children in household		0.22* [0.04, 0.39] (0.09)	0.05 [-0.07, 0.17] (0.06)
5. Conscientiousness			0.09 [-0.05, 0.23] (0.08)
Intercept	2.71*** [1.78, 3.71] (0.50)	-0.06 [-1.11, 0.99] (0.55)	0.14 [-1.23, 1.50] (0.73)
<i>Marginal R²</i>	0.21	0.29	0.50
<i>N</i>	87	87	87

Note. + indicates $p < 0.10$, * indicates $p < 0.05$, ** indicates $p < 0.01$, *** indicates $p < 0.001$. The analyses include 87 participants who completed measures at all timepoints, but results are similar when all available data from 113 employees are used in analyses. 95% confidence intervals for regression coefficients are reported in brackets below each coefficient, and standard errors for regression coefficients are reported below each unstandardized regression coefficient in parentheses.

Figure 1. Employees' mindsets about remote work, but not employees' mindsets about intelligence, predict negative emotion and positive emotion experienced during remote work. * indicates $p < 0.05$, ** indicates $p < 0.01$. Error bars represent the standard error of the mean.

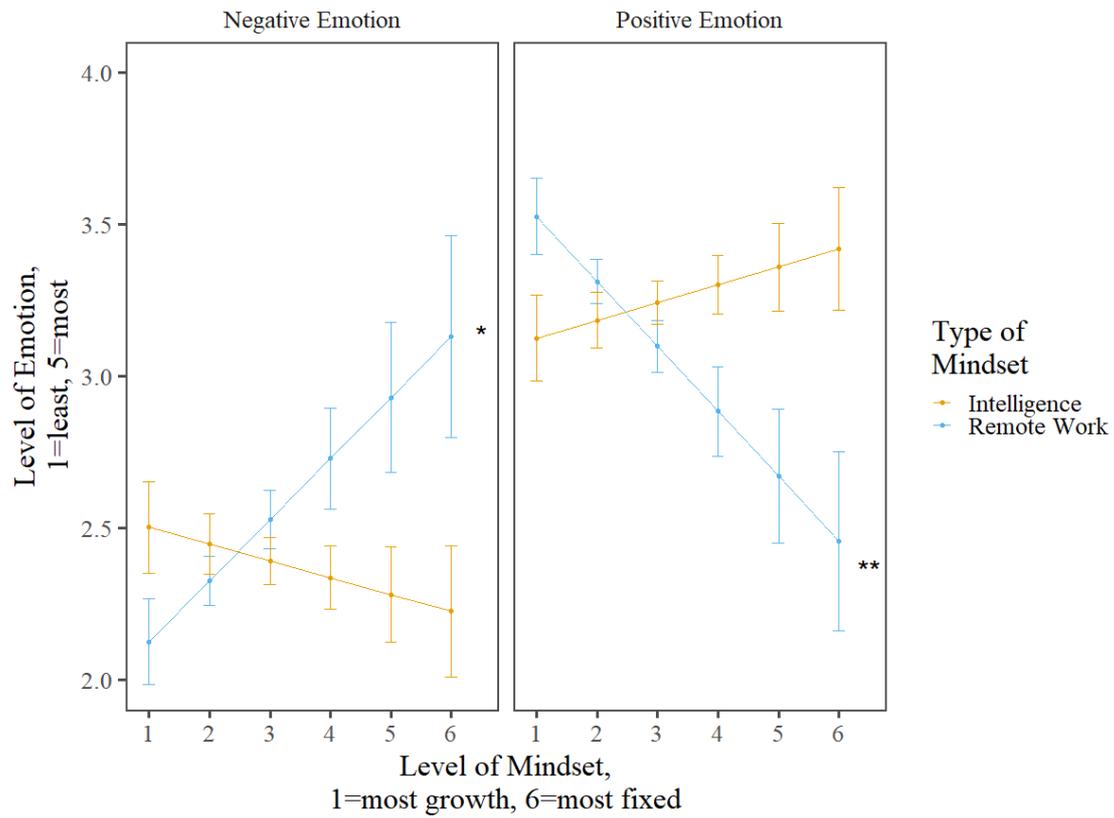


Figure 2. Employees who endorsed more fixed mindsets about remote work reported higher levels of negative emotion, which in turn predicted lower perceived productivity on subsequent weeks. * indicates $p < 0.05$, ** indicates $p < 0.01$, *** indicates $p < 0.001$. CI=confidence interval for the indirect effect.

