Remote workers' wellbeing in the age of COVID-19

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Abstract. *Social isolation measures used worldwide to reduce the impacts of COVID-19 led many office workers to work remotely with little notice. While researchers have studied remote collaboration for more than two decades, the scale and context of remote work during a pandemic is unprecedented and has changed personal and work dynamics. In this paper, we discuss a survey study investigating the impact of remote work during the COVID-19 pandemic in Brazil, informed by Olson & Olson's framework for distributed collaboration. We report preliminary findings from this study, focusing specifically on workers' wellbeing. Our results suggest that the main factors influencing workers' well beings are Common Ground Challenges, Collaboration Readiness, Collaboration Technology Readiness, Organizational Management, and Interruptions.*

1. Introduction

The COVID-19 pandemic has impacted workers globally. Preventative measures of social isolation led many companies to transition their employees into full time remote work in a very short time-frame [Brynjolfsson et al. 2020]. Working from home is possible for many knowledge workers due to technological resources such as videoconferencing, email, instant messaging, and access to shared documents and repositories. However, we have known since the 1980's that remote work is not trivial, as it impacts informal communications required for successful collaboration [Kraut et al. 1988, Allen 1977]. The transition to remote work often requires specific strategies [Olson and Olson 2000, Olson et al. 2008, Kozlowski and Ilgen 2006] and non-trivial coordination efforts with family members, work colleagues and others [Ciolfi et al. 2020].

Several researchers have investigated remote work in the last few decades, and found factors that mediate the success of remote collaborators such as collaboration readiness and common ground [Olson and Olson 2000, Bjørn et al. 2014]. They also identified that remote work can lead to additional challenges such as increased conflicts [Hinds and Bailey 2003]. However, the current pandemic represents a special context, since many workers started working from home by mandate. Indeed, adopting remote work with little advance notice might have impacted a transition process that typically involves several phases, including preparation [Hertel et al. 2005] and coordination with different stakeholders [Ciolfi et al. 2020]. Thus, several researchers have studied how the pandemic impacted work (e.g., [Bezerra et al. 2020]; [Ralph et al. 2020]; [Ford et al. 2020]; [Machado et al. 2020]).

Currently, entire organizations are working remotely. Social isolation also impacted individuals' personal lives by restricting services such as childcare, school, and

cleaning services. We believe these "special" circumstances may affect how individuals experience remote work because they also have to handle other aspects of their lives (e.g., home schooling or sharing office space with family members [Mark 2015]). In short, studying this mandatory remote collaboration among knowledge workers is an opportunity to learn what challenges they are facing so that they can be addressed in the future.

In this paper, we share preliminary results of a study investigating the impact of the sudden, mandatory remote work based on the perception of knowledge workers. We conducted a survey in Brazil, one of the countries most affected by COVID-19 [Lancet 2020], in the beginning of the social isolation period. Our survey was based on Olson and Olson's theoretical framework about distance work [Olson and Olson 2000].

2. Distributed Collaboration Framework

Our empirical study is based on a framework on distributed collaboration from Olson & Olson's seminal paper "Distance Matters" [Olson and Olson 2000]. This framework describes four major concepts associated to collaborative remote work: common ground, coupling of work, collaboration readiness, and collaboration technology readiness. Organizational management was later introduced as a fifth concept [Olson et al. 2008].

Each of these concepts refer to specific aspects required for the success of remote collaborative work. *Common Ground*, based on the process of grounding in communication [Clark and Brennan 1991], refers to a mutual understanding among collaborators, where individuals share information and understand each others' assumptions. Meanwhile, *Coupling of Work* refers to how interdependent the tasks of different collaborators are: tightly coupled work is more interdependent, requiring more communication, while loosely coupled work can be accomplished independently. Software development organizations have learned to minimize such coupling [Bjørn et al. 2014].

Collaboration Readiness encompasses attitudes and behaviors among collaborators, such as their motivation to engage in proactive communication. *Collaboration technology readiness* refers to challenges involved in adopting or using collaboration technology. This concept originally focused on challenges such as limited bandwidth and technology literacy, but as technological matured, this concept refers more to the effective use of existing technology to accomplish needed tasks [Bjørn et al. 2014].

Lastly, *Organizational Management* involves managerial, structural, and legal aspects of work, specifically, how they must be compatible with remote work [Olson and Olson 2013], as well as incentives to collaboration [Orlikowski 1992].

3. Research Methods

We collected data through an online survey, and utilized statistical methods to analyze the data. The survey consisted of 31 questions (available in https://github.com/clarac/distancesurvey/wiki) ranging from demographics to specific questions according to each dimension of the Olsons' framework. For instance, in the case of common ground, we asked about the effort required to be understood by colleagues and to handle conflicts. There were 1 to 3 questions for each of the five concepts to collect data on their multiple aspects. In addition, we included questions about the potential impact of interruptions due to remote work [Mark 2015]. In this paper, we present preliminary findings examining the relationships of wellbeing with such variables.

3.1. Survey design and data collection

We used an online survey that collected data over a 5-week period between April and May of 2020. All questions were phrased as comparisons between the period of remote work during the current pandemic and before the pandemic. An initial draft of the questions went through a pilot phase. Based on feedback from initial pilot participants, we revised the questions and launched the survey.

The respondents were recruited through posts on the authors' LinkedIn accounts and direct messages by email. We also asked informants to share the survey with other potential respondents in a snowballing process. We were not able to track the total number of individual people who saw the recruitment post. We received a total of 401 responses, and 366 of them were determined to be valid. Removed data either did not meet the study criteria (i.e., work remotely during the pandemic) or were repeated data from the same individual. Among the respondents, 164 were women, 197 were men and 5 did not specify a gender. Their ages ranged from 20 to 66 (median=36). Most participants (N=245) had technology-related job titles (e.g., software engineer, product manager).

We use wellbeing as an indicator of how different aspects of the emergency remote work and organization measures impacted workers. We collected data about wellbeing from a multiple choice question that prompted participants to choose an option that best described their state of mind in a list of four positive (e.g., comfortable) and four negative (e.g., concerned) options. This question also allowed for a custom response. We classified all answers in a binary field indicating wellbeing as positive (N=222) or negative (N=144).

3.2. Data analysis

We used SPSS statistics to analyze the data. For the constructs composed by more than one indicator (first order constructs) common ground, collaboration readiness, collaboration technology readiness, and interruptions, we conducted a confirmatory factor analysis (CFA) using covariance-based structural equation modeling (CB–SEM). The four-factor confirmatory measurement model presented very acceptable fit (j2 / df = 2,567; goodness of fit index = ,931; incremental fit index = ,952; comparative fit index = ,951; root mean square error of approximation = ,066) according to [Hair et al. 1998]. To assess discriminant validity, we contrasted the squared correlation of each factor pair with the variance extracted from each factor [Fornell and Larcker 1981]. In each case, the average variance extracted (AVE) exceeded the squared correlation, supporting discriminant validity. Cronbach's alphas and composite reliability (CR) scores for the four constructs were above 0,70, and AVEs values were all greater than 0,50, like recommended by [Hair et al. 1998] as a condition for internal reliability. We than used item parceling for the analysis following the total aggregation procedure suggested by [Bagozzi and Heatherton 1994] for the four constructs. In this sense, each first order construct was considered an observable variable by computing the average of its statements.

We did not conduct a confirmatory factor analysis for two concepts: Organizational Management and Coupling of Work. In the first case, we provided a list of incentives and the participants could select which ones were being adopted by their organizations and include new ones. Therefore, this variable reflects and index which includes the sum of the total number of incentives the participant's organization offered during the social isolation period. Similarly, the concept of Coupling of Work was obtained through a sin-

gle question about the number of high dependency tasks the participants had to deal with. Each of the concepts from the Olsons' framework alongside with the concept of interruption were summarized into one single variable. In the rest of the paper we represent the results of these concepts in one single value.

Specifically, we conducted t-tests comparing groups with positive or negative wellbeing on a range of different variables. These variables included the theoretical concepts discussed in the previous section and other variables that we collected and that might impact wellbeing. We organize these variables by different levels, as explained below:

- **City**: external factors caused by the progress of the pandemic by number of cases and number of deaths by city.
- **Organizational Factors:** that are particular to the organization: size (i.e., number of employees), domain, level of distribution (collocated, offices in several cities in the same country, offices in different countries), Collaboration Technology Readiness, and Organizational Management (measured by the number and types of incentives provided by the organization).
- **Team Factors:** reflect or impact a team: Coupling of Work, Collaboration Readiness, and Interruption Level.
- **Individual Factors:** particular to the individual: Common Ground Challenges, Prior Remote Experience, Days Working Remotely, Age.

In addition, we also conducted t-tests focused specifically on the concept of Organizational Management. For this analysis, we classified measures taken and incentives given to address the remote work into the following groups:

- **Organizational:** Changes in performance expectations and evaluation or in leadership.
- **Team:** Resources or incentives for team engagement, e.g., virtual happy hour, changes in meetings, etc.
- **Individual:** Gifts, schedule flexibility, etc.

These analyses allowed us to investigate what differentiates workers with positive and negative wellbeing while working remotely influenced by their emotional stability (that is, a negative wellbeing person's when s(he) is frustrated or positive when person is motivated) and report nuanced results.

4. Preliminary Findings

In this section, we provide evidence of variables linked to worker wellbeing. We find that factors in the levels of the organization, team, and individual have significant relationships with wellbeing. We also discuss how workers who received organizational management incentives differ from workers who not receive incentives during the pandemic.

4.1. Wellbeing and theoretical concepts

Figure 1 displays the results for the first set of t-tests. First, at the city level we find no difference between the two groups for either variable (local COVID-19 cases and deaths). We expected that the progress of the pandemic would influence wellbeing, as the increase in cases could create greater concerns or represent a higher likelihood of impact on a

family member or friend. The non-significant results might be due to the time period when the survey was deployed – the beginning of the social isolation period. Another possible explanation is that risk perceptions and concerns might not increase in tandem with the number of cases reported, as perceived risks might differ from actual risks [Slovic 2000].

On the organizational level, two variables showed significant results. Those with positive wellbeing have significantly higher Organizational Management and Collaboration Technology Readiness. In other words, the organizations of those respondents took more measures to address the transition into remote work, and they experienced less challenges with the newly adopted technologies. These results indicate a relationship between positive wellbeing and the measures taken by the organization to transition into remote work, both in terms of what technologies it adopted to facilitate how the remote work was conducted and incentives provided to employees to increase worker satisfaction, or at least, minimize the impact of the pandemic. For instance, practices that encourage coworkers to take virtual breaks together, to change the frequency and schedule of meetings, and to establish a limited time to finish their workday. While these measures and their impact would likely vary depending on the organization and the nature of the work, these results highlight the importance of such decisions. Regarding the technologies, the most used were video conferences, shared screen/workspace, real-time messaging, cloud-based tools, etc for employees to conduct their day-to-day work.

Level	**Variable**	**Wellbeing**	**N**	**Mean**	**Std. Dev.**	***t***	**Sig.**
City	Acumulated COVID-19 cases	Negative	135	4160.58	7813.250	.304	.762
		Positive	210	3906.94	7412.065		
	COVID-19 Deaths	Negative	135	327.59	660.351	.265	.791
		Positive	210	308.93	622.873		
Organization	**Collaboration Technology Readiness**	Negative	144	2.75	.643	-4.930	.000
		Positive	222	3.11	.685		
	Organization Management	Negative	144	3.17	1.690	-3.002	.003
		Positive	222	3.79	2.214		
	Company Size (Ln)	Negative	138	12349.61	47059.974	-.774	.439
		Positive	216	18473.47	84932.099		
Team	Coupling of Work	Negative	144	3.14	.987	.501	.617
		Positive	222	3.09	.779		
	Interruption Level	Negative	144	3.56	1.361	7.214	.000
		Positive	222	2.57	1.230		
	Collaboration Readiness	Negative	144	3.64	.833	-5.790	.000
		Positive	222	4.11	.637		
Individual	Days Working Remotely	Negative	144	41.89	16.331	-.749	.455
		Positive	222	43.45	21.205		
	Prior Remote Experience (days)	Negative	144	255.07	940.706	.028	.978
		Positive	222	252.57	767.405		
	Common Ground Challenges	Negative	144	3.79	.605	6.813	.000
		Positive	222	3.33	.634		
	Age	Negative	144	36.35	8.080	-1.132	.258
		Positive	222	37.40	8.986		

Figura 1. T-tests results for variables in a likert scale ranging from 1 to 5.

In terms of team-level factors, we find that individuals with positive wellbeing have higher Collaboration Readiness and lower levels of interruptions, i.e., a lower number and duration of interruptions. However, we find no significant difference in terms of changes in Coupling of Work, a surprising result as this concept influences success in distributed collaborations [Olson and Olson 2000]. Differences in the other two variables are expected (e.g., interruptions can negatively impact mood and stress levels [Mark 2015], and indicate that both of them are important aspects of remote work during a pandemic.

Lastly, we find no difference in most individual level variables. Prior experience with remote work and the time since social isolation started did not differ significantly among individuals with positive and negative wellbeing. We expected, instead, that those with higher experience in remote work would have more positive wellbeing due to a less impactful transition to working from home. This is an aspect that we plan to explore during the interviews and future work. On the other hand, Common Ground challenges are significantly higher among those who have negative well-being. In this case, we used a 5-point Likert scale to measure the extent to which the informant reported to face challenges to achieve common ground. Therefore, the higher the average, the more challenges (s)he faced. This relationship likely reflects higher stress or effort among those who struggle to achieve common ground with remote collaborators.

In general, all but one theoretical concept tested (Coupling of Work) showed significant differences among groups with positive and negative wellbeing. These results provide evidence of the influence such factors have on workers, even in the specific context of emergency remote work. A possible explanation for the Coupling of Work results is that, as Bjorn et al [Bjørn et al. 2014] have reported, software development organizations have learned to change the way they work to minimize coupling, and most of our respondents worked in information technology organizations.

Among all other variables tested, only the interruption level (i.e., quantity and duration of interruptions) has a significant relationship with wellbeing. Interruptions might be more impactful in the context of social isolation, since there are important differences between normal remote work and that in the context of social isolation, including closed schools and reduced availability of childcare services. For example, individuals who have kids at home might face more challenging [Mark 2015] (e.g., coordination and time management) to balance their professional and family lives.

4.2. Differences in wellbeing by organizational incentives

As one can expect, an organization's ability to influence team- and individual-level factors is limited. However, in our survey the concept of Organizational Management directly measures initiatives that are within the control of an organization. We focused specifically in the incentives offered by the organizations to address emergency remote work during the pandemic. To further investigate these incentives, we conducted a second set of *t-tests* among groups with positive and negative wellbeing by types of incentive: individual, team, and organization. Figure 2 shows the results of these tests in detail.

		Levene's Test Eq. of Variances		t-test for Equality of Means						
Incentive	Eq. variance	F	Sig.	t	df	Sig. 2-tailed	Mean Diff.	Std. Error	95% Conf. Int. Lower	95% Conf. Int. Upper
Individual	assumed	.255	.614	-.576	364	.565	-.038	.065	-.166	.091
	not assumed			-.579	310.5	.563	-.038	.065	-.165	.090
Team	assumed	8.452	.004	-2.766	364	.006	-.355	.128	-.608	-.103
	not assumed			-2.846	333.5	.005	-.355	.125	-.601	-.110
Organization	assumed	3.447	.064	-1.243	364	.215	-.146	.117	-.377	.085
	not assumed			-1.287	338.9	.199	-.146	.113	-.369	.077

Figura 2. Second set of t-tests by types of organization incentives.

Among the three types of incentives, only team incentives resulted in a significant relationship with wellbeing. While we expected all three kinds of incentives to impact wellbeing, it is not surprising to find particular importance in team incentives. These measures (e.g., providing opportunities for virtual social interaction among co-workers) likely have the ability to impact common ground, interruption level and collaboration readiness which in turn, have been shown to be aspects that influence well-being.

5. Conclusion

In this study, we report the impact of remote work during the early period of social isolation caused by the COVID-19 pandemic. We collected data through a survey informed by Olson & Olson's theoretical framework [Olson and Olson 2000], [Olson and Olson 2013] with knowledge workers in Brazil. Preliminary results demonstrate significant relationships between worker wellbeing and Collaboration Technology Readiness, Organization Management, Common Ground Challenges, Collaboration Readiness, and Interruption Level. Further, organizational incentives were beneficial to wellbeing.

Our study has limitations. We used a convenience sample based on the authors' social networks. This explains why most of the sample is composed of IT professionals. Finally, we do not know if we would observe similar patterns if the workers suffer mentally and are emotionally exhausted during our window of observation or if they had more time to prepare for remote work. We plan to conduct additional research, including new surveys and interviews, to study worker wellbeing over time.

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