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The impact of remote work and mediated communication frequency on isolation and psychological distress

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ABSTRACT

A massive shift towards remote work practices has presented many organizations and employees with acute challenges associated with multi-locational work. This shift underscores the need to reconsider isolation as one of the focal challenges of organizations in an era of increasingly dispersed and mediated work practices. This study relies on a three-wave survey among Finnish workers to investigate how remote work practices and the use of information and communication technology (ICT) have impacted perceptions of isolation during the global health pandemic, and whether these relationships have an effect on psychological distress. The findings indicate that facilitating the use of ICTs may help organizations and employees combat isolation, while simultaneous increases in remote work practices lead employees to feel more isolated. In addition, the findings highlight a reciprocal effect between psychological distress and isolation, suggesting that strain may both increase perceptions of isolation and be a result of being isolated.

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Remote work; isolation; psychological distress; mediated communication; ICT use

Isolation is often cited as a key challenge for individuals in remote work environments (Mulki & Jaramillo, 2011), such as virtual teams (Orhan et al., 2016), homeworkers (Lal & Dwivedi, 2009), and teleworkers (Cooper & Kurland, 2002). The consequences may be severe, as isolation could lead to disengagement, low job satisfaction, reduced wellbeing and poor performance (Marshall et al., 2007). To reduce remote workers' perceptions of physical isolation, research suggests that organizations and managers should promote face-to-face (FTF) interactions with and between colleagues (Gajendran & Harrison, 2007; Golden et al., 2008). In global contexts, occasional site visits are often recommended to strengthen interpersonal relationships (Nurmi & Hinds, 2020). In remote work, spending more than 2.5 days per week working remotely is found to lead to the deterioration of workplace relationships (Gajendran & Harrison, 2007).

In addition, frequent mediated communication may help to overcome some of the challenges remote workers experience (Nurmi & Hinds, 2020) as these technologies can prove to be valuable resources for employees (Ter Hoeven et al., 2016). However, restrictions and lockdown measures due to the global health pandemic (Covid-19) have placed additional constraints on work modalities, forcing everyone to conduct their work tasks virtually, often inhibiting FTF office work. Existing knowledge on remote work can be questioned in an extraordinary pandemic context (Wang et al., 2021). Hence, the context of the pandemic presents a unique opportunity to understand the (opposing) implications of remote work and mediated communication frequency for remote worker experiences. This study examines the impact of remote work under these conditions on perceptions of physical isolation and psychological distress.

In doing so, we seek to make several contributions. First, empirical evidence on the relationship between remote work frequency and isolation is far from univocal. Although some studies have presented evidence supporting the relationship between remote work frequency and isolation (Charalampous et al., 2019; Cooper & Kurland, 2002), others have found that individuals working at home experience the highest levels of inclusion (opposite of isolation; Morganson et al., 2010). Other studies have not demonstrated a significant relationship between remote work frequency and isolation, even under conditions of extensive remote work (Bentley et al., 2016; Golden et al., 2008; Montreuil & Lippel, 2003). Often research suggested that these challenges can be effectively managed through information and communication technology (ICT) use that facilitate remote work (Lal & Dwivedi, 2009; Sewell & Taskin, 2015; Ten Brummelhuis et al., 2012). Although studies have been conducted on interventions to prevent isolation among elderly people through the use of ICTs (Chen & Schulz, 2016) and on the ways ICT use can reduce isolation of homeworkers by facilitating access to work (Hislop et al., 2015), longitudinal research on the impact of mediated communication on isolation in remote work settings is scarce. Our study contributes to this literature by testing the lagged impact of remote work frequency on isolation, and the role of mediated communication frequency.

Furthermore, we contribute to a better understanding of the potential implications of remote work. For instance, we contribute by examining the causal relations between job stressors (here: isolation) and strain (here: psychological distress) triggered by remote work and mediated communication frequency. The longitudinal design allows for a more nuanced

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understanding than would be possible with cross-sectional studies as reciprocal effects can be analysed simultaneously – i.e. *stressor-effects* and *strain-effects* (Guthier et al., 2020). Although many studies have attempted to probe at the causal relationships between work-related stressors and wellbeing outcomes, a recent meta-analysis demonstrates that the reverse relationships are often stronger (Guthier et al., 2020). Hence, this study also explicitly considers reversed and reciprocal causal models.

Finally, in a context of global pandemic we demonstrate what happens to employees' perceptions of isolation with remote work mandates and the possibility to communicate only through ICTs over a prolonged time. This study is important, as physical isolation is increasingly common, especially under circumstances of social distancing and remote work mandates; however, contemplating or worrying about it is still a shameful topic that is often stigmatized, trivialized, and ignored (Wright & Silard, 2021). Ultimately, the effects of isolation on employees' wellbeing as well as the potential of mediated communication practices to reduce isolation can inform in making effective and sustainable workplace designs and interventions far beyond the pandemic.

Theoretical framework

The importance of social relationships in the workplace is often explicitly recognized in studies of human motivation (Ryan & Deci, 2000) and job design (Grant, 2007). Employees' belongingness to an organization is constructed through different resources, such as their daily social interactions and exchanges with their peers and supervisors. The shift to remote work has reduced opportunities for such social interaction, including support and feedback (Golden & Veiga, 2008), especially during the pandemic with even fewer opportunities for FTF interactions (Hwang et al., 2020). Although isolation is a multidimensional concept (Bartel et al., 2012; Marshall et al., 2007; Orhan et al., 2016), typically referring to professional, social, or physical isolation (Beauregard et al., 2019), we focus on isolation as a perception of physical separation between co-workers. Physical separation was one of the focal points in the initial efforts of the Covid-19 pandemic to contain the virus and flatten the curve. Across the globe organization and governments mandated remote work practices leading to an abrupt shift in work locations, and the physical separation of organizational members (Brooks et al., 2020; Dwivedi et al., 2020). Similarly, Orhan et al. (2016) discuss that perception of isolation is caused by physical distance, and may logically flow from situations where people are not co-located, and Bartel et al. (2012) recognize that physical isolation is a key challenge in virtual work settings. Hence, this study focuses specifically on the perceptions of physical isolation.

The effects of physical isolation can be studied by building on the belongingness hypotheses proposed by Baumeister and Leary (1995). According to the theory, people have an intrinsic drive to form and maintain interpersonal relationships, and frequent contact to others is used to facilitate belongingness and cultivate relationships. Studies have suggested that individuals are motivated to maintain both general belongingness and more specific belongingness to different coalitions (Leary & Cox, 2008). Such context-specific belongingness (such as belonginess to a work group or organization) has been shown to be separable from a more general sense of belonging (Cockshaw et al., 2013). Thus, belongingness hypothesis provides a suitable theoretical framework for studying (physical) isolation in the context of other types of (physical) isolation measures due to a global pandemic.

Although not all remote workers report being isolated, studies have identified physical isolation as a key problem associated with such job designs and an often-cited source of detrimental outcomes (Cooper & Kurland, 2002; Golden et al., 2008; Larson et al., Larson, et al., 2020, March 18; Orhan et al., 2016). Importantly, even though remote work may create conditions that are potentially detrimental to social relationships, individual employees can take initiative to decrease isolation and counterbalance the negative impact of physical dispersion (Charalampous et al., 2019; Gajendran & Harrison, 2007). Research has shown that the mere opportunity for conversation created by the availability of clear communication channels may serve to generate conversations in work settings (Kraut et al., 1990), and in times of excessive remote work during the pandemic, it is more likely that mediated communication possibilities are also utilized.

ICT use to communicate with co-workers can be seen as a resource (Ter Hoeven & Van Zoonen, 2020) as mediated communication can be functional in achieving work goals and reduce job demands (Schaufeli & Bakker, 2004) surfacing from the distance to co-workers in remote work settings. By reducing the psychological costs (feelings of being separated and alone), mediated communication can help to reduce the percecptions of isolation under the constraints of a pandemic, where employees may have fewer options to avoid excessive remote work. Similarly, Greer and Payne (2014) suggest that the use of communication technologies could compensate for missing elements of human interaction and thereby help overcome some of the social challenges associated with the physical separation of workers. Hence, we hypothesize the following direct effects:

H1: Remote work frequency at T1 increases perceptions of isolation at T2 and, similarly, from T2 to T3.

H2: Mediated communication frequency at T1 reduces perceptions of isolation at T2 and, similarly, from T2 to T3.

However, the extent to which mediated communication is sufficient to remedy the problem of isolation in remote work is not clear. Some studies found that remote workers used mobile devices to stay connected to colleagues to overcome professional isolation (Lal & Dwivedi, 2009). In the context of global work and in the absence of site visits, Nurmi and Hinds (2020) demonstrated that more frequent communication though various platforms – email, telephone, teleconferencing, videoconferencing, virtual conferencing, and instant messaging – allowed global workers to maintain interpersonal relationships. In contrast, other studies could not confirm that ICT use improved social presence among remote workers (Fonner & Roloff, 2012). Although some technologies approach the richness of FTF communication, they are typically not equal to it

(Golden et al., 2008; Straus & Olivera, 2000). Orhan et al. (2016) also indicate the necessity of FTF interaction to reduce isolation. Still, studies on remote work highlight the potentially mitigating impact of communication technology use (Ten Brummelhuis et al., 2012; Ter Hoeven & Van Zoonen, 2020), and research on the belongingness hypothesis (Baumeister & Leary, 1995) seems to suggest that while remote work increases perceptions of isolation, the frequency of mediated communication can reduce it. Thus, we hypothesize an interaction between remote work frequency and mediated communication frequency on isolation.

H3: The impact of remote work frequency at T1 on isolation at T2, is moderated by mediated communication frequency at T1, such that it mitigates this impact, and similarly from T2 to T3.

Isolation and psychological distress

Psychological distress in a workplace setting can be characterized by feelings of unhappiness and a negative affect, typically attributed to work-related stress (Bowen et al., 2018). In general, isolation due to physical distancing during the COVID-19 has been found to impact psychological distress, especially for older adults (Gorenko et al., 2020) and front-line employees such as medical staff (Van Zoonen & Ter Hoeven, 2021). Research among healthcare professionals has suggested that social isolation contributes to distress (during the SARS outbreak) and that interventions should be targeted at the mediators of psychological distress, including isolation (Aiello et al., 2011).

However, these findings are not exclusive to frontline workers during a pandemic but can affect professionals across occupational groups (Tuzovic & Kabadayi, 2020). In a review, Tuzovic and Kabadayi (2020) suggested that the shift to remote work and (self-)isolation may lead to feelings of loneliness and mental health problems while research among teleworkers has also demonstrated that isolation may increase psychological strain (Bentley et al., 2016). Isolation has been associated with increased levels of stress and depression in the workplace both before (Mann & Holdsworth, 2003) and during the COVID-19 (Killgore et al., 2020). Organizational membership has been recoqnized as important for various reasons, especially to provide social support and norms for behaviour and to enable individuals to reach goals that are otherwise impossible or much more difficult to achieve (Beehr et al., 2000). As such, isolation may be a source of stress, as employees are deprived of access to valuable (social) resources (Marshall et al., 2007). Similarly, isolation among workers is found to increase exhaustion and reduce engagement, two important indicators of occupational wellbeing (Bentein et al., 2017).

Although relationships do not need to be FTF to fulfil belongingness needs, physical separation from co-workers has been found to decrease the availability of opportunities to forge social connections and increase perceptions of isolation (Cooper & Kurland, 2002; Perry et al., 2018). Cooper et al. (2001) suggest that the absence of support from co-workers, (i.e. isolation), can be a major stressor for workers. Ultimately, isolation experienced by remote workers may result in weaker affective ties, unfulfilled social belongingness needs and fewer resources (Colbert et al., 2016) leading to increased psychological distress. Hence, we hypothesize:

H4: Perceived isolation at T1 increases psychological distress at T2 and, similarly, from T2 to T3.

H5: Remote work frequency at T1 increases psychological distress at T3 through perceived isolation at T2.

However, mediated communication frequency with colleagues can operate as a resource when employees experience psychological distress during remote work. According to the resources and demands model applied to the context of ICT use (Schaufeli & Bakker, 2004; Ter Hoeven et al., 2016), mediated communication is negatively related to detrimental wellbeing outcomes, as it enhances communication efficiency and accessibility between colleagues. This way, mediated communication can have a health-promoting effect and thus, reduce psychological distress by decreasing perceived isolation.

H6: Mediated communication frequency at T1 reduces psychological distress at T3 through perceived isolation at T2.

Methods

Procedure and sample

This study was initiated shortly after the first lockdown measures were instated in Finland on 16 March 2020 in response to the COVID-19 outbreak. The first round of data (March 26th – April 15th) was collected using a convenience sampling method during which we also solicited contact details from respondents to contact them for follow-up studies. Open survey invitations were published online, and we solicited the help of several large labour unions and ministries to distribute the survey link to their members and employees. We used personalized reminders and forced response options in our survey tooling to avoid item and construct level missing data. As reflected in the response rates described below, non-response led to person level missing data across waves. The sampling procedure resulted in an initial response of 5,452 Finnish employees, of which 3,184 provided their contact details and consent for the follow-up studies. During the second round of data collection (May 8th – May 23rd) these 3,184 respondents were invited and 1,895 returned a completed survey (response rate $= \left(\frac{total\ responses\ T2}{total\ responses\ T1}\right) x\,100 = 34.76\%$; $\left(\frac{totalresponsesT2}{totalinvitedforT2}\right) x100 = 59.5\%$). The third round of data collection (September 28th – October 13th) among the participants who were still in the study, yielded a response of 1,164 completed surveys (response rate is $\left(\left(\frac{total\ responses\ T3}{total\ responses\ T1}\right) x\,100 =\right.$

Table 1. Correlations and descriptive statistics.

	Mean (Sd)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Mediated communication (T1)	3.01 (0.72)																		
2. Remote work frequency (T1)	6.78 (0.89)	.043																	
3. Isolation (T1)	4.34 (1.31)	−.059	.206*																
4. Psychological distress (T1)	3.05 (0.66)	−.020	.053	.346*															
5. Mediated communication (T2)	2.94 (0.70)	*.759*	.035	−.057	.034														
6. Remote work frequency (T2)	6.76 (0.90)	.048	*.837**	.189*	−.050	.036													
7. Isolation (T2)	4.49 (1.30)	−.091	.191*	*.639**	−.324*	−.092*	.205*												
8. Psychological distress (T2)	3.18 (0.70)	.039	.038	.363*	*.639**	−.034	.037	.423*											
9. Mediated communication (T3)	2.87 (0.69)	*.712*	−.001	−.077*	.047	*.715**	.027	−.114*	.061*										
10. Remote work frequency (T3)	6.43 (1.23)	.058	*.725**	.127*	.003	.060*	*.756**	.126*	.042	.053									
11. Isolation (T3)	4.34 (1.38)	−.076	.127*	*.543**	−.285*	−.075*	.119*	*.634**	−.367*	−.096*	.126*								
12. Psychological distress (T3)	3.22 (0.72)	−.053	.086*	.334*	*.521**	−.031	.092*	.347*	*.651**	−.102*	.023	.386*							
13. Gender	1.80 (.047)	−.105	−.031	−.008	−.036	−.078*	−.018	.051	.019	−.113*	−.020	.049	−.002						
14. Age	46.45 (10.27)	.040	−.031	−.132*	.044	.031	−.032	−.087*	.097*	.007	−.011	−.098*	.107*	−.086*					
15. Work hours	38.01 (5.90)	.123	.084	−.011	.032	.088*	.068*	−.026	.058	.114*	.060*	−.003	.029	−.038	−.001				
16. Tenure	11.07 (10.05)	.007	−.009	−.090*	.013	.024	−.014	−.089*	.076*	−.004	−.003	−.064*	.075*	−.021	.563*	.024			
17. Household size	2.47 (1.20)	.010	.008	−.016	−.024	.035	−.013	−.037	.002	.065*	−.001	.021	.009	−.024	−.120*	−.038	−.071*		
18. Remote office	1.69 (0.46)	.040	−.084	−.169*	.123*	−.004	−.082*	−.128*	.140*	.001	−.081*	−.136*	.150*	−.031	.147*	−.038	.077*	.113*	
19. Remote work before pandemic	2.91 (1.44)	.014	.220*	−.139*	−.095*	.019	.215*	−.102*	−.087*	.044	.291*	.021	−.087*	−.006	−.005	−.042	−.006	.011	.109*

Note: Values in italics represent stability coefficients of the same constructs across waves. Significant correlations are flagged *.

21.35%; compared to invited $\left(\frac{total\ responses\ T3}{total\ invited\ for\ T3}\right) x\ 100$ 61.42%;). The analyses rely on respondents that completed all waves (n = 1,164).

Research suggests that the optimal time lag depends on the nature of the constructs, the underlying temporal process, and the context in which variables of interest are expected to influence the nature and rate of change (Dormann & Griffin, 2015). Several considerations were taken into account when deciding on the time lags for this study. The longer time lag between T2 and T3, compared to T1 and T2, is because we tried to keep in pace with the regulations and outbreak responses. The situation at the end of September was similar to the situation in March – May in terms of regulations and the overall severity of the pandemic. Hence, practical considerations were taken into account as the trajectory and duration of the pandemic was uncertain (Dormann & Griffin, 2015). In addition, we attempted to reduce potential dropout during the summer months. The relatively short time lags seemed appropriate here as research has called for more "shortitudinal" research designs (Dormann & Griffin, 2015). Research on concepts related to psychological wellbeing have been shown to be affected on time horizons as short as one month (Daniels & Guppy, 1997), or one week (Muntz & Dormann, 2020).

The respondents were predominantly female (76.6%); 23.3% were male. The average age of the respondents was 46.45 years (*SD* = 10.27). The respondents reported an average organizational tenure of 11.07 years (*SD* = 10.05) and an average workweek of 38.01 hours (*SD* = 5.90). Only 11.7% of the respondents indicated that they held managerial positions. Most of our respondents worked in the public administration sector (45.3%); other sectors included support services (10.2%), professional services (9.1%), information and communications (8.1%), education (5.1%) and manufacturing (4.6%), among others. Interestingly, a large majority of the respondents (77.7%) indicated that they assessed the probability of job loss due to the crisis as highly improbable. In terms of social demographics, most of the respondents were part of two-person households (42.4%); others were part of one-person (19.8%), three-person (16.2%) or four-person (15.1%) households. In total, 34.3% of the respondents had at least one child (< 18 years) living at home.

Measures

The correlations and descriptive statistics are reported in Table 1.

Mediated communication refers to the frequency with which various ICTs are used for interactions with colleagues. We assessed the frequency with which email, phone calls, online conferencing, text or instant messaging, enterprise social media, and collaboration tools were used over a two-week period (Hoch & Kozlowski, 2014; Kacmar et al., 2003). Responses concerning individual technologies were summed to an overall index of mediated communication frequency. Higher scores indicate greater frequency of mediated communication with colleagues (1 [no mediated communication with colleagues] to 6 [daily communication with colleagues]). In line with Park et al. (2011)we consider the index to be a formative indicator scale because individual items are not parallel forms of the same underlying construct such as for instance, the psychological distress scale (see also Bollen & Lennox, 1991). This approach follows previous work on communication technology use in remote work context (Hoch & Kozlowski, 2014; Kacmar et al., 2003; Park et al. 2011).

Remote work refers to the frequency with which employees work from home. Remote work frequency was measured using one item, "How often have you worked remotely during the COVID-19 pandemic?" The responses ranged from 0 (never) to 7 (six or seven days per week). Though respondents were not required to work more than five days, in the context of the pandemic employees may spread their workload over multiple (shorter) workdays, including weekends. On average only about 4.3% of our respondents indicated spreading their remote work practices across six or seven workdays. An average of 77.2% of respondents worked remotely five days per week.

Isolation was measured by adopting four items from Orhan et al. (2016) used to assess physical isolation. We define physical isolation as employees' perceptions of separation and physical isolation from colleagues (Bartel et al., 2012; Beauregard et al., 2019); respondents were instructed to evaluate the following items in the context of work: "I am separated from others whom I work with", "I often feel I am no longer close to anyone", "I miss having people around me" and "I am isolated from others I work with." The responses ranged from 1 (strongly disagree) to 7 (strongly agree).

Psychological distress was measured using five items from the general health questionnaire (GHQ-12; Goldberg, 1972) previously used by Bordia et al. (2004). The GHQ-12 has been widely used to screen for general psychological health or psychological distress (Wang & Lin, 2011) in general samples and among employees (Avey et al., 2010) specifically at times of organizational change (Bordia et al., 2004). The respondents were prompted to denote the extent to which they had experienced strain symptoms by comparing their work experiences at the present to their usual experience (i.e., before the pandemic). The items included "to what extent have you felt capable of making decisions about things?" The responses ranged from (1) "much less than usual" to (4) "much more than usual" but were recoded so that higher scores indicated more psychological distress. This approach follows previous longitudinal investigations of distress among Finnish workers in the context of organizational change (Kinnunen et al., 2004).

Control variables

We included household size and remote office characteristics (e.g., presence of a separate home office). In addition, age, gender, and organizational tenure have been found to affect workplace relationships more generally, in that older employees with longer organizational tenure indicate more established relationships (Akkirman & Harris, 2005). Finally, we included remote work before the pandemic experience as control variable, as these experiences may influence the impact of remote work frequency and mediated communication practices during the pandemic. Inspection of the correlations between these control variables and the study concepts indicate that especially remote work before the pandemic and

access to a remote office seem to correlate significantly with the central concepts in our study. As such these controls were included in the analyses used to test our hypotheses.

Analytical approach

Data was analysed in AMOS using a full cross-lagged panel design, meaning that all variables were measured at all three time points. We first estimated the measurement model using confirmatory factor analysis (CFA). Subsequently, we examined common method variance at each measurement occasion as all measures were self-reported. We continued to examine factorial invariance and finally tested the hypothesized structural model. The full model estimates three sets of structural paths: I) autoregressive paths were modelled for all variables; II) all latent variables within each measurement occasion were allowed to correlate with one another; III) the error terms of the indicators of the latent constructs were allowed to covary with the corresponding error terms at the other two measurement occasions (Cole & Maxwell, 2003).

Note that remote work and mediated communication frequency are represented by one observed indicator and one index score, respectively. However, as the assumption that these single indicators would perfectly estimate the latent construct is likely to be flawed, we accounted for measurement error (Kline, 2015). We estimated partially latent structural models, by estimating the proportion of variance in the single indicators that is due to measurement error (see Kline, 2015). Following Kline (2015) and Petrescu (2013) we used a conservative value to estimate a measurement error of 0.1 * the variance. In addition, hypothesis 3 posits an interaction between the two terms. The moderation is modelled using multiplicative term using the cross products of the indicator of the main variables (see Cortina, et al. 2001for a discussion of moderation approaches in SEM). Excellent model fit is achieved when cut-off criteria for incremental fit indices – i.e., the Tucker-Lewis Index (TLI) and the Comparative Fit Index (CFI) – are above .95. For absolute indices – i.e., standardized version of the root mean squared residual (SRMR) and the root mean square of approximation (RMSEA) – threshold values of ≤ 0.09 and ≤ 0.05, respectively, indicate excellent model fit (Hu & Bentler, 1999). The χ2 statistic primarily serves as a relative measure to evaluate model fit between the retained and alternative models or the nested models using a Δχ2 test (Kline, 2015).

The modelling procedure included the estimation of a number of competing models. First, the baseline model ($M_{(baseline)}$) with autoregressive paths was examined, i.e., the regression weights between the same variables across measurement occasions. Subsequently, several models with cross-lagged structural paths were modelled and compared, including causal, reversed causal, and reciprocal models. Bootstrapping was used to obtain the model parameters and bias corrected confidence intervals for regression weights. For all models, including the measurement model, the Maximum Likelihood (ML) estimator was used.

Preliminary analyses

Non-response analysis

Drop-out was examined by comparing the panel group (n = 1164) with the dropouts (n = 4290). Little's test for missing completely at random (MCAR) indicated that missings were not MCAR χ2 = 41.67, p < .001. However, this test is known to be rather sensitive to sample size (Newman, 2014). As such we examine potential bias the various ways. Based on the study constructs, we found that panel respondents did not differ from the drop-out group in terms of remote work ($M_{drop\text{-}out}$ = 3.95, SD = 1.53; M_{panel} = 3.87, SD = 1.52; t = 1.465, p = .143), isolation ($M_{drop\text{-}out}$ = 4.31, SD = 1.41; M_{panel} = 4.37, SD = 1.42; t = −1.184, p = .236), and psychological distress ($M_{drop\text{-}out}$ = 3.03, SD = 0.63; M_{panel} = 3.05, SD = 0.66; t = −1.035, p = .300). In addition, in terms of mediated communication practices the drop-out group reports a slightly higher overall frequency than the panel group ($M_{drop\text{-}out}$ = 3.08, SD = 0.76; M_{panel} = 3.01, SD = 0.72; t = 3.093, p = .002). Furthermore, causal homogeneity was established by comparing the panel and drop-out group through cross-sectional multi-sample SEM analysis (i.e., panel [n = 1164] versus drop-out [n = 4290]). Furthermore, we found no significant differences in the relationships for the drop-out group compared to the panel. Finally, there were only small differences between the socio-demographics of the panel group and the drop out. Hence, we conclude that there were

Table 2. Goodness-of-fit indices of the competing models.

Name	Model	χ^2	*df*	TLI	CFI	RSMEA (95% CI)	SRMR	Δ χ^2 (Δ*df*)	Model comparison
$M_{measure}$	Measurement Model	904.60	318	0.96	0.97	0.040 (0.037; 0.043)	.05		
$M_{baseline}$	Only autoregressive structural paths	1373.21	425	0.94	0.95	0.044 (0.041; 0.046)	.07		
M_{causal}	$M_{baseline}$ + → Remote work and Communication → Isolation Strain	1328.34	419	0.94	0.95	0.043 (0.041; 0.046)	.06	44.87* (6)	$M_{baseline}$ vs M_{causal}
$M_{reversed}$	$M_{baseline}$ + Strain → Isolation → Remote work and Communication	1352.69	419	0.94	0.95	0.044 (0.041; 0.046)	.07	20.52* (6)	$M1_{baseline}$ vs $M1_{reversed}$
$M_{reciprocal}$	$M1_{reversed}$ + $M2_{causal}$	1301.75	413	0.94	0.95	0.043 (0.040; 0.046)	.06	71.46* (12) 26.59* (6) 50.94* (6)	$M1_{baseline}$ vs $M1_{recirpocal}$ $M1_{causal}$ vs $M1_{reciprocal}$ $M1_{reversed}$ vs $M1_{reciprocal}$

* = p < .05

no serious selection problems due to panel loss and it is not likely that causal dynamics are influenced by participants dropping out of the study.

Measurement model

The overall measurement model included twelve constructs, representing four different factors (i.e., remote work frequency, mediated communication frequency, isolation, and strain), measured at three time points. The measurement model was estimated using the maximum likelihood estimator and demonstrated good model fit (see Table 2). The factor loadings for isolation ranged from .55 to .86 at T1, .54 to .85 at T2, and .61 to .91 at T3. In addition, the average variance extracted (AVE) were $.52_{T1}$, $.53_{T2}$, and $.63_{T3}$; and the max reliability (H) values were $.82_{T1}$, $.82_{T2}$, and $.86_{T3}$. For psychological distress, the factor loadings ranged from .62 to .69 at T1, .63 to .81 at T2, and .72 to .84 at T3. The AVE values were $.49_{T1}$, $.52_{T2}$, and $.60_{T3}$; the max reliability (H) values were $.84_{T1}$, $.85_{T2}$, and $.89_{T3}$. The model indicates good measurement reliability as composite reliabilities range from .76 to .88 and maximum reliability (MaxR[H] from .82 to .89, all above the threshold .70 (Hair et al. 2010). The model also demonstrates adequate convergent and discriminant validity. Specifically, the square root of the AVE was greater than the inter items correlations, and the maximum shared variance between constructs ranged from .38 to .49. Overall, the measurement model does not raise any reliability or validity concerns.

Common method variance

Although we rely on data collected across three points in time, data are self-reported on each occasion. Therefore, we examined the degree of common method variance. First, using Harman's single-factor, we tested for the possible presence of bias. All items that may be affected by the common method (i.e., all items within each measurement occasion), were loaded on a single factor to assess the extent to which one general factor accounts for the majority of covariance between measures. The explained variances for a single factor at T1 (32.1%), T2 (34.2%), and T3 (36.7%), seem to indicate that common method bias is not a major issue in this data (Podsakoff et al., 2003). Subsequently, a common latent factor technique was used to capture the common variance among observed variables in the model using cross-sectional confirmatory factor analyses. Adding a common latent factor did not yield large differences in standardized regression weights. The squared factor loadings indicated that the average shared variance among observed variables at T1 was 3.6%, at T2 was 0.4%, and at T3 was 3.4%. Ultimately these results indicate that common method bias was not of substantial concern to our data.

Longitudinal factorial invariance

To test whether the measurements had comparable meaning across all three waves measurement invariance was assessed. First, weak invariance entails constraining factor loadings of the same items to be equal across time. Model comparison indicated that the constraint model did not show significantly worse model fit compared to the unconstraint model ($\Delta\chi^2$ (8) = 12.59, p = 0.127). Subsequently, strong invariance was tested by extending equality constraints to the intercepts and factor variances ($\Delta\chi^2$ (10) = 12.99, p = 0.224).

Finally, strict invariance was investigated by imposing equality constraints on the measurement residuals, this model did show worse model fit compared to the unconstraint model ($\Delta\chi^2$ (20) = 54.65, p < 0.001). Overall, these results indicate that assumptions of weak and strong factorial invariance may hold (which is of particular interest when comparing regression coefficients), while strict measurement invariance could not be established across measurement occasions. Hence, overall, we conclude that the measures show sufficient longitudinal invariance and satisfy preconditions for further analysis (Little et al., 2007). We now move on to testing the hypothesized structural model while imposing established invariance constraints.

Results

Hypotheses tests

Table 2 shows that the reciprocal model demonstrated excellent model fit and fitted significantly better to the data than competing models. The retained model includes remote work frequency, mediated communication frequency as independent variables, isolation as mediator, and strain as dependent variable. Furthermore, remote work frequency before the pandemic and access to a remote office were included as controls.[1] The standardized solutions are provided in Figure 1, below we report the understandardized solution.

Hypothesis 1 reflects the assumption that remote work frequency increases isolation. Remote work frequency at T1 increases isolation at T2 (B = 0.121, BC95% (.022; .218) p = .024), and remote work at T2 increases isolation at T3 (B = 0.187, BC95% (.080; .294) p = .001). Hence, these findings support hypothesis 1. The reversed effects, which we did not hypothesize, are not significant as isolation at T1 was not related to remote work at T2 (B = −0.012, BC95% (−.039; .013) p = .318), nor was isolation at T2 significantly related to remote work at T3 (B = −0.030, BC95% (−.073; .014) p = .172).

In contrast, hypothesis 2 assumes that mediated communication frequency reduces isolation. The findings demonstrate that mediated communication frequency at T1 reduces isolation at T2 (B = −0.155, BC95% (−.260; −.051) p = .005); and similarly, communication technology use decreases isolation between T2 and T3 (B = −0.131, BC95% (−.253; −.018) p = .022). Hence, hypothesis 2 is supported. Again, beyond what was hypothesized, the results indicate that the relationship between isolation at T1 is not significantly related to mediated communication at T2 (B = −0.018, BC95% (−.041; .006) p = .135); however, isolation at T2 is found to reduce mediated communication at T3 (B = −0.029, BC95% (−.056; −.002) p = .034)

Hypothesis 3 examines the interaction between remote work and mediated communication frequency on isolation in more detail. The results indicated that there are no significant

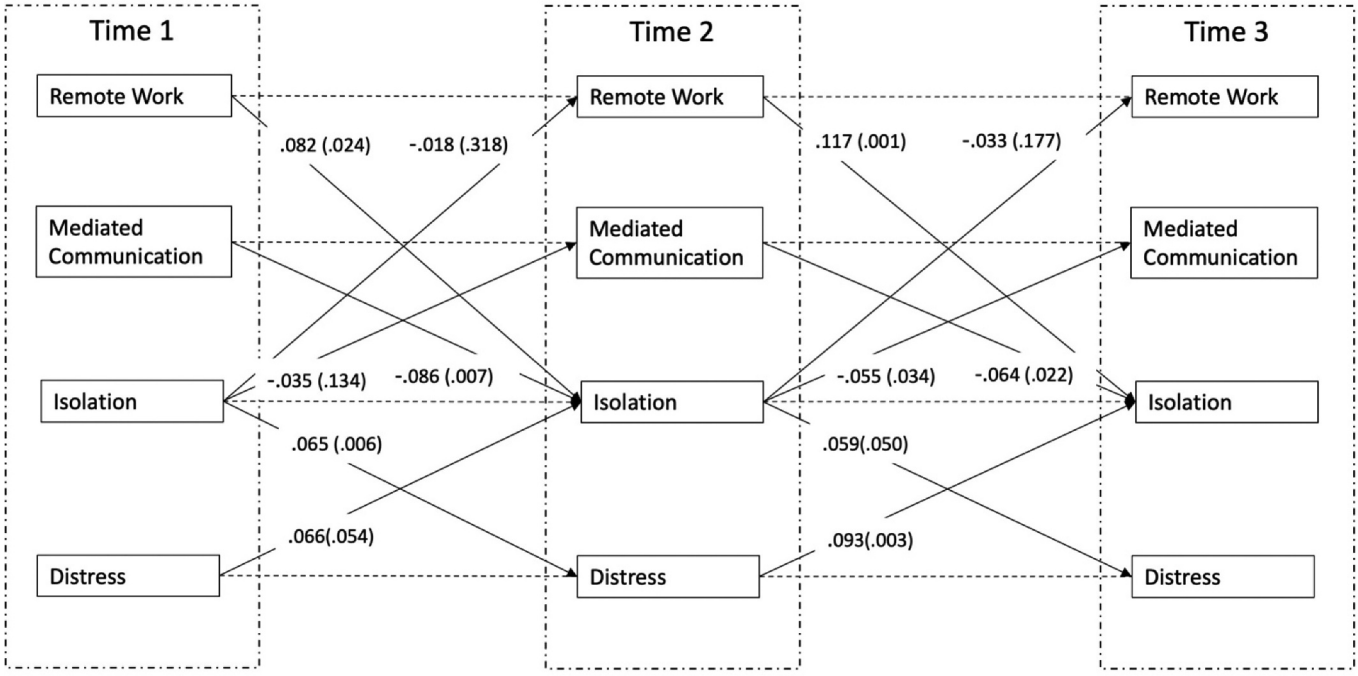

Figure 1. Retained SEM model with standardized direct effects. Values in parentheses are p-values associated with standardized coefficients. The model included control variables (remote work frequency before pandemic and remote office), dashed lines represent autoregressive components. For sake of clarity these regression weigths are not depicted in the figure.

interactions of communication frequency on the cross-lagged effects of remote work on isolation, between T1 and T2 (B = −0.033, BC95% (−.173; .078) p = .451) or between T2 and T3 (B = −0.011, BC95% (−.093; .099) p = .881). Hence, hypothesis 3 was not supported.

Hypothesis 4 reflects the assumption that isolation increases psychological distress. The findings indicate that isolation at T1 increases psychological distress at T2 (B = 0.032, BC95% (.003; .062) p = .030), and isolation at T2 increases psychological distress at T3 (B = 0.030, BC95% (.001; .061) p = .050). These findings support the rationale reflected in hypothesis 4. Furthermore, the findings also indicate that psychological distress at T1 increases isolation at T2 (B = 0.142, BC95% (.004; .278) p = .050), and psychological distress at T2 increases isolation at T3 (B = 0.204, BC95% (.073; .338) p = .003).

Finally, hypotheses 5 and 6 suggest indirect effects of remote work and mediated communication on psychological distress through isolation. The findings demonstrate that remote work at T1 increases psychological distress at T3 through isolation at T2 (B = 0.004, BC95% (.000; .010) p = .036). These findings support hypothesis 5. Hypothesis 6 articulates that mediated communication frequency could reduce psychological distress through reduced levels of isolation. The findings indicated that mediated communication decreased psychological distress through isolation (B = −0.005, BC95% (−.013; −.000) p = .033), supporting hypothesis 6.

Discussion

The findings demonstrate that remote work frequency increases perceptions of isolation, while mediated communication frequency reduces perceptions of isolation. Notably, the results do not support the notion that remote work frequency and communication frequency interact in predicting perceptions of isolation. Rather, it seems that remote work and communication frequency are relatively independent factors that both aggravate and mitigate perceptions of isolation. Furthermore, the findings highlight that isolation and psychological distress mutually affect each other over time. Hence, though we hypothesized that isolation would increase psychological distress, in line with Guthier et al. (2020), we also find strong support for a "strain-effect" such that distress also has a considerable impact on the perception of isolation, which could be conceived as a job stressor.

Theoretical implications

The findings of this study contribute to the literature on the implications of remote work (Cooper & Kurland, 2002; Golden et al., 2008), especially during the COVID-19 pandemic (Larson et al., Larson, et al., 2020, March 18). Some studies have suggested remote work may lead to isolation (Cooper & Kurland, 2002). However, often this relationship is not confirmed, as other studies for instance, indicated that perceptions of isolation were rare and not intense even among full-time teleworkers and those who teleworked as much as three or four days a week (Montreuil & Lippel, 2003). The reason for this is that employees can, and do, often effectively deploy strategies to reduce perceptions of isolation. For instance, Sewell and Taskin (2015) concluded that remote workers engaged in acts of spatiotemporal scaling to reduce a sense of isolation and increased communication with the intent of signalling availability. With limited options for FTF contact, remote workers may engage in more frequent mediated communication to

maintain interpersonal relationships (Lal & Dwivedi, 2009), even though these strategies may not always prove to be sufficient (Fonner & Roloff, 2012). Furthermore, most studies have investigated remote work under conditions where employees have substantial flexibility and control over when and where they work (Greer & Payne, 2014; Sewell & Taskin, 2015). This typically allows workers to adjust their schedules and location according to their needs, utilizing this flexibility to improve social relationships at work (e.g., site visits for global workers; Nurmi & Hinds, 2020).

Communication technologies are an important and necessary requisite for successful remote work practices (Charalampous et al., 2019). Our findings demonstrate that while remote work frequency contributes to isolation, mediated communication frequency seems to reduce isolation. However, the findings do not confirm a moderation effect of mediated communication on the cross-lagged effect of remote work frequency on isolation. Previous studies on remote work have suggested that adequate communication technology use can ensure communication quality, efficient communication (Ten Brummelhuis et al., 2012) and foster pro-social behaviours such as helping behaviours (Ter Hoeven & Van Zoonen, 2020). The absence of a moderation effect between remote work frequency and mediated communication frequency on isolation in this study indicates that the relationship between remote work and isolation is not dependent on the frequency of mediated communication. In other words, our findings suggest that remote work and mediated communication operate as two opposite but independent factors affecting isolation in opposite ways.

Arguably, the absence of a moderation effect could be attributed to notion that this study focused on isolation, while previous studies focused on efficiency of communication and aspects of job performance (e.g., Ten Brummelhuis et al., 2012; Ter Hoeven & Van Zoonen, 2020). In addition, the forced nature of remote work in the context of this study, as opposed to discretionarily utilizing remote work options to meet individual needs, may degrade mediated communication to a necessary evil rather than an opportunity that affords greater workplace flexibility. Thus, in this study mediated communication frequency may be less effective in mitigating the negative implications of remote work frequency, because mediated communication is no longer the enabler of flexibility, but a facilitator of a forced change in work location. Although mediated communication frequency may still directly reduce isolation, it may be less effective in mitigating the impact of remote work frequency in a context where employees have limited control over where they work and how they employee communicate.

Furthermore, the findings demonstrate a reciprocal relationship between isolation and psychological distress. These results are in line with the belongingness hypothesis proposed by Baumeister and Leary (1995), indicating that humans have a pervasive, inherent drive to form and maintain lasting, significant, and positive interpersonal relationships. Isolation could be viewed as an indication of thwarted social relationships and a possible lack of belongingness. Arguably, isolation could highlight the absence of relevant (social) resources (Anderson et al., 2015), contributing to psychological distress. Notably, the findings also indicate that psychological distress may contribute to perceptions of isolation. Hence, the bidirectional nature of the relationship between isolation and distress seems to create a double bind where employees experiencing psychological distress end up feeling more isolated, while those who feel more isolated end up experiencing greater psychological distress Overall, in line with Guthier et al. (2020) the findings highlight the importance of expanding job stress theories by including a focus on strain-effects.

Practical implications

The findings have several important practical implications. Similarly to the research by Cooper and Kurland (2002) our study suggest that remote workers and managers could benefit from training programson how to maintain open communication between remote workers. This could facilitate sufficient interaction through structured daily check-ins and prevent employees from feeling deprived of social relationships (Larson et al., Larson, et al., 2020, March 18). Furthermore, beyond providing an adequate technological infrastructure, organizations should provide opportunities for remote social interaction, especially through informal encounters that are particularly affected by abrupt transitions to remote work. Such encounters could happen by leaving time before and after online meetings or by organizing online social events. However, it should be noted that managers should safeguard an environment that does not normalize constant connectivity but focuses on interaction quality.

Furthermore, organizations can facilitate access to resources that address isolation and help employees manage predictable stressors associated with sustained physical distancing (Brooks et al., 2020). Such resources could focus on providing emotional support and behavioural health interventions. Furthermore, it is important to normalize emotional responses, as perceptions of isolation and feeling lonely in general are often still stigmatized in society and organizations. Some organizations have hired (vitality) coaches to provide help to employees and to obtain emotional support. Such coping-focused resources may cultivate psychological well-being (Kaslow et al., 2020) and alleviate stress during remote work.

Limitations and future research

Some limitations need to be acknowledged. First, while we measured physical isolation (Orhan et al., 2016), isolation is a multidimensional construct. Although our findings are in line with other studies that have focused on social isolation and psychological strain (Bentley et al., 2016). Orhan et al. (2016) found that physical and informational isolation both negatively impacted job satisfaction but the impact of informational isolation seemed particularly profound. Hence, future studies should focus on identifying whether and how various dimensions of isolation (e.g., physical, informational, or social) may operate differently in remote work settings. For instance, future studies could include professional and social isolation (Beauregard et al., 2019), include informational isolation (Orhan et al., 2016), or study isolation from colleagues and isolation from the company separately (Marshall et al., 2007).

Second, we did not have information on the extent to which employees' work tasks were interdependent on co-workers' efforts or on the impact of perceived autonomy and control. These are important constructs to consider in future research, as an abrupt transition to remote work may be particularly likely to lead to perceptions of isolation for employees who work interdependently with colleagues.

Third, research on dispersed work contexts has chronicled the importance of synchronous versus asynchronous communication (Kirkman & Mathieu, 2005). Although our measures include technologies that could be considered more or less synchronous, we do not have information on how these technologies have actually been used. For instance, some may use instant messaging or emails more synchronously than others. Hence, the data do not permit the analysis of, or classification into, synchronous or asynchronous channels. Future research may examine the extent to which synchronous versus asynchronous communication may impact isolation and strain in different ways.

Fourth, as the trajectory and impact of, as well as the response to, the pandemic was hard to predict it was difficult to schedule the study such that the conditions under which work was conducted would be similar across time points. For instance, we decided to follow up on our initial survey relatively soon, resulting in a shorter time lag between T1 and T2 compared to T2 and T3. Though we kept pace with the pandemic, this limits our ability to compare effect sizes between T1 and T2 and between T2 and T3. For instance, increases or decreases in effect size may be the result of a different time lag. We also point out that the reported effect sizes of the lagged effects are relatively small. In addition, although all participants were affected by the same (governmental) restrictions at all time points, we did not control for specific lockdown measures at the organizational level. Furthermore, we do not have information on whether for instance, social distancing outside of work might have a spillover effect on physical isolation from colleagues. Fifth, we relied on respondents that completed all three waves. Although the data provide no evidence to suspect bias due to dropout, the results also indicate that missings are not MCAR. Although, there are more elegant approaches to handling monotonic missing data such full information maximum likelihood, its relative benefits may be limited in the context of this study (Newman, 2014). Specifically, this would require a tradeoff between using full information with missing data and bootstrapping to obtain bias-corrected model parameters. Finally, strict measurement invariance could not be established. As a result, the potential bais caused by measurement non-invariance obstructs the comparison of latent factor means across measurement occasions (Van der Schoot et al., 2015).

Nonetheless, in contrast to most of the research on remote work and isolation that is cross-sectional in nature (Bentley et al., 2016), our longitudinal analysis demonstrated a reciprocal impact between isolation and psychological distress, indicating that isolation may be a source of stress for remote workers, and distress may fuel perceptions of isolation. This highlights the importance of acknowledging strain-effects in stressor-strain models (Guthier et al., 2020). Finally, the analysis demonstrates that remote work frequency leads to greater isolation while mediated communication frequency may reduce isolation. Notably, though, we could not confirm a significant interaction between remote work and communication frequency, suggesting these are two relative independent predictors of isolation.

Note

1. Note that the results for all hypothesized relationships do not differ between the model that includes the control variables and model that does not include the control variables. The only notable difference between both models is that the (reverse) relationship between distress at T1 and isolation at T2 just fails to reach significance in the model with control variables (beta = .066 p = .054), while this relationship is significant in the model without the control variables (beta = .072 p = .036).

Disclosure statement

We have no known conflict of interest to disclose.

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