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Competing motives in a pandemic: Interplays between fundamental social motives and technology use in predicting (Non)Compliance with social distancing guidelines☆

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ABSTRACT

During the COVID-19 pandemic, individuals were advised to adhere to social distancing guidelines limiting physical interpersonal contact. Humans have a suite of adaptations to satisfy belonging needs while avoiding diseased conspecifics. Competition between motivational systems may explain adherence and resistance to social distancing guidelines and how technologically mediated interactions further shape these decisions. This study is a preregistered analysis of data in a representative sample collected during the pandemic investigating how individual differences in affiliative and pathogen-avoidant motives predict interest in physical interactions (N = 2409). Germ aversion predicted disinterest in physical interactions and need to belong predicted interest. Additional analyses revealed technology use satisfied belonging motives that unexpectedly heightened interest in physical contact. Exploratory analyses further indicate that internet speed was similarly associated with greater interest in physical interactions. We frame these results through a competing fundamental social motives framework and discuss how to address future pandemics effectively.

The highly communicable nature of COVID-19 has necessitated the enactment of social policies designed to minimize its spread. One highly effective means to prevent disease transmission is social distancing from others in order to reduce infectious disease transmission (Gagnon, Lloyd, & Gagnon, 2020; Moore, Lee, Hancock, Halley, & Linos, 2020). However, limited contact with others can thwart individuals' sense of belonging, a critical human motivation, which could undermine disease-avoidance strategies and manifest as resistance to social distancing protocols. Loneliness is psychologically taxing (Cohen & Janicki-Deverts, 2009), and shelter-in-place orders and isolation have corresponded with increasing rates of anxiety and depressive disorders (e.g., Brooks et al., 2020). The competing prioritization of affiliation and disease-avoidance thus presents an adaptive challenge to humans. Satisfying goals relevant to one fundamental social motive comes at the expense of another, with individuals foregoing satiation of one if the other is more salient. Though extended social distancing would satisfy disease avoidance goals during the COVID-19 pandemic, such measures sacrifice satiating affiliative goals. This dissatisfaction of affiliation goals may lead individuals to downregulate disease concerns (Sacco, Young, & Hugenberg, 2014) and increase one's proclivity toward risk-taking in the service of satisfying unmet affiliative needs (van Beest & Williams, 2006). Among those chronically interested in identifying affiliative opportunities, such risk-taking could be especially deleterious during a pandemic, as it increases the risk of contracting and spreading disease.

Though difficult to satisfy affiliative motives without interpersonal contact within a pandemic, various technologies could afford opportunities for surrogated social interactions (Gabriel, Valenti, & Young, 2016). Recent reports further indicate that individuals, particularly older adults, have become increasingly interested in utilizing technology (e.g., Zoom, emails) to sustain their relationships during the pandemic (Kotwal et al., 2021). Other technology-mediated interactions (e.g., parasocial relationships, video calls) have previously demonstrated a degree of efficacy in eliciting a sense of belonging that could reduce loneliness (Derrick, Gabriel, & Hugenberg, 2009; Sacco & Ismail, 2014). Increased utilization of technology during the pandemic could subsequently foster greater adherence to social distancing guidelines, as

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individuals' affiliative needs could be satisfied through such mediated communication and not feel compelled to seek affiliative opportunities elsewhere in a physical environment.

The current study reports on data collected during the COVID-19 pandemic assessing how motivational states differentially predict adherence to CDC guidelines designed to blunt the spread of the disease, including the extent to which individuals limited their physical interactions with others within that timeframe. We specifically considered dispositional motivations to affiliate and avoid pathogens and how these competing motives operate in opposition to shift individuals' (dis)interest in behavior that would increase their likelihood of contracting infectious diseases (Sacco et al., 2014). Most important in understanding how to develop technological interventions to encourage compliance with social distancing protocols, this work additionally sought to identify how social surrogacy through various forms of technology common throughout the pandemic would additionally satisfy affiliative motives and whether this satisfaction would specifically foster interest in adhering to social distancing guidelines. We additionally considered how various constraints of technology, namely through differing internet speeds and access to high-speed internet, could influence adherence to social distancing protocols based on their seeming ability to ensure satisfaction of basic needs.

1. Tradeoffs in affiliation and pathogen avoidance

Humans' fundamentally social nature has historically necessitated an ability to cultivate and maintain social bonds through group living to ensure their survival (Baumeister & Leary, 1995). Inclusion in group living affords continued access to resources allocated through cooperation and increased reproductive opportunities otherwise absent in solitary living. The potential consequences of exclusion from group living have subsequently led to the evolution of a sociometer in humans (Leary & Baumeister, 2000), a psychological alarm system that enacts following exclusion to motivate individuals to identify and pursue affiliative opportunities (Leary, Tambor, Terdal, & Downs, 1995). Exclusionary experiences foster an interest in affiliative experiences that could involve an increase in ingratiating behaviors that would serve to ensure access to group living (Maner, DeWall, Baumeister, & Schaller, 2007).

Despite the benefits of group living, close interactions with others necessitate a tradeoff with other fundamental social motives. Increased affiliative opportunities ultimately provide increased opportunities for disease transmission among conspecifics in densely populated ecologies (Hoang et al., 2019; Jones et al., 2008; Salathé et al., 2010). Thus, just as the sociometer may have evolved to warm humans of insufficient social connections (Leary et al., 1995), it has been further argued that humans have concurrently evolved a motivational system to identify and avoid environmental pathogens, known as the behavioral immune system (Murray & Schaller, 2016). Chronic and situational activation of this behavioral immune system facilitates identification of pathogenically threatening environments (Wang & Ackerman, 2019) and conspecifics (Young, Sacco, & Hugenberg, 2011). This activation subsequently heightens aversion to interpersonal contact (Mortensen, Becker, Ackerman, Neuberg, & Kenrick, 2010; Sawada, Auger, & Lydon, 2018), prioritization of interpersonal reticence (Murray & Schaller, 2012), and desire to instill rigid social structures that could serve to reduce infection risk (Brown & Sacco, 2020). In fact, oversaturation of affiliative motives heightens concerns of infection (Brown & Sacco, in press).

A competing affiliative motive may nonetheless downregulate the behavioral immune system if the former is more acutely salient than disease threats. Affiliative and pathogen-avoidant motives operate in direct opposition of each other, wherein satisfying one motive is often at the expense of satisfying the other. Exclusionary experiences reduce individuals' aversion toward facial features connoting infection risk in the service of reaffiliation, indicating a prioritization of belonging motives over disease concerns (Sacco et al., 2014). The motivation to reestablish belonging motives can even lead to risky socialization that increases the odds of disease transmission. For example, chronic and acute activation of affiliative motives heighten preferences for extraverted interaction partners (Brown, Medlin, Sacco, & Young, 2019; Brown & Sacco, 2017; Brown, Sacco, & Medlin, 2019). Despite extraversion affording the opportunity for extensive social networks, the increased interpersonal contact inherent in these networks nonetheless increases risk of exposure to infectious disease (Nettle, 2005; Pollet, Roberts, & Dunbar, 2011). These results suggest individuals are willing to incur costs of disease transmission to replenish their sense of belonging. Consequently, compliance with public health guidelines may depend on the relative salience and prioritization of disease-avoidance and affiliation motives (Young, Brown, & Sacco, in press).

2. Social surrogacy in technology

The absence of affiliative opportunities through interpersonal contact frequently results in feelings of frustration among those who are isolated (Baumeister, DeWall, Ciarocco, & ; Leary, Twenge, & Quinlivan, 2006), which could lead individuals to seek social connection despite the risks. Utilization of social surrogates during isolation could provide satisfaction of salient affiliative needs, including the use of technology to provide additional opportunities for social connections (Gabriel et al., 2016). In the absence of human interaction, individuals frequently form bonds with pets that provide restorative effects on their sense of belonging (McConnell, Brown, Shoda, Stayton, & Martin, 2011). Technology has further become a central route through which this surrogacy occurs, with individuals frequently developing parasocial relationships with television personalities, particularly if they exhibit a chronically heightened desire to belong (Greenwood & Long, 2009). These vicarious relationships, which include those with technology, subsequently provide a sense of belonging in the absence of more traditional interpersonal bonds (Derrick et al., 2009; Keefer, Landau, Rothschild, & Sullivan, 2012; Keefer, Landau, & Sullivan, 2014). This satisfaction of affiliative needs through technological modalities would make surrogacy advantageous in pathogenic environments in which interpersonal contact is particularly risky. Nonetheless, such access to these surrogates may be limited, given constraints imposed by internet access broadly, with higher-speed internet potentially satisfying affiliative motives more readily.

The extensive social distancing during the COVID-19 pandemic saw an unprecedented increase in the use of technologically mediated interactions (e.g., Zoom calls) to reduce the likelihood of disease transmission while individuals strove to continue everyday life. Notably, previous research indicating that technologically mediated interactions can satisfy affiliative needs better than not interacting with someone (Kotwal et al., 2021; Makhanova & Shepherd, 2020; Sacco & Ismail, 2014). Among those with chronic concerns of affiliation and pathogen avoidance, such technology use could serve to facilitate attainment of salient needs and be highly desirable in pandemic. Pathogen-avoidant individuals could view technology as means to participate in group living without increasing their risk of infection, whereas individuals with a chronically heightened need to belong could view technology as means to satisfy their affiliative needs. With the satisfaction of affiliative needs through technology, it would seem sensible to predict individuals would thus be less likely to seek affiliative opportunities through interpersonal interactions that would expose them to infection during a pandemic.

The specific technologies employed for these social surrogacies are further likely to influence the degree to which these interactions would ultimately satisfy one's affiliative needs, thereby downregulating interest in physical interactions. For example, high-speed internet could afford greater approximation of physical interactions compared to slower internet speeds, particularly using video calls unimpeded by lags and buffering time. It could be possible that this better approximation of physical interactions through high-speed internet may satisfy affiliative

needs more readily, thereby downregulating individuals' interest in seeking affiliative opportunities through physical domains.

3. Current research

The current study sought to identify how chronic activation of affiliative and pathogen-avoidant motives operate in opposition to each other in the context of adherence to social distancing guidelines during a pandemic. Specifically, we assessed individual differences in need to belong and perceived vulnerability to disease while tasking participants to indicate the extent to which they adhered to CDC guidelines of maintaining social distance during the COVID-19 pandemic. Given that salience of pathogen-avoidant motives downregulates interest in affiliative opportunities (e.g., Brown & Sacco, 2016; Mortensen et al., 2010; Sacco et al., 2014), we hypothesized that individuals with chronically heightened perceived vulnerability to disease would be more maintaining physical distance from others.

Conversely, the heightened interest in affiliating with pathogenically riskier others among those with chronically activated affiliative motives led us to hypothesize those with dispositionally heightened need to belong would be less interested in maintaining physical distance (Brown & Sacco, 2017). We were further interested in understanding the interplay between these competing motives to determine whether the salience of one motive takes precedence in predicting an interest in physical interactions. If affiliative motives take precedence, then chronic need to belong will predict a heightened interest in physical interactions despite dually salient pathogen-avoidant motives. Conversely, if pathogen-avoidant motives take precedence, then such motives would attenuate the predicted interest in physical contact among those highly motivated for affiliation. We framed this analysis as competing hypotheses.

In addition to these hypotheses, we were interested in understanding how technology-mediated interactions the activation of affiliative and disease-avoidant motives, with subsequent impacts on adherence to CDC compliance. Given previous work indicating that technologically mediated interactions appear to be an adequate medium for satisfying belonging needs (Kotwal et al., 2021; Sacco & Ismail, 2014), we hypothesized that individuals would report less frequent engagement in physical contact during the pandemic, which we predicted would be rooted partially in the satisfaction of their belonging needs. Concurrently, we were interested in understanding how technology could serve as a buffer from the frustration inherent in isolation that could lead individuals to deviate from social distancing protocols (Baumeister et al., 2005; Leary et al., 2006). This prompted us to hypothesize the association between technology use and physical interactions will be additionally mediated by reduced frustration for the measures employed to during the pandemic.

Although not included in our pre-registration plan, we were further interested in understanding the role of different technological experiences in shaping interpersonal behavior during the pandemic. Most notably, we considered the speed of one's internet connection, given that faster internet would ostensibly facilitate greater satisfaction of belonging needs when operating in largely virtual environments. We considered whether participants had broadband internet and self-reported internet speed as exploratory predictors for whether individuals maintained physical distance in addition to considering how they may lead to frustration of the pandemic. Our specific tentative predictions were that high-speed internet and access to broadband internet would satisfy belonging motives more readily compared internets as slower speeds. This was also predicted to be the basis of subsequent interest reduced interest in physical contact. Data, materials, and pre-registered hypotheses are available at: https://osf.io/brpx3.

4. Method

4.1. Participants

We recruited participants through Qualtrics Panels for a longitudinal study during the summer months of the COVID-19 Pandemic (i.e., July and August 2020), spanning across four time points to develop a comprehensive database of pandemic-related responses as a function of pathogen-avoidant and affiliative motives from which researchers could pre-register hypotheses based on a list of available variables before conducting cross-section and longitudinal analyses. For the current analysis, we focus entirely on the first time point that afforded us the opportunity to collect responses from an initial sample of 2409 complete responses in July 2020. This analytic decision was to provide a baseline cross-sectional analysis to inform preliminary findings on the interplay between competing motives in shaping responses to the pandemic. A sensitivity analysis indicated we were adequately powered to detect small effects ($\rho = 0.05$, $1\text{-}\beta = 0.80$). No data were excluded from analyses from this initial time point.

This sample was recruited to be nationally representative with responses from participants across all 50 U.S. states and Washington D.C. Participants were compensated at a rate commensurate with the degree they participated across time, with reimbursement rates determined by Qualtrics and varying depending on the difficulty recruiting participants representing different demographic groups ($M_{Age} = 44.98$ years, $SD = 15.28$, range: 18–65; 1437 women, 913 men, 59 identifying as transgender/nonbinary; 67.2% White, 12.6% Black, 9.9% Asian, 6.3% Hispanic; 9.7% Other). We also had 61.8% of participants reporting using broadband internet and 38.2% reporting not using broadband. Participants additionally reported moderately fast internet ($M = 4.81$, $SD = 1.48$) along a single 7-point scale (1 = *Not Fast at All*; 7 = *Extremely Fast*).

5. Materials and procedure

Consenting participants provided demographic information and responded to different measures and demographic information across time points. Though we focus primarily the variables listed below, a list of variables collected are available upon request.

Pathogen-Avoidant Motives. Participants reported their dispositional motivations to avoid environmental pathogens using the Perceived Vulnerability to Disease Scale (PVD; Duncan, Schaller, & Park, 2009). This 15-item measure consists of two subscales assessing perceived infectability (PI; $\alpha = 0.79$) and germ aversion (GA; $\alpha = 0.70$) along 7-point scales (1 = *Strongly Disagree*; 7 = *Strongly Agree*), with higher scores reflecting greater motivation to avoid pathogens. These subscales' modest correlation necessitated our consideration of them separately in subsequent analyses.

Affiliative Motives. Participants indicated their dispositional interest in affiliation using the Need to Belong Scale (NTB; Leary, Kelly, Cottrell, & Schreindorfer, 2013). This 10-item measure operates along 7-point scales (1 = *Strongly Disagree*; 7 = *Strongly Agree*), with higher scores reflecting greater interest in affiliation ($\alpha = 0.77$).

Basic Needs Satisfaction. Although we were primarily interested in satisfaction with belonging needs, we nonetheless assessed the entire gamut of previously defined basic social needs, which also include self-esteem, control, and meaning (Zadro, Boland, & Richardson, 2006). Each need was assessed using five 5-point scales (1 = *Not at All*; 5 = *Always*) with higher scores indicating greater satisfaction of a given need ($\alpha s > 0.72$).

Physical Interaction. Participants indicated how frequently they had physical interactions since the start of the Pandemic through five ad hoc items (i.e., leaving home, eating in restaurants, attending in-person religious services, being in crowds, in-person interactions) operating along 7-point scales (1 = *Not at all Frequently*; 7 = *Very Frequently*), with higher scores indicating more frequent engagement in physical interactions ($\alpha = 0.86$).

CDC Adherence. Participants indicated how well they felt they were adhering to CDC guidelines along four ad hoc items that assessed engagement in health-enhancing behaviors that were possible while engaging others in physical interactions that would reduce the risk of infection (i.e., maintaining 6 ft of distance, wearing a mask in public, wearing a mask even when optional, washing hands). Items operated along 7-point scales (1 = *Not at all Well*; 7 = *Very Well*), with higher scores reflecting greater adherence to guidelines (α = 0.84).

Technology Use. Participants indicated the extent they utilized ten different modalities of technology during the Pandemic (e.g., Zoom, Facebook), which operated along 7-point scales (1 = *Not at all Frequently*; 7 = *Very Frequently*; α = 0.86).

Tolerance of Pandemic. We assessed frustration/tolerance with the pandemic and its guidelines using a single-item scale (1 = *Very Frustrated*; 7 = *Very Much Tolerating*).

6. Results

6.1. Confirmatory analyses

Our analyses can be divided into confirmatory analyses that were pre-registered and exploratory analyses that were not predicted.

Bivariate Correlations. Given both the volume of correlational analyses being conducted (i.e., 11 variables) and the large sample size, we have adjusted our alpha criterion for significance to α = 0.004 to reduce the Type I Error rate. In tests of our initial hypotheses for the interplay between pathogen-avoidant and affiliative motives, NTB was positively associated with physical interaction frequency. Conversely, GA was negatively predictive of physical interaction engagement, such that germ-averse individuals were less likely to engage others in physical interactions; no association emerged for PI.

Both facets of PVD were unsurprisingly correlated with adherence to CDC guidelines, although GA was an especially strong predictor. Interestingly, NTB was also associated with greater adherence to CDC guidelines regarding health enhancement. In identifying how such motives predict technology use, PI and NTB were both associated with more technology use that would ostensibly facilitate connections. Table 1 provides bivariate correlations in this analysis.

PI and NTB were further associated with interest in technologically mediated interactions. Two additional expected correlations emerged for tolerance of the pandemic. A negative correlation indicated individuals less tolerant of the pandemic engaged in physical interactions more frequently; a positive correlation indicated greater tolerance for the pandemic was associated with more adherence to CDC guidelines. Additionally, GA was associated with greater tolerance toward the pandemic.[1]

Interactive Effects in Motivational Tradeoffs. Given the predictions of disease salience downregulating interest in affiliation and affiliative concerns downregulating pathogen avoidance (Sacco et al., 2014), we found it prudent to test the competition between these two motives directly using a moderation analysis to determine which motive more strongly predicted one's proclivity toward physical interactions. We used Model 1 of PROCESS (Hayes, 2013) to test the interactive effects between NTB and GA; our decision to use GA was due to the significant association it possessed with engagement in physical interactions that PI did not.

Effects were qualified by an interaction, $b = -0.10$, $SE = 0.02$, $t = -4.46$, $p < .001$, 95% CI [-0.14, −0.05]. We then compared the associations between NTB and physical interactions at high (+1 SD) and low levels of GA (−1 SD). At low-GA, high-NTB participants reported heightened engagement in physical interactions, $b = 0.41$, $t = 10.47$, SE = 0.04, $p < .001$, 95% CI [0.33, 0.48]. A similar positive association emerged at high-GA at a substantially reduced magnitude, $b = 0.19$, $SE = 0.03$, $t = 5.60$, $p < .001$, 95% [0.12, 0.25]. These findings suggest affiliative motives pervasively heighten interest in physical interactions, yet heightened GA reduces this interest.

Basic Needs Satisfaction Through Technology. We additionally considered how technologically mediated interactions could satisfy basic needs, which could ameliorate engagement in social distancing during the pandemic. Technology use was associated with greater satisfaction of both belonging and control needs, while also being associated with lower satisfaction of meaning needs and being unassociated with self-esteem needs (see Table 1). Unexpectedly, a positive association emerged between interest in physical interactions and satisfaction of belonging needs, suggesting that a sense of belonging does not necessarily reduce an interest in engaging others physically. Nonetheless, the technology usage that satisfied belonging needs was also associated with greater tolerance of the pandemic. Furthermore, this tolerance was associated with less frequent engagement in physical interactions, whereas greater belonging needs satisfaction was associated with more frequent interactions. These associations justified us to conduct our pre-registered mediation analyses.

We conducted simultaneous mediations with Model 4 of PROCESS with technology use as a predictor and physical interaction frequency as an outcome with belonging and tolerance as mediators with 10,000 bootstraps. Indirect effects emerged for both proposed mediators. Heightened tolerance facilitated through technology fostered disinterest in physical interactions, 95% CI [-0.015, −0.003]. Heightened satisfaction of belonging needs, contrary to hypotheses, fostered greater interest in physical interactions, 95% CI [0.001, 0.007]. See Fig. 1.

6.2. Exploratory analyses

We conducted several additional exploratory analyses to identify various demographics effects, particularly as they relate to technology use in predicting pandemic-related behavior. We continued to employ α = 0.004 as our significance criterion to reduce the likelihood of Type I Error. As seen Table 1, age was associated with heightened GA, greater adherence to CDC guidelines, and greater tolerance of the pandemic. Conversely, age also associated with lower PI, NTB, satisfaction of belonging needs, technology use, and interest in physical interactions.

We additionally compared sex differences in this current sample; we excluded the 59 participants identifying as transgender or nonbinary in this analysis, given the small number reporting as such. As seen in Table 2, women reported greater NTB, GA, and adherence to CDC guidelines compared to men. Men reported greater interest in physical interactions.

We additionally compared participants with and without broadband internet in their interest in physical interactions and their frustration with the pandemic, given these variables' relevance to maintaining social distance. Independent samples *t*-tests indicated that broadband users reported greater tolerance of the pandemic. Broadband users further reported less interest in physical interactions, although this difference did not attain significance at our adjusted alpha for exploratory analyses (see Table 3). Additional bivariate correlations indicated faster internet was associated with greater tolerance for the pandemic and greater interest in physical interactions. However, internet speed was associated with reduced satisfaction of belonging needs (see Table 4).

7. Discussion

Results partially support for our central hypotheses, particularly those related to the competition between pathogen-avoidant and affiliative motives. Whereas heightened need to belong predicted greater frequency of interpersonal contact during the pandemic, pathogen-

[1] When controlling for participant age, effects remained largely consistent with the primary analysis. Several effects became no longer significant, although they remained in the same direction as originally reported. We provide the correlation matrix of these effects in an online supplemental file.

Table 1
Bivariate correlations across study variables. *Note.* PI=Perceived Infectability; GA = Germ Aversion; NTB=Need to Belong; Belong = Belonging Needs; SE=Self-Esteem Needs; Cont. = Control Needs; Mean. = Meaning Needs; Phys. = Physical Interactions; CDC = Adherence to CDC Guidelines; Tech = Technology Use; F/T = Frustration/Tolerance of Pandemic.

	GA	PI	NTB	Belong	SE	Cont.	Mean.	Phys.	CDC	Tech	F/T
PI	.21**										
NTB	.06*	.22**									
Belong	-.01	.26**	.22**								
SE	.04	-.26**	-.22**	-.70**							
Cont.	.03	-.29**	-.34**	-.70**	.56**						
Mean.	.05	-.28**	-.29**	-.80**	.74**	.73**					
Phys.	-.25**	.05	.18**	.10**	.06**	-.21**	-.16**				
CDC	.40**	.06**	.08**	-.12**	.19**	.02	.13**	-.23**			
Tech	-.03	.20**	.34**	.08**	.05	.22**	-.15**	.57**	.08**		
F/T	.13**	.04	-.01	-.08**	.13**	.04	.09**	-.07*	.42**	.07**	
Age	.13**	-.17**	-.19**	-.25**	.27**	.20**	.29**	-.30**	.25**	-.45**	.11**

*p < .004.
**p < .001.

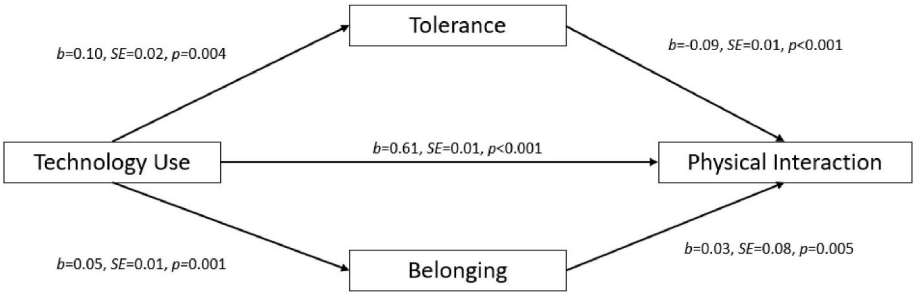

Fig. 1. Mediational pathways of technology use on frequency of physical interactions with tolerance of the Pandemic and satisfaction of belongingness as mediators.

Table 2
Means (and standard deviations) of men's and women's reported levels of each relevant study variable.

	Men	Women	*t*	*d*
NTB	3.77 (1.01)	3.92 (1.02)	−3.42*	0.14
GA	4.55 (1.07)	4.77 (1.10)	−4.68**	0.20
PI	3.43 (1.11)	3.56 (1.25)	−2.65	0.11
Belong	2.61 (0.80)	2.63 (0.83)	−0.74	0.03
SE	3.34 (0.82)	3.38 (0.89)	4.24**	0.18
Control	3.35 (0.78)	3.34 (0.80)	.20	0.01
Meaning	3.62 (0.82)	3.56 (0.89)	1.45	0.06
Physical Interaction	2.88 (1.52)	2.57 (1.32)	5.21**	0.22
CDC Adherence	5.28 (1.45)	5.47 (1.47)	−3.11**	0.13
Technology Use	3.07 (1.46)	3.12 (1.22)	−0.79	0.03
Frustration/Tolerance	4.56 (1.75)	4.60 (1.82)	−0.57	0.02

*p < .004.
**p < .001.

Table 3
Means (and standard deviations) of broadband and non-broadband users in their interest in physical interactions during the pandemic and frustration/tolerance of the pandemic.

	Broadband	Non-Broadband	*t*	*d*
Physical Interaction	2.66 (1.44)	2.79 (1.36)	8.17*	0.34
Frustration/Tolerance	4.80 (1.75)	4.20 (1.80)	−2.06	0.08

*p < .001.

Table 4
Bivariate correlations between internet speed and relevant study variables.

	Frustration/Tolerance	Physical Interaction	Belonging
Internet Speed	.18*	.12*	-.15*

*p < .001.

avoidant motives were associated with reduced frequency. These diverging associations provide evidence for how these motivational states lead individuals to incur tradeoffs in the service of satisfying the salient motive at the expense of another (Sacco et al., 2014).

Such findings further indicate that the more affective component of behavioral immune system responses typified by GA facilitated engagement in this tradeoff. This is consonant with work implicating GA in heightening interpersonal reticence that could have manifested as interest in maintaining social distance from others (e.g., Brown, Keefer, Sacco, & Bermond, 2019; Makhanova & Shepherd, 2020). The lack of association for perceived infectability could have been related to its function being to identify pathogenic threat regardless of environment, including those already in social environments. Additional analyses identifying the primacy of one motive in shaping affiliative decisions indicated individuals' chronically high affiliative motives are down-regulated considerably in the presence of similarly salient pathogen-avoidant motives, a finding suggesting humans' pervasive affiliative needs are adaptively reduced to ameliorate infection risk (Sawada et al., 2018).

Both aspects of PVD were unsurprisingly associated with adherence to CDC guidelines to reduce the spread of COVID-19, although the association was larger for GA. This difference in magnitude could be rooted in germ-averse individuals' concomitant interest in adhering to social norms (Murray & Schaller, 2012). Such conformity would seem sensible, given the increasing normativity of these guidelines throughout the pandemic that frequently became compulsory (e.g., mask mandates) during data collection. Interestingly, affiliative motives were associated with greater adherence to CDC guidelines. To ensure one's capable of engaging in the scarce affiliative opportunities imposed by the pandemic, highly affiliative individuals could be particularly interested in adhering to guidelines in the service of maintaining their social bonds by wearing masks during interactions and maintaining adequate social distance when in public. Similarly, past work has found increased conformity following activation of belonging motives (e.g.,

Williams, Cheung, & Choi, 2000), and CDC adherence may reflect a similar desire to conform to group norms. This is an interesting finding, insofar as it suggests that affiliate motives can be harnessed to *increase* compliance with social distancing measures if the behavior is viewed as socially desirable (e.g., the "alone together" campaign).

7.1. Effects of technology use

These results contribute to an increasing understanding of the interplay between technology and psychological processes by addressing how technology influences whether individuals are willing incur the costs of a motivational tradeoff based on its ability to provide complementary affiliative opportunities in the absence of others. Our results demonstrated how technology use could satisfy affiliative needs during pandemics and how such motives could influence subsequent maintenance of physical distance from others. First, NTB and PI were associated with technology use. This could reflect an interest in social surrogacy to ensure contact with others (Gabriel et al., 2016). A fear of missing out (FOMO) that typifies extensive social media use in the service of ensuring one's continued contact could be further motivating the technology use among individuals with dominant affiliative motives (Przybylski, Murayama, DeHaan, & Gladwell, 2013). Additionally, high-PI individuals' interest in technology could be a result of their chronic perception of any environment as an infection risk that necessitates their reliance on technology to ameliorate risks of face-to-face interactions. This reliance on technology has different functional bases for given motives. Future research would benefit from identifying the mechanisms through which these motives predict engagement with technology.

Technology use was further associated with heightened satisfaction of belongingness needs during the pandemic, yet this satisfied belongingness need was unexpectedly associated with greater interest in physical interactions. Despite being unexpected, this finding in nonetheless sensible when considering previous work demonstrating that technologically mediated interactions better than isolation, but also less satisfying than physical interactions (Sacco & Ismail, 2014) Recent findings further suggest social surrogacy is not a perfect substitute for more ancestrally relevant interactions (Paravati, Naidu, & Gabriel, 2021). A surrogated interaction could have elicited social cravings that would have motivated interest in physical interactions despite infection risk (van Beest & Williams, 2006). Put simply, if technology-mediated forms of communication are a form of "social snacking," then they may have merely whetted participants' appetites for a real meal, rather than satiating cravings for interactions.

These social cravings could be further evidenced by the dissatisfaction of belonging needs among individuals reporting faster internet. Greater immediacy of social surrogacy through technology could highlight the shortcomings of such interactions compared to those in physical spaces that would also motivate the concomitant increased interest in physical interactions seen among those with faster internet. Participants' reliance on technology could have similarly produced "Zoom overload," or fatigue from having to rely on excessive nonverbal cues in virtual meetings for which humans had no evolutionary history (see Bailenson, 2021). Nonetheless, the exploratory nature of these findings with internet connectivity should warrant caution in interpretation, with future studies seeking to replicate effects with how internet speed may influence affiliative behavior in physical spaces. Nonetheless, higher-speed internet did ultimately heighten participants' tolerance of restrictions despite the greater interest physical interactions and relative dissatisfaction of belonging needs. These findings could indicate that high-speed internet buffers individuals from many deleterious effects from the pandemic that preclude satisfaction of affiliative needs, albeit imperfectly.

The enhanced tolerance of the pandemic through technology use was a relatively effective buffer against physical interactions, as evidenced by the reduction in interactions among those who reported greater tolerance for the pandemic. That is, more technology use during the pandemic heightened tolerance for the pandemic, which subsequently reduced participants' engagement in physical interactions during that time. This latter finding could suggest that targeting and reducing feelings of frustration could be effective at facilitating adherence to social distancing guidelines. An implication then is that public health campaigns should aim to increase coping skills with the ongoing pandemic to prevent growing frustration (e.g., with lockdowns, distance learning, etc.) from translating into non-compliance.

Several effects emerged in our exploratory demographic analyses. First, women reported more heightened activation of affiliative and pathogen-avoidant motives compared to men. Asymmetries in pathogen-avoidant motives could reflect women's greater vulnerability to infectious disease, particularly during pregnancy, that could produce more deleterious consequences of infection for women (e.g., Al-Shawaf, Lewis, & Buss, 2015). For affiliative motives, men reported greater interest in physical interactions than women. This could be a result of men's typically higher levels of agency that could potentiate interest in social interactions (Archer, 1996). These results could speak to possible asymmetries in how pandemics may differentially affect men and women and whether technology-mediated interactions could elicit unique responses to men and women given their functional differences in motivational states.

7.2. Limitations and future directions

The current study presents several limitations that necessitate future research. Most notably, on a level of generality, these data were collected during a unique time in human history in the COVID-19 pandemic, which could have shaped distinct responses to pathogenic threat that may unique to this particular virus and the social restrictions it imposed. Although our findings are broadly consistent with what would be expected within pathogenic ecologies in modulating interpersonal behaviors (e.g., Schaller & Murray, 2008), a mismatch between ancestral environments nonetheless persists with modern contexts that formally imposed social distancing guidelines. Future work would benefit from finding proxies to these study data in historic pandemics to determine the extent these particular data generalize to other acute disease threats.

Although our results remain theoretically sensible in understanding how fundamental motives shape interpersonal behavior within a pandemic, the current study would have benefited from considering additional personality variables to identify complementary processes that may exist in conjunction with our motivational explanations. That said, recent research has touched on this, including work showing that conscientiousness predicts adherence to health-enhancing behaviors within the pandemic (Bogg & Milad, 2020) and extraversion predicts a failure to socially distance (Ludeke, Vitriol, Larsen, & Gensowski, 2021). Future work would benefit from identifying potential interactive effects between these personality variables and the fundamental motives described in this study in shaping how individuals interact in pandemics, given how environmental pathogens calibrate cultural expressions of personality and interpersonal behaviors (e.g., Murray, Fessler, Kerry, & White, 2017; Schaller & Murray, 2008).

The present research also examined the activation of affiliation and disease-avoidance needs at a trait-level (granting that the unique context of a global pandemic may have broadly impacted motivational states). Future research would benefit from experimental activation of affiliative and pathogen-avoidant motives in shaping interest in maintaining physical distance from others in pathogenically threatening ecologies. To activate affiliative motives, this could involve the use of Cyberball paradigms designed as exclusionary experiences, which foster interest in risky behaviors and social interactions (Brown, Sacco, & Medlin, 2019; van Beest & Williams, 2006). A study could ask socially excluded participants about their willingness to engage others physically during a pandemic despite the potential risk. Moving beyond pandemics, such

paradigms could prove advantageous in identifying whether individuals become less interpersonally reticent toward disease cues or downregulate their perceptions of human congregation as threatening, given previous research indicating that disease salience heightens reticence (Mortensen et al., 2010) and aversion to crowds (Wang & Ackerman, 2019).

In the activation of pathogen-avoidant motives, studies could prime disease salience before prompting individuals to indicate the degree to which they would prefer to interact with individuals physically or through technology. Although technologically mediated interactions have previously been shown to be less satisfying (Sacco & Ismail, 2014), the downregulation of belonging motives following disease salience could reduce interest in pursuing physical interactions that could pose an infection risk (Sacco et al., 2014). Furthermore, studies could determine whether disease salience may further heighten perceptions of social surrogates (e.g., fictional characters) as especially capable of satisfying belonging needs (Derrick, Gabriel, & Tippin, 2008). The additional association between GA and tolerance for the pandemic could additionally inspire future work investigating how disease salience could heighten tolerance toward the consequences in living in a pathogenic environment. Given that our findings demonstrated unique patterns for both GA and PI, as such motives differentially influence one's interest in engaging others physically (e.g., Brown & Sacco, 2020), future research would further benefit from considering motivational primes that specifically activate affective and cognitive components of the behavioral immune system separately.

Our findings additionally indicate tolerance toward the pandemic is a notable mediator for the association between technology use and disinterest in physical interactions. It would be advantageous for future research to determine whether increased tolerance toward social guidelines during public health crises may improve adherence to guidelines. For example, a future study could employ interventions (e.g., mindfulness) designed to heighten tolerance toward distressful or frustrating events during a health crisis (e.g., Nila, Holt, Ditzen, & Aguilar-Raab, 2016). Indeed, one's ability to tolerate distress serves as a protective factor against risky or dangerous behavior (e.g., Benuto, Yang, Bennett, & Lancaster, in press), suggesting measures designed to heighten tolerance could be advantageous in inoculating individuals from a maladaptive coping strategy of extensive physical contact with others during a pandemic.

8. Conclusion

The COVID-19 pandemic has provided a unique series of challenges to humans in their desire to satisfy their various competing motivational states that necessitates individuals to incur costly tradeoffs. The current study captured one such series of tradeoffs in individuals' desire to avoid infection while at the expense of satisfying their fundamental need to affiliate. These findings provide evidence for how technological advances may facilitate the interplay between motives to identify potentially ancestrally informed solutions to reduce the interpersonal costs during public health crises.

Credit statement

This study was conceived and developed by all three authors. MB programmed the study, with SGY and DFS facilitating data collection through their federal grant to conduct this research. MB performed primary analyses and wrote an initial draft. SGY and DFS provided critical feedback. All authors approved of the final submission.

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