Psychological Flexibility in Response to Changes in Ecological Affordances:

Implications of Changing COVID-19 Rates on Disease Psychology

by

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ABSTRACT

Do individuals flexibly and adaptively calibrate their motivation, thoughts, feelings, and behaviors in response to changing ecological opportunities and threats? Using a longitudinal six-wave survey data set collected during the COVID-19 pandemic, the study addresses three research questions: are some psychological features or characteristics more or less likely to be calibrated in response to environmental change, are certain types of people more sensitive to these ecological changes, and do individuals become more sensitized or habituated to these changes over time? The results demonstrate that individuals can flexibly adjust their psychology directly relevant to managing COVID-19 infection: people were more strongly motivated to avoid disease and perceived that they were more vulnerable to COVID-19 infection during periods when the threat of COVID-19 infection was high. Political liberals were particularly sensitive to ecological infection changes in adjusting their disease avoidance motivation. Importantly, the study also found a significant quadratic effect of COVID-19 cases on disease avoidance motivation, perceived COVID vulnerability, and preventative behaviors. This indicates that the effect of COVID-19 cases was especially pronounced during the early phase of the pandemic when new cases were relatively low, but diminished as time passed and new cases increased. These findings highlight the adaptive nature of human behavior in response to changing environmental circumstances and underscore the importance of considering both individual and contextual factors in understanding psychological flexibility.

To my family,

who have been pillars of strength and reservoirs of belief in me.

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CHAPTER 1

INTRODUCTION

Changes in ecological conditions often pose new threats or opportunities, creating a need for individuals to flexibly and adaptively calibrate their motivational priorities, thoughts, feelings, and behaviors in ways that minimize potential threats and maximize potential opportunities. For example, changes in resource availability due to a natural disaster may require individuals to prioritize finding new sources of food and water, whereas changes in physical violence risk due to a war may require individuals to prioritize self-defense or find a safe place to live. Similarly, changes in disease infection risk due to the recent COVID-19 pandemic require individuals to adjust their cognition, motivation, and behaviors to reduce their risk of infection. Examining how individuals respond to ecological changes and adapt to these changes is a crucial aspect of adaptive psychological flexibility.

The current dissertation aims to investigate the flexibility of psychology within the same individuals in response to changes in ecological affordances—the environmental opportunities and threats they face. The COVID-19 pandemic provides a unique opportunity to study how people respond to changes in the risk of pathogen infection over time. I ask three questions: Are some psychological features or characteristics more or less likely to be calibrated in the face of environmental change? Are certain types of people more sensitive to these ecological changes? Do individuals become more sensitized or habituated to these changes over time? Leveraging naturally changing ecological infection risk during the current COVID-19 pandemic, and a longitudinal six-wave survey dataset that captured individuals' motivations, feelings, beliefs, and behaviors during that time, the proposed study aims to address how individuals adapt and calibrate their psychology in response to changing environmental infection risk and identify potential individual differences in the degree of sensitivity to changing ecological affordances.

It is well established that individuals who live in different environments often differ in their cognition, emotion, motivation, and behavior in order to manage the ecological affordances present in their environment. For instance, people living in ecologies with high pathogen prevalence exhibit certain psychological traits that may help reduce their risk of infection by decreasing their likelihood of coming into contact with pathogens or engaging in behaviors that increase the risk of transmission, including being less dispositionally extraverted, less open to new experiences, and less sexually promiscuous (Schaller & Murray, 2008). They are also more likely to endorse and adhere to accepted societal practices, such as by conforming to majority opinion (Murray et al., 2011), holding collectivist values (Fincher et al., 2008; Fincher & Thornhill, 2012), endorsing ideological positions that encourage adherence to traditional values (Tybur et al., 2016), and endorsing moral values that emphasize group loyalty, obedience, and respect for authority (Murray et al., 2013). These ecological adaptations have important implications for between-individual differences, including cross-cultural (Sng et al., 2018) and cross-temporal differences (Grossmann & Varnum, 2015; Varnum & Grossmann, 2016, 2017).

Importantly, the opportunities and challenges an environment affords can change over even short periods of time. For instance, ecological pathogen infection risks constantly change over time depending on factors such as temperature (Murtas & Russo, 2019), prevalence of the pathogen in the population (Chandra et al., 2013), and behavior of the vectors that transmit the pathogen (Ewing et al., 2017). Because such changes can have significant impact on people's lives, people often adjust, modify, and calibrate one's mind and behavior in ways to minimize potential threats and maximize potential opportunities. In the case of ecological changes in risk of influenza, for example, this may include paying more attention to the current risk of infection in one's local area (Broniatowski et al., 2013; Gozzi et al., 2020), constantly updating the probability of getting infected, and taking other preventive measures such as wearing a mask, washing hands frequently, and getting vaccinated (Usher et al., 2020).

Additionally, because people cannot perceive pathogens directly, they may be vigilant for known cues diagnostic of infection (e.g., skin rashes, coughing, hygiene habits) and be able to discover and use new cues. During the COVID-19 pandemic, for example, some Americans used others' political affiliation as a novel cue to infection risk because opposition to certain behaviors, such as mask-wearing, was highly correlated with political party affiliation in the U.S. (Calvillo et al., 2020; Green et al., 2020; Van Green & Tyson, 2020). Indeed, Ko et al. (in prep) found that American participants who were dispositionally high in disease avoidance motivation believed that Republicans were more likely to infect others and felt more disgust toward them. Importantly, when new COVID-19 case numbers were relatively high, *within*-person upregulation in disease avoidance motivation significantly predicted both stronger beliefs that Republicans were likely to infect others and decreases in disgust toward and avoidance of Democrats. These effects were also exhibited by Republican participants. These findings demonstrate that, in addition to between-person dispositional differences, *within*-person calibration of disease avoidance motivation played a significant role in how people identified and managed the changes in ecological risk of COVID-19 infection.

It is important to note, however, that not all individuals in the Ko et al. study calibrated their disease avoidance motivation in the same way in response to ecological changes, raising interesting questions about the potential effects of ecological changes on affordance management flexibility and calibration. For example, are some psychological features or characteristics more or less likely to be calibrated? Which individuals were more likely to sensitively up- or down-regulate their disease avoidance motivation based on ecological changes? And what role do between-person differences have on within-person calibration to ecological changes? Research from personality psychology (e.g., Beck & Jackson, 2021; Craik, 2000; Fleeson, 2001) and developmental psychology (e.g., Charles et al., 2013; Hedeker et al., 2009; Hülür et al., 2015) point to the value of integrating considerations of short-term variability with between-person differences for better predicting behavior, and such an approach is likely to be valuable for better understanding the mechanisms underlying within-person calibration of psychological features and processes in response to changing ecological conditions.

Although within-person changes in affordance management strategies are theoretically important aspects of the adaptive flexibility of human psychology, investigating such changes is challenging due to methodological limitations, such as difficulties inherent in manipulating ecological conditions experimentally and the potential for demand characteristics in experimental priming studies. That said, the COVID-19 pandemic provided a unique opportunity to study how individuals responded to changes in the risk of pathogen infection over time. By leveraging naturally changing COVID-19 infection risk within the ecology across time, it was possible to investigate how people calibrated their cognition, emotion, motivation, and behavior in response to changes in ecological affordances and identify which between-person factors were most important in shaping these responses, given that the impact of changes in ecological COVID infection risk might not have been uniform across different individuals. By collecting data from the same individuals at multiple points in time, the available six-wave longitudinal panel survey of a U.S. representative sample could provide valuable insights.

Overview of the Current Research

The three research questions related to how individuals flexibly adapted their disease psychology in response to changes in ecological infection risk during the COVID-19 pandemic. The first question was whether some psychological features were more likely to be calibrated in response to changes in ecological affordances. I hypothesized that features directly relevant to managing changes in COVID-19 infection would be more responsive to environmental COVID-19 changes. For instance, given that the COVID-19 SARS-CoV-2 virus was primarily transmitted through respiratory droplets, individuals' motivation to avoid places or people who might carry diseases might be more responsive to ecological infection risk. In contrast, individuals' disgust sensitivity toward body odor might not have been influenced by ecological infection risk.

The second research question aimed to investigate whether certain personality traits made individuals more responsive to changes in ecological infection risk. One hypothesis suggested that individuals who had a strong motivation to avoid infection, perceived themselves as vulnerable to disease, or felt particularly susceptible to COVID-19 would be more likely to adjust their disease psychology in response to changes in the environment. Essentially, those with greater disease concerns may have been more sensitive to modifying their attitudes and behaviors to align with changing ecological conditions.

The third question examined whether individuals became more sensitized or habituated to ecological changes. I hypothesized that individuals may have initially been more sensitive to and affected by relatively minor changes in the environment but may have eventually become less sensitive as they became accustomed to the new conditions, thereby requiring greater ecological changes before calibration. To test this hypothesis, I examined whether the negative quadratic tracking term, indicating a habituation in sensitivity to the number of new COVID-19 cases, better predicted individuals' disease psychology compared to the positive linear tracking term alone.

CHAPTER 2

METHOD

Participants

Participants were recruited as part of a broader study (Neuberg et al., 2020) focused on testing hypotheses regarding the effects of COVID-19 on a wide range of prejudices, as moderated by factors such as political ideology and social attitudes. For the first wave, 1,503 Prolific participants were recruited on April 8, 2020, and invited to take follow-u*p* surveys on June 3 (participating N = 1,113), August 5 (N = 939), September 23 (N = 805), November 18, 2020 (N = 734), and February 3, 2021 (N = 715). On average, participants completed 4 waves (SD = 1.9).

Measures

Ecological Changes in COVID-19 Infection Risk

Ecological COVID infection risk was assessed at the national level by tracking the 7-day average number of new infection cases from the Centers for Disease Control and Prevention (W1 = 30,620, W2 = 21,695, W3 = 56,758, W4 = 43,560, W5 = 162,799, W6 = 133,020) to capture the range of variation in the risk of infection.

Disease Avoidance Motivation

To assess how individuals change their motivation to avoid disease, disease avoidance motivation was measured using 3 items from the original six-item Disease Avoidance subscale of the Fundamental Social Motives inventory (Neel et al., 2016): "I avoid places and people that might carry diseases", "I do not worry very much about getting germs from others" (reverse-coded)," and "I don't mind being around people who are sick" (reverse-coded) (1 = *strongly disagree*, 7 = *strongly agree*). This measure was assessed at all six waves of the study.

Perceived Vulnerability

To assess perceived vulnerability to infectious diseases in general, participants indicated their agreement with the 2 highest factor-loading items from the Perceived Infectability subscale of the Perceived Vulnerability to Disease scale (Duncan et al., 2009): “In general, I am very susceptible to colds, flu, and other infectious diseases” and “I am unlikely to catch a cold, flu, or other illness, even if it is ‘going around’” (reverse-coded) (1 = *strongly disagree*, 7 = *strongly agree*). This measure was assessed at the first to fifth waves of the study.

COVID-specific Vulnerability

To assess perceived vulnerability to COVID-19 infection, participants indicated their agreement on “I am vulnerable to being infected by the novel coronavirus (i.e., COVID-19)” (1 = *strongly disagree*, 9 = *strongly agree*). This measure was assessed at all six waves of the study.

Pathogen Disgust Sensitivity

To understand how individuals change their affective sensitivity to pathogen risk, pathogen disgust sensitivity was measured using 4 items from the Pathogen Disgust Sensitivity subscale of the Three-Domain Disgust Scale (Tybur et al., 2009): “Standing close to a person who has body odor”, “Shaking hands with a stranger who has sweaty palms”, “Sitting next to someone who has red sores on their arm”, “Accidentally touching a person’s bloody cut” (0 = *not at all disgusting*, 6 = *extremely disgusting*). This measure was assessed at the first to fifth waves of the study.

Preventative Behavior

To understand how individuals changed how they responded to the risk of infection from COVID-19, behavioral intentions and outcomes were measured. From the 2nd wave on, participants were asked whether they frequently wash their hands and wear a mask to avoid contracting or spreading COVID-19 and whether they try hard to follow all of the COVID-19 “rules” for proper behavior (1 = *strongly disagree*, 9 = *strongly agree*). This measure was assessed at the second to sixth waves of the study.

Demographics

Participants’ political party affiliation, political orientation (1 = *extremely liberal*, 7 = *extremely conservative*), gender identity, and parental status (i.e., whether they have minor-aged children) were measured.

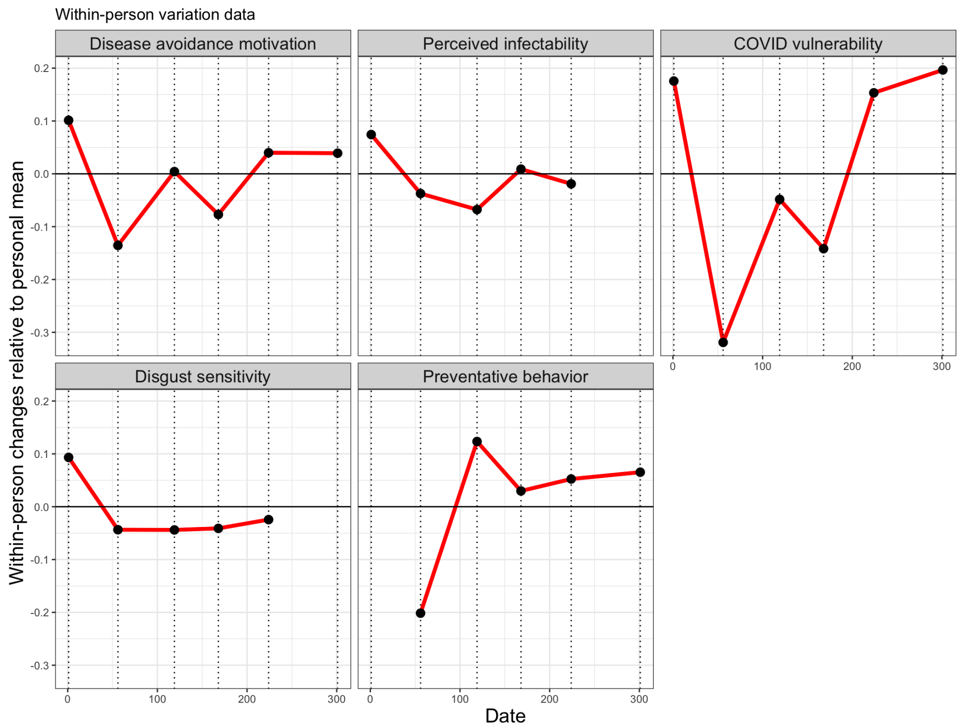
CHAPTER 3

RESULTS

As an initial step in exploring the dataset, I created a plot of each datapoint representing within-person changes relative to participants' personal mean across six survey dates, starting from the first survey (Figure 1). I observed that the within-person changes for each of the five disease psychology variables shifted across the six waves, and that they did not conform perfectly to a linear regression line.

Figure 1

Within-Person Changes Relative to Personal Mean by Survey Date on the Five Disease Psychology Variables

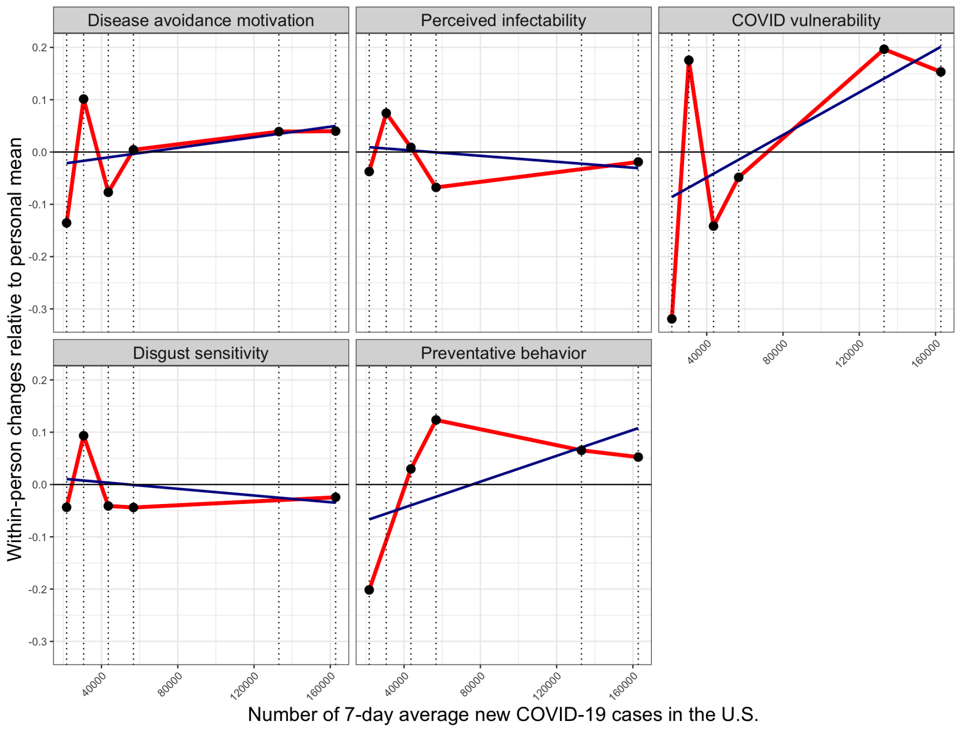


Note. Disease avoidance motivation and COVID vulnerability were collected at all six waves. Perceived infectability and disgust sensitivity were collected from 1st to 5th waves. Preventative behavior was collected from 2nd to 6th waves.

In addition, I plotted a linear regression line to explore the relationship between the number of 7-day average new COVID-19 cases in the U.S. and within-person changes relative to personal mean across six waves (Figure 2). Disease avoidance motivation, COVID vulnerability, and preventative behavior exhibited a positive linear trend, whereas perceived infectability and pathogen disgust sensitivity had a negative linear trend.

Figure 2

Within-Person Changes Relative to Personal Mean by the Number of 7-Day Average New COVID-19 Cases in the U.S. on the Five Disease Psychology Variables



Note. Disease avoidance motivation and COVID vulnerability were collected at all six waves. Perceived infectability and disgust sensitivity were collected from 1st to 5th waves. Preventative behavior was collected from 2nd to 6th waves. Blue line = linear regression line

1. Are Some Psychological Features or Characteristics More Versus Less Likely to Be Calibrated?

The first research question aimed to identify whether certain psychological features or characteristics were more likely to be calibrated than others. Specifically, I investigated within-person changes in psychological features known to play a crucial role in how individuals manage and navigate the risk of infection. These included disease avoidance motivation, perceived vulnerability, COVID-specific vulnerability, pathogen disgust sensitivity, and preventative behaviors.

To investigate how COVID-19 cases at each time point influenced individuals' disease psychology, for each disease psychology variable, I employed a Bayesian autoregressive model with time varying ecological changes in COVID-19 infection risk as my predictor. These models incorporated random effects, and test for unique means between participants (α_i), unique carryover effects between participants (φ_i), and unique COVID case effects between participants (β_i). Carryover effects reflect how strongly a participant's disease psychology at the previous time point shaped their disease psychology at the next time point (e.g., lagged effect or temporal autocorrelation). COVID case effects reflect how strongly COVID-19 cases at each time point shaped their disease psychology at that same time point.

This model also examines between-person *variance* to assess whether there are sufficient variabilities between individuals in their mean levels, carryover effects, and COVID-case effects of disease psychology. With sufficient variability, I can test whether other variables moderate these differences (Research Question #2).

To account for measurement error and adjust for possible unreliability that can cause Lüdtke's and Nickell's bias using raw data, all predictors were latent-centered in the within-person sub-model (Asparouhov et al., 2018; Lüdtke et al., 2008; Nickell, 1981). Latent-centering involves subtracting each individual's mean score from their observed scores to estimate the deviation from their typical level of disease psychology.

All reported p-values were based on one-tailed analyses conducted in Mplus for Bayesian analyses. Because the Bayesian research question involves a directional hypothesis (i.e., the hypothesis predicts the direction of the effect), a one-tailed test is more appropriate and the default in Mplus.

$$Disease\ avoindace\ motivation_{ti} =$$
$$\alpha_i + \varphi_i \times Disease\ avoidance\ motivation^{LC}_{(t-1)i} + \beta_i \times COVID^{LC}_{ti} + e_{ti} \qquad (1)$$

$$e_i \sim N(0, \sigma^2)$$

$$\alpha_i = \gamma_{00} + u_{0i}$$

$$\varphi_i = \gamma_{10} + u_{1i}$$

$$\beta_i = \gamma_{20} + u_{2i}$$

$$COVID^{LM}_i = \gamma_{30} + u_{3i}$$

COVID Case Effect

The study aimed to examine the influence of COVID-19 cases at each time point on the five disease psychology variables (Table 1). In anticipation of the analyses presented below, there were significant positive linear tracking effects of COVID-19 cases for disease avoidance motivation and COVID-specific vulnerability, above and beyond within-person carryover effects. This suggests that increases in the ecological risk of COVID-19 infection predicted increases in how people were motivated to avoid places and people who might carry diseases and how people perceived being vulnerable to being infected by the COVID-19. In contrast, there was a significant negative linear tracking effect of COVID-19 cases for pathogen disgust sensitivity, such that increases in the ecological risk of COVID-19 infection predicted decreases in how sensitively individuals felt disgusted toward body odor, sweat, sores, and cuts. There was no significant COVID case effect on preventative behavior.

Table 1
A Bayesian autoregressive model with a time-varying ecological changes in COVID-19 infection risk

	Disease avoidance motivation	COVID vulnerability	Pathogen disgust sensitivity	Preventative behavior
Between-person Means				
Unique mean (α_i)	5.45	5.66	5.14	8.01
Carryover effect(φ_i)	0.29	0.36	0.54	0.46
COVID effect (β_i)	0.02	0.12	-0.12	0.09
Between-person Variance				
Unique mean (α_i)	0.66	2.28	0.45	0.71
COVID effect (β_i)	0.18	0.18	0.13	0.18
COVID effect	0.02	0.03	0.09	0.05
95% CI on between-person differences				
Unique mean (α_i)	[3.86, 7.04]	[2.70, 8.62]	[3.83, 6.45]	[6.36, 9.66]
Carryover effect(φ_i)	[-0.54, 1.12]	[-0.47, 1.19]	[-0.17, 1.25]	[-0.37, 1.29]
COVID effect (β_i)	[-0.22, 0.26]	[-0.20, 0.44]	[-0.71, 0.47]	[-0.35, 0.53]

Note. All estimates are statistically significant $p < .001$.

Disease Avoidance Motivation

A Bayesian autoregressive model with 1 timepoint lagged examined the effects of COVID-19 cases on disease avoidance motivation, while accounting for the within-subject carryover effect (i.e., lagged effect, temporal autocorrelation) and between-subject variability.

At the between-person level, which examines differences between different individuals, the mean of disease avoidance motivation (γ_{00}) was estimated to be 5.45

(*SD* = 0.03, *p* < .001, 95% CI [5.39, 5.51]) on a 1-7 scale. The mean of carryover effect (γ_{10}) was estimated to be 0.29 (*SD* = 0.03, *p* < .001, 95% CI [0.24, 0.34]), which suggests that a participant's disease avoidance motivation at one time point significantly and positively predicted their disease avoidance motivation at the next time point. Importantly, the mean of COVID case effect (γ_{20}) was estimated to be 0.02 (*SD* = 0.01, *p* = .018, 95% CI [0.00, 0.05]). This indicates that the number of 7-day average new COVID-19 cases in the U.S. significantly and positively predicted individuals' disease avoidance motivation at the same time point, after accounting for carryover effects. In other words, participants' disease avoidance motivation was shaped by the current level of COVID-19 cases in addition to the influence of their previous disease avoidance motivation.

That said, there was significant variance in the magnitude of those effects. This indicates that different participants had significantly different mean levels, carryover effects, and COVID case effects. The variance of disease avoidance motivation (u_{00}) at the between-level was estimated to be 0.66 (*SD* = 0.05, *p* < .001, 95% CI [0.56, 0.75]), the variance of carryover effect (u_{10}) was estimated to be 0.18 (*SD* = 0.02, *p* < .001, 95% CI [0.15, 0.21]), and the variance of COVID case effect (u_{20}) was estimated to be 0.02 (*SD* = 0.01, *p* < .001, 95% CI [0.01, 0.04]).

Based on the estimated between-person level mean and variance, the mean level of disease avoidance motivation for 95% of participants was between 3.86 and 7.04, indicating a wide range of mean levels of disease avoidance motivation across individuals. The carryover effect ranged from -0.54 to 1.12, indicating that the influence of a participant's disease avoidance motivation at one time point on their subsequent disease avoidance motivation varied widely across individuals. Similarly, the COVID case effect ranged from -0.22 to 0.26, indicating that the extent to which individuals' disease avoidance motivation was influenced by changes in COVID-19 cases varied across individuals. These results suggest that while, on average, COVID-19 cases had a positive effect on disease avoidance motivation (γ_{20} = 0.02), the magnitude and direction of the effect varied across individuals (u_{20} = 0.02). Some individuals had a negative COVID case effect (i.e., reduced disease avoidance motivation with increasing COVID-19 cases), whereas others had a positive COVID case effect (i.e., increased disease avoidance motivation with increasing COVID-19 cases).

Perceived Infectability

The estimated between-level posterior variance-covariance matrix for perceived infectability was not positive definite as it should be, indicating a potential issue with the model. This suggests that the model may not have been able to accurately estimate the variance-covariance matrix due to convergence issues or other factors. Further exploration of the model and data may be necessary to identify and address the problem.

COVID-specific Vulnerability

At the between-person level, the mean of COVID-specific vulnerability (γ_{00}) was estimated to be 5.64 (*SD* = 0.06, *p* < .001, 95% CI [5.52, 5.76]), the mean of carryover effect (γ_{10}) was estimated to be 0.36 (*SD* = 0.03, *p* < .001, 95% CI [0.31, 0.41]), and the mean of COVID case effect (γ_{20}) was estimated to be 0.12 (*SD* = 0.02, *p* < .001, 95% CI [0.09, 0.16]), indicating a significant COVID case effect on COVID-specific vulnerability over and beyond the carryover effect.

There were significant between-person variations on mean level (u_{00} = 2.28, D = 0.18, *p* < .001, 95% CI [1.95, 2.65), carryover effect (u_{10} = 0.18, *SD* = 0.01, *p* < .001, 95% CI [0.15, 0.21], and COVID cases effects (u_{20} = 0.03, *SD* = 0.02, *p* < .001, 95% CI

[0.01, 0.07]). This indicates that different participants had significantly different mean levels, carryover effects, and COVID case effects.

Pathogen Disgust Sensitivity

At the within-level, the residual variance of pathogen disgust sensitivity was estimated to be 0.56 (*SD* = 0.024, *p* < .001, 95% CI [0.52, 0.61]). At the between-level, the mean of pathogen disgust sensitivity (γ_{00}) was estimated to be 5.14 (*SD* = 0.04, *p* < .001, 95% CI [5.07, 5.21]), the mean of carryover effect (γ_{10}) was estimated to be 0.54 (*SD* = 0.03, *p* < .001, 95% CI [0.49, 0.59]), and the mean of COVID case effect (γ_{20}) was estimated to be -0.12 (*SD* = 0.05, *p* = 0.003, 95% CI [-0.20, -0.02]), indicating significant negative linear tracking COVID case effect on pathogen disgust sensitivity, over and beyond the significant carryover effect.

There were significant between-person variations on mean level (u_{00} = 0.45, *SD* = 0.06, *p* < .001, 95% CI [0.34, 0.57]), carryover effect (u_{10} = 0.13, *SD* = 0.02, *p* < .001, 95% CI [0.10, 0.17]), and COVID cases effects (u_{20} = 0.09, *SD* = 0.05, *p* < .001, 95% CI [0.01, 0.19]) of pathogen disgust sensitivity. This indicates that different participants had significantly different mean levels, carryover effects, and COVID case effects.

Preventative Behavior

At the within-level, the residual variance of preventative behavior was estimated to be 0.60 (*p* < .001, 95% CI [0.55, 0.65]). At the between-level, the mean of preventative behavior (γ_{00}) was estimated to be 8.01 (*p* = .003, 95% CI [7.91, 8.11]), the mean of carryover effect (γ_{10}) was estimated to be 0.46 (*SD* = 0.13, *p* < .001, 95% CI [0.40, 1.01]), and the mean of COVID case effect (γ_{20}) was estimated to be 0.09 (*SD* = 0.30, *p* = 0.030, 95% CI [-0.01, 0.117]), indicating a marginally significant positive linear tracking COVID case effect on preventative behavior, over and beyond a significant carryover effect.

There were significant between-person variations on mean level (u_{00} = 0.71, *p* < .001, 95% CI [0.55, 0.87]), carryover effect (u_{10} = 0.18, *SD* = 0.04, *p* < .001, 95% CI [0.001, 0.213]), and COVID cases effects (u_{20} = 0.05, *SD* = 0.01, *p* < .001, 95% CI [0.02, 0.07]) of preventative behavior. This indicates that different participants had significantly different mean levels, carryover effects, and COVID case effects.

However, we should interpret these findings with caution, given that the posterior *SD* for the intercept in this model was unrealistically high, which may indicate potential issues with the model or the data. Further investigation may be necessary to identify and address the problem.

Summary

Consistent with the hypothesis, disease avoidance motivation and COVID-specific vulnerability, which are directly related to managing changes in ecological infection risk, were more responsive to changes in the COVID-19 cases compared to less directly relevant features, such as pathogen disgust sensitivity. Surprisingly, the study found that preventative behaviors were not as sensitively calibrated by changes in the ecological COVID infection risk as I had predicted.

That said, the study also found that there were significant between-person differences in how ecological infection risk (i.e., COVID-19 cases) predicted participants' disease avoidance motivation and COVID-specific vulnerability, above and beyond the effects of their previous levels of disease avoidance motivation and COVID-specific vulnerability. These results highlight the importance of considering individual differences when studying disease psychology and suggest that some individuals may be more sensitive to changes in the COVID-19 environment than others.

2. Are Certain Types of People More Sensitive to These Ecological Changes in Infection Risk?

The second research question investigated whether demographic factors, such as political orientation, gender, and parental status, moderated the within-person calibration of cognition and motivation in response to changes in the ecological risk of COVID-19 infection. I hypothesized that a group of individuals with relatively higher dispositional levels of disease-relevant psychology, such as those who identified as liberal (compared to conservative), women (compared to men), and parents with minor-aged children (compared to non-parents or parents with children older than minor age), would exhibit more sensitive calibration of their COVID-relevant disease psychology in response to changes in the ecological risk of COVID-19 infection.

To investigate how individual's political orientation, gender identity, and parental status explained between-person differences in mean level, carryover effect, and COVID case effect, Bayesian autoregressive models were used with each demographic moderator included (e.g., $\gamma_{01},\ \gamma_{11},\ \gamma_{21}$ in the model below). Additionally, to account for individual variability in volatility—i.e., how much individuals change across time—a location-scale model was employed, which allowed for the estimation of within-person variance for each participant. This approach allowed for the direct estimation of volatility (e.g., ω_0 in the model below) and the examination of moderators (e.g., ω_1 in the model below) that may explain why some individuals are more volatile than others. The results are reported in Table 2.

$$DiseaseMotive_{ti} = \alpha_i + \varphi_i DiseaseMotive^c_{(t-1)i} + \beta_i Covid^c_{ti} + e_{ti} \quad (2)$$

$$e_i \sim N(0, \sigma_i^2)$$

$$\alpha_i = \gamma_{00} + \gamma_{01} Conservatism^c_i + \gamma_{02} Covid^b_i + u_{0i}$$

$$\varphi_i = \gamma_{10} + \gamma_{11} Conservatism^c_i + u_{1i}$$

$$\beta_i = \gamma_{20} + \gamma_{21} Conservatism^c_i + u_{2i}$$

$$Covid^b_i = \gamma_{30} + u_{3i}$$

$$\sigma_i^2 = \exp(\omega_0 + \omega_1 Conservatism^c_i + u_{4i})$$

Table 2

A Bayesian autoregressive model with a time-varying covariate of ecological changes in COVID-19 infection risk with moderator

	Disease avoidance motivation	**Perceived infectability**	**COVID vulnerability**	**Pathogen disgust sensitivity**	**Preventative behavior**
Political orientation (higher = more conservative, lower = more liberal)					
Intercept (γ_{01})	**-0.13**	**-0.13**	**-0.31**	0.06	0.00
	[-0.17, -0.09]	[-0.22, -0.05]	[-0.39, -0.23]	[-0.01, 0.12]	[-0.02, 0.01]
Carryover (γ_{11})	**0.03**	-0.02	**0.04**	0.01	**0.09**
	[0.001, 0.06]	[-0.03, 0.003]	[0.01, 0.07]	[-0.01, 0.03]	[0.07, 0.11]
COVID (γ_{21})	**-0.02**	0.00	-0.01	0.00	0.00
	[-0.04, -0.01]	[-0.08, 0.07]	[-0.03, 0.02]	[-0.04, 0.05]	[-0.01, 0.004]
Volatility (ω_1)	**0.06**	-0.02	0.04	0.00	**0.43**
	[0.02, 0.10]	[-0.06, 0.03]	[-.003, 0.09]	[-0.04, 0.04]	[-0.33, 0.52]
Gender identity (0 = man, 1 = woman)					
Intercept (γ_{01})	**0.35**	**0.40**	**0.45**	**0.29**	
	[0.23, 0.47]	[0.16, 0.60]	[0.20, 0.70]	[0.13, 0.43]	
Carryover (γ_{11})	-0.05	**0.12**	0.03	0.00	
	[-0.16, 0.05]	[0.07, 0.17]	[-0.07, 0.13]	[-0.06, 0.05]	
COVID (γ_{21})	**-0.05**	-0.08	-0.01	-0.09	
	[-0.09, -0.01]	[-0.35, 0.20]	[-0.01, 0.06]	[-0.28, 0.15]	
Volatility (ω_1)	-0.06	0.02	-0.10	0.02	
	[-0.21, 0.08]	[-0.12, 0.14]	[-0.25, 0.06]	[-0.14, 0.16]	
Parental status (0 = no minor-aged child, 1 = have (a) minor-aged child(ren))					
Intercept (γ_{01})	-0.09	**0.29**	-0.20	-0.11	0.00
	[-0.26, 0.08]	[0.02, 0.58]	[-0.51, 0.12]	[-0.28, 0.09]	[-0.65, 0.04]
Carryover (γ_{11})	**0.14**	-0.05	0.03	**-0.09**	**0.11**
	[0.02, 0.27]	[-0.12, 0.02]	[-0.10, 0.15]	[-0.16, -0.01]	[0.02, 0.19]
COVID (γ_{21})	0.01	0.01	-0.06	0.00	0.00
	[-0.05, 0.06]	[-0.28, 0.34]	[-0.16, 0.03]	[-0.24, 0.23]	[-0.01, 0.02]
Volatility (ω_1)	-0.10	0.09	0.08	0.09	0.20
	[-0.06, 0.28]	[-0.08, 0.28]	[-0.09, 0.26]	[-0.10, 0.29]	[-0.19, 0.57]

Note. Bolded estimates are statistically significant $p < .025$.

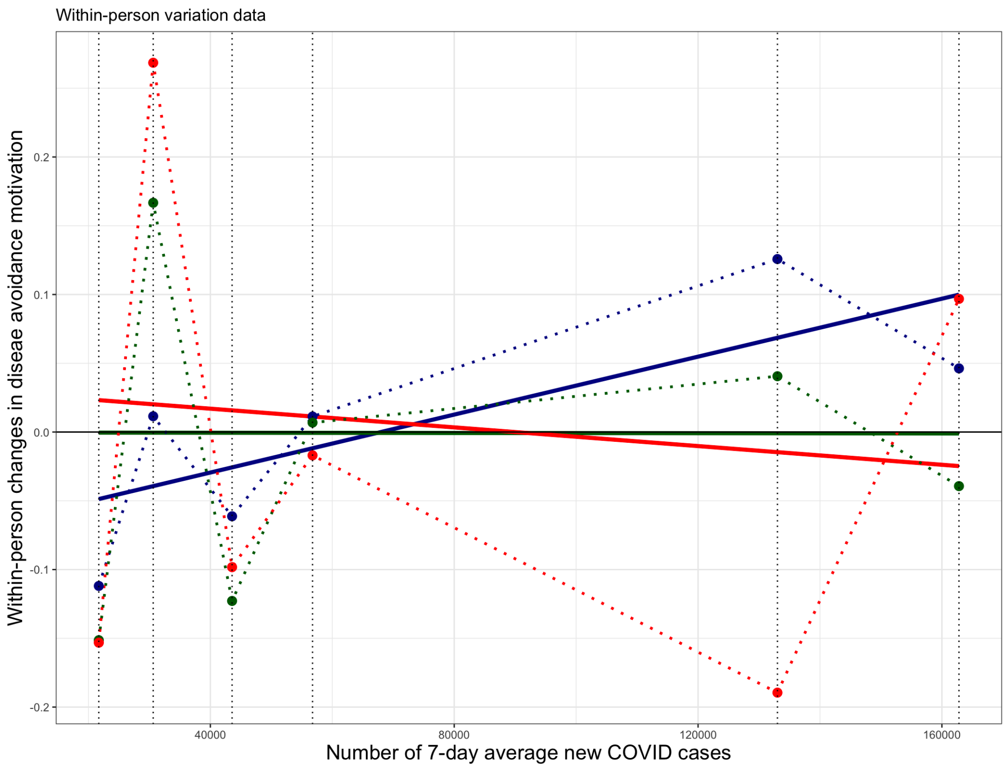
Political Orientation

I hypothesized that liberals may be more sensitive to ecological changes in COVID-19 risk in calibrating their disease psychology. This is because, in the United States, Republican politicians and supporters were less likely than Democratic politicians and supporters to believe that COVID-19 is a significant threat to public and personal health (Calvillo et al., 2020; Green et al., 2020; Van Green & Tyson, 2020). Past research suggests that Republicans were less likely to comply with social distancing guidelines and shutdown measures in the US during the early stages of the pandemic compared to individuals who identified with other political parties (Barbalat & Franck, 2022; Hill et al., 2021; Roberts & Utych, 2021).

Disease Avoidance Motivation. Figure 3 shows that disease avoidance motivation varied by number of 7-day average new COVID-19 cases in the U.S. and differed based on participants' political party affiliation. The linear regression line indicates a slight positive association between disease avoidance motivation and new COVID-19 cases for Democrat participants, and a slight negative association for Republican participants.

Figure 3

Within-person changes in disease avoidance motivation by number of 7-day average new COVID-19 cases, stratified by participants' political party affiliation.



Note. Solid line = linear regression line; Blue = Democrats; Green = Independents; Red = Republicans

At the between-person level, there was a significant negative effect of conservatism on mean level of disease avoidance motivation (γ_{01}= -0.130, *SD* = 0.020, *p* < .001, 95% CI [-0.17, -0.091]), a significant positive effect of conservatism on carryover effect (γ_{11}= 0.031, *SD* = 0.015, *p* = 0.021, 95% CI [0.001, 0.060]), a significant negative effect of conservatism on COVID case effect (γ_{21}= -0.021, *SD* = 0.007, *p* = 0.001, 95% CI [-0.035, -0.007]), and a significant positive effect of conservatism on volatility (ω_1= 0.063, *SD* = 0.021, *p* = 0.003, 95% CI [0.021, 0.104]). This means that a one-unit increase in conservatism predicted a 0.130 decrease in mean disease avoidance motivation, a 0.031 increase in how disease avoidance motivation at the previous timepoint predicted the subsequent one, a 0.021 decrease in how ecological infection risk of COVID-19 predicted disease avoidance motivation, and a 1.07 increase in how much individual's disease avoidance motivation varied across time (i.e., exp(0.063)). These results suggest that liberals were more highly motivated to avoid disease and that they more sensitively calibrated their disease avoidance motivation to COVID cases than did conservatives. In contrast, conservatives were more strongly influenced by their previous levels of disease avoidance motivation and exhibited greater variability in their levels of disease avoidance motivation over time than did liberals.

Other Disease Psychology. Conservatives had lower levels of perceived infectability (γ_{01}= -0.134, *SD* = 0.042, *p* < 0.001, 95% CI [-0.218, -0.046]) and COVID-specific vulnerability (γ_{01}= -0.309, *SD* = 0.040, *p* < 0.001, 95% CI [-0.388, -0.230]) compared to liberals. However, there were no significant differences in pathogen disgust sensitivity and preventative behaviors. Conservatives had stronger carryover effects in their COVID-specific vulnerability (γ_{11}= 0.037, *SD* = 0.016, *p* = 0.012, 95% CI [0.005, 0.067]) and preventative behavior (γ_{11}= 0.088, *SD* = 0.010, *p* < 0.001, 95% CI [0.067, 0.107]), and greater volatility in their preventative behavior (ω_1= 0.429, *SD* = 0.048, *p* < 0.001, 95% CI [0.334, 0.523]). Importantly, political orientation did not significantly moderate the COVID case effect for perceived infectability, COVID-specific vulnerability, pathogen disgust sensitivity, and preventative behavior (see Table 3).

Summary. I hypothesized that individuals who identified as politically liberal, who tended to be concerned about COVID-19 more, would be more sensitive to changes in infection risk and calibrate their disease avoidance motivation, COVID-specific vulnerability, and preventative behavior accordingly (as proposed in hypothesis #1). Although liberal participants did demonstrate higher levels of disease avoidance motivation and perceived greater vulnerability to COVID-19, political orientation only explained between-individual differences in the effect of COVID cases on disease avoidance motivation, not on COVID-specific vulnerability. Specifically, politically liberal individuals were more sensitive to changes in COVID cases when it came to their disease avoidance motivation, but not in their perception of vulnerability to COVID-19 infection. Notably, there were no significant differences between liberals and conservatives in mean levels of preventative behavior, which was unexpected.

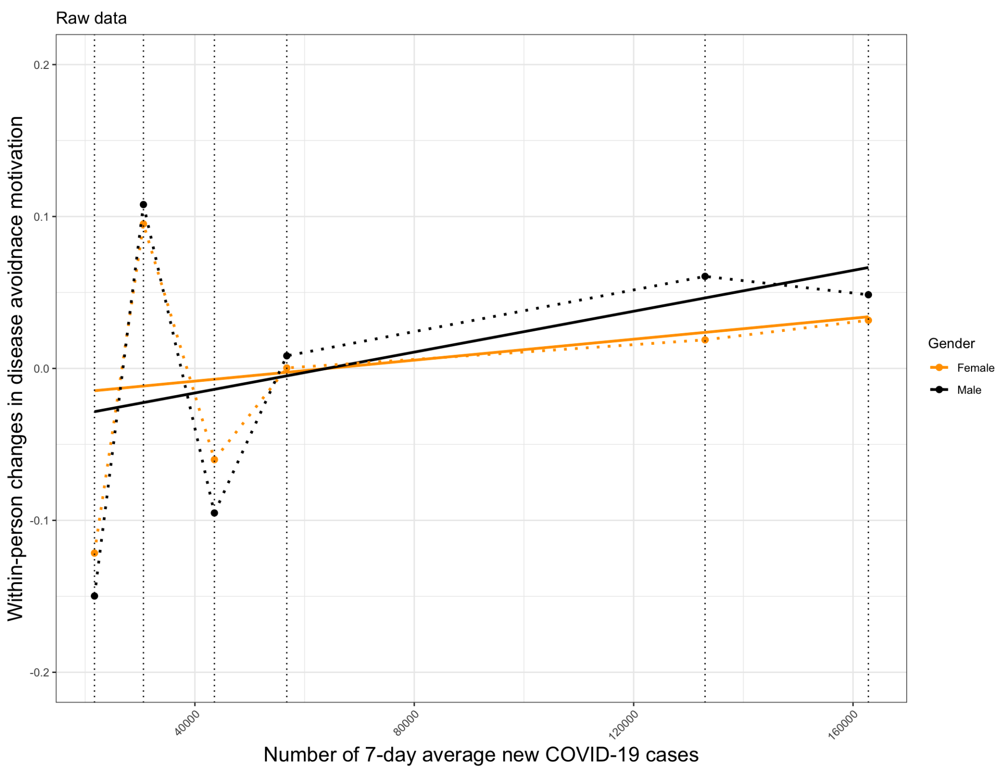
Gender Identity

I hypothesized that women, compared to men, would have greater sensitivity to ecological changes in COVID-19 risk in calibrating their disease psychology. Past research suggests that women are more dispositionally likely to feel vulnerable to infection (Díaz et al., 2016; Duncan et al., 2009) and report higher levels of stress, fear, and worry in response to COVID-19 infection threats, thereby engaging in behaviors that aim to reduce their risk of infection (Levkovich & Shinan-Altman, 2021). These findings suggest that women may be more sensitive in calibrating their perceived vulnerability to COVID-19, motivation to avoid disease, and preventative behavior in response to ecological changes in COVID-19 infection risk.

Disease Avoidance Motivation*.* At the between-person level, there was a significant positive effect of gender identity on disease avoidance motivation (γ_{01}= 0.350, *SD* = 0.061, *p* < .001, 95% CI [0.230, 0.472]) and a significant negative effect of gender identity on COVID case effect (γ_{21}= -0.045, *SD* = 0.021, *p* = 0.013, 95% CI [-0.087, -0.005]). However, there was no significant effect of gender identity on carryover effect (γ_{11}= -0.053, *SD* = 0.053, *p* = 0.158, 95% CI [-0.156, 0.052]) or volatility (ω_1= -0.063, *SD* = 0.073, *p* = 0.190, 95% CI [-0.207, 0.080]). Being a woman, compared to being a man, increased disease avoidance motivation by 0.350 but decreased COVID-19 case effects by 0.045. The results suggest that, even though women were more highly motivated to avoid disease than were men, men calibrated their disease avoidance motivation more sensitively to COVID cases than did women (See Figure 4). Overall, the study replicated previous findings that women are generally more motivated to avoid places or people who might carry disease, but it also revealed that higher motivation did not necessarily lead to greater sensitivity to ecological change.

Figure 4

Within-person changes in disease avoidance motivation by number of 7-day average new COVID-19 cases, stratified by participants' gender identity



Note. Solid line = linear regression line; Gold = Women; Black line = Men

Preventative Behavior*.* The estimated between-level posterior variance-covariance matrix was not positive definite, which could indicate a potential issue with the model. This suggests that the model may have encountered convergence issues or other factors that prevented it from accurately estimating the variance-covariance matrix. Further investigation of the model and data may be required to identify and resolve the problem.

Other Disease Psychology*.* Consistent with prior research, women exhibited higher levels of perceived infectability (γ_{01}= 0.400, *SD* = 0.112, *p* < .001, 95% CI [0.161, 0.600]), COVID-specific vulnerability (γ_{01}= 0.453, *SD* = 0.127, *p* < .001, 95% CI [0.202, 0.700]), and pathogen disgust sensitivity (γ_{01}= 0.285, *SD* = 0.078, *p* < .001, 95% CI [0.127, 0.430]). Women also displayed a greater carryover effect in their perceived infectability (γ_{11}= 0.119, *SD* = 0.-27, *p* < .001, 95% CI [0.068, 0.173]), but no significant gender differences were found in COVID-specific vulnerability and pathogen disgust sensitivity. Notably, gender identity did not significantly moderate the COVID case effect or volatility for perceived infectability, COVID-specific vulnerability, pathogen disgust sensitivity, and preventative behavior (see Table 3).

Summary. I hypothesized that women, who tend to be more concerned about disease, would more sensitively calibrate their disease avoidance motivation, COVID-specific vulnerability, and preventative behavior by ecological changes in infection risk. Although women did demonstrate higher levels of disease avoidance motivation and perceived greater vulnerability to COVID-19, my analysis found that men were more sensitive on ecological infection changes on their disease avoidance motivation. Overall, the study replicated previous findings that women are generally more concerned about disease, but it also revealed that higher personal disease concern did not necessarily lead to greater sensitivity to ecological change.

Parental Status

I hypothesized that parents, especially those with minor-aged children, may more sensitively calibrate their disease psychology to ecological changes in COVID-19 risk to ensure the well-being of their family. Past research suggests parents are more generally likely to be risk-sensitive (Tang et al., 2016), perceiving greater risk and making more risk-averse choices (Eibach & Mock, 2011; Görlitz & Tamm, 2020), especially when they have young children (Chaulk et al., 2003; Görlitz & Tamm, 2020).

Parents with minor-aged children were found to perceive greater infectability (γ_{01}= 0.287, *SD* = 0.142, *p* = .016, 95% CI [0.022, 0.576]) compared to those without minor-aged children. However, there were no significant differences between the two groups in terms of disease avoidance motivation, COVID-specific vulnerability, pathogen disgust sensitivity, and preventative behavior. Parents with minor-aged children had stronger carryover effects on their disease avoidance motivation (γ_{11}= 0.143, *SD* = 0.062, *p* = .012, 95% CI [0.019, 0.266]) and preventative behavior (γ_{11}= 0.105, *SD* = 0.043, *p* = .006, 95% CI [0.023, 0.188]), but weaker carryover effects on their pathogen disgust sensitivity (γ_{11}= -0.085, *SD* = 0.039, *p* = .013, 95% CI [-0.164, -0.009]). However, it is important to note that parental status did not significantly moderate the COVID case effect or volatility for any of the variables analyzed, including disease avoidance motivation, perceived infectability, COVID-specific vulnerability, pathogen disgust sensitivity, and preventative behavior. Overall, these findings suggest that although parental status may be associated with differences in perceived infectability and carryover effects on certain variables, it does not appear to play a significant role in how individuals respond to COVID cases in their disease-related psychology.

3. Do Individuals Become More Sensitized Versus Habituated to These Ecological Disease Changes?

The third research question aimed to identify whether individuals become more sensitized versus habituated to these ecological disease changes over time. To this end, a statistical model was utilized that examined both linear and quadratic patterns of COVID-19 cases over time, to determine whether the quadratic tracking patterns of COVID-19 cases predicted psychological calibration beyond the linear tracking patterns. It was hypothesized that individuals would exhibit greater sensitivity to changes in COVID-19 cases during the earlier stages of the pandemic, when the risk of infection was relatively low. This would be reflected in relatively large calibrations of cognition, motivation, and behavior in response to small increases in the risk of infection. However, in the later waves, as the risk of infection persisted and the spread and fatality of COVID-19 increased, individuals would become habituated to the risk and would require greater increases in the risk of infection to produce similar calibrations in cognition, motivation, and behavior. This process of habituation is expected to reduce the sensitivity of individuals to changes in the risk of infection over time.

To investigate the impact of the quadratic term of COVID-19 cases on disease psychology above and beyond the carryover effect (φ_i) and the linear tracking COVID case effect (β_{1i}), I utilized the same Bayesian autoregressive model that was employed for Research Question #1, but with the addition of a quadratic tracking effect (β_{2i}; See Equation 3 below).

$$Disease\ avoidance\ motivation_{ti} = \alpha_i + \varphi_i \times Disease\ avoidnace\ motivation_{(t-1)i}^{LC}$$
$$+\beta_{1i} \times COVID_{ti}^{LC} + \beta_{2i} \times \left(COVID_{ti}^{LC}\right)^2 + e_{ti} \qquad (3)$$
$$e_i \sim N(0, \sigma_i^2)$$
$$\alpha_i = \gamma_{00} + u_{0i}$$
$$\varphi_i = \gamma_{10} + u_{1i}$$
$$\beta_{1i} = \gamma_{20} + u_{2i}$$
$$\beta_{2i} = \gamma_{30} + u_{3i}$$
$$COVID_i^{LM} = \gamma_{40} + u_{4i}$$

The analysis revealed that, above and beyond carryover effect and linear tracking effect of COVID-19 cases, a quadratic tracking effect of COVID-19 cases significantly predicted participants' COVID-specific vulnerability (γ_{30} = -0.09, *SD* = 0.04, *p* < .001, 95% CI [-0.16, -0.03]) and preventative behaviors (γ_{30} = -0.17, *SD* = 0.02, *p* < .001, 95% CI [-0.20, -0.14]) and marginally significantly predicted disease avoidance motivation (γ_{30} = -0.03, *SD* = 0.02, *p* = .03, 95% CI [-0.07, 0.001]) (Table 3). These findings suggest that individuals were more responsive to and affected by small ecological changes in the COVID-19 when new COVID-19 cases were relatively low. However, when new COVID-19 cases were relatively high, they became less sensitive to these changes. As a result, greater changes in new COVID-19 cases were required to effectively shift disease avoidance motivation, COVID-specific vulnerability, and preventative behavior. However, given that there was a significant correlation between number of 7-day average new COVID-19 cases in the U.S. and date of the wave (*r* = 0.83, *t*(4) = 3.01, *p* = 0.039; greater COVID-19 cases in the latter waves), it is difficult to determine whether it was the number of new COVID cases or the date that contributed to people's habituation.

Despite the small effect sizes, there were significant between-person variations on disease avoidance motivation (u_{30} = 0.002, *SD* = 0.001, *p* < .001, 95% CI [0.001, 0.004]), COVID-specific vulnerability (u_{30} = 0.004, *SD* = 0.004, *p* < .001, 95% CI [0.001, 0.015]), and preventative behaviors (u_{30} = 0.002, *SD* = 0.001, *p* < .001, 95% CI [0.001, 0.005]), suggesting that there were between-person differences on how the quadratic term of COVID-19 shaped one's disease psychology. However, caution is warranted when interpreting these results because the effect sizes were very small, and the statistical significance may not reflect meaningful differences between individuals. In turn, as expected, none of the demographic factors moderated between-person differences in the quadratic tracking effect of COVID-19.

Moreover, the estimated between-level posterior variance-covariance matrix for perceived infectability and pathogen disgust sensitivity was not positive definite, which could indicate a potential issue with the model. This suggests that the model may have encountered convergence issues or other factors that prevented it from accurately estimating the variance-covariance matrix. It is possible that the variance was too small to effectively explore the complex relationships across time. Further investigation of the model and data may be required to identify and resolve the problem.

Table 3

A Bayesian autoregressive model with a time-varying covariate of ecological changes in COVID-19 infection risk and quadratic tracking COVID case effect

	Disease avoidance motivation	**COVID vulnerability**	**Preventative behavior**
Means			
Intercept	**5.45**	**5.63**	**8.01**
	[5.38, 5.51]	[5.51, 5.75]	[7.92, 8.09]
Carryover effect	**0.29**	**0.35**	**0.45**
	[0.24, 0.34]	[0.30, 0.40]	[0.40, 0.50]
Linear COVID effect	**0.06**	**0.23**	**0.28**
	[0.02, 0.11]	[0.15, 0.31]	[0.24, 0.33]
Quadratic COVID effect	**-0.03**	**-0.09**	**-0.17**
	[-0.07, 0.001]	[-0.16, -0.03]	[-0.20, -0.14]
Variance			
Intercept	**0.66**	**2.29**	**0.71**
	[0.56, 0.75]	[1.96, 2.66]	[0.57, 0.87]
Carryover effect	**0.18**	**0.18**	**0.18**
	[0.15, 0.21]	[0.15, 0.21]	[0.15, 0.21]
Linear COVID effect	**0.01**	**0.02**	**0.04**
	[0.003, 0.03]	[0.004, 0.06]	[0.02, 0.07]
Quadratic COVID effect	**0.002**	**0.004**	**0.002**
	[0.001, 0.004]	[0.001, 0.015]	[0.001, 0.005]

Note. All means and variances were statistically significant.

CHAPTER 4

DISCUSSION

The present study sheds light on the concept of psychological flexibility within individuals in response to changes in ecological affordances over time, specifically in the context of disease psychology during the first year of the COVID-19 pandemic in the United States. The findings suggest that individuals flexibly adjust their motivation and cognition directly relevant to managing COVID-19 infection in ways that minimize potential threats. An individual's disease avoidance motivation and perceived vulnerability to COVID-19 was partly shaped by both their pre-existing motivation and perceived vulnerability, respectively, and the current ecological affordances, as demonstrated by a significant positive linear effect of new COVID-19 cases. Specifically, during periods when the ecological threat of COVID-19 infection was relatively high and significant, people were more strongly motivated to avoid disease and believed that they were more vulnerable to COVID-19 infection. Political liberals and men, relative to political conservatives and women, were particularly sensitive to ecological infection changes in adjusting their disease avoidance motivation. Importantly, the quadratic effect of COVID-19 cases was also significant: the positive linear effect of COVID-19 cases was especially salient and strong during the early phase of the pandemic, when new COVID-19 cases were relatively low, but the positive effect of COVID-19 cases diminished as time passed even though the numbers of new cases increased. These results highlight the adaptive nature of human behavior in response to changing environmental circumstances and underscore the importance of considering both individual differences and ecological factors in understanding psychological flexibility within the same individuals.

The present research investigated how certain psychological features or characteristics within the infection management system may be calibrated differently depending on the nature of the ecological infection threat. Consistent with the proposed hypothesis, the study found that greater effects on psychological features directly related to managing changes in COVID-19 infection, which primarily spread through respiratory droplets. People's disease avoidance motivation and COVID-specific vulnerability were more responsive to changes in the COVID-19 environment compared to less relevant psychological features such as perceived infectability (in general) and pathogen disgust sensitivity (toward body odor or sweats). The 7-day average number of new COVID-19 cases in the U.S. was a significant predictor of within-person shifts in disease avoidance motivation and perceived COVID vulnerability, even after controlling for their pre-existing disease avoidance motivation and COVID vulnerability. These findings suggest that ecological risk factors, such as the prevalence of new COVID-19 cases, may have a significant impact on individuals' disease psychology that are directly related to the nature of COVID-19 infection, but not on other psychological systems that are broadly relevant to managing other types of diseases or infections. These results suggest that individuals may prioritize certain COVID-related disease psychological features over others when responding to changes in the COVID environment.

Next, the current research investigated whether certain groups of people were more sensitive to changes in infection risk due to ecological changes. The study hypothesized that—compared to conservatives, men, and non-parents—liberals, women, and parents would be more likely to be sensitive to these changes as they tend to perceive greater risk and report higher aversion to potential risks. The findings showed that liberals, who have had a dispositionally stronger motivation to avoid diseases during the COVID-19 pandemic, were indeed more sensitive and responsive to changes in COVID cases when calibrating their disease avoidance motivation. However, the study found no evidence of this for perceived infectability and COVID vulnerability. Despite perceiving greater vulnerability to infection in general and specifically to COVID-19, liberals did not more sensitively calibrate their perceived infectability and perceived vulnerability to COVID-19.

Despite women reporting higher motivation to avoid diseases, this study revealed that men were more sensitive to COVID cases when calibrating their disease avoidance motivation. Furthermore, although women perceived greater infection risk in general and to COVID-19, in particular, both men and women showed similar sensitivity to ecological COVID-19 infection risk. Overall, although this study replicated earlier findings that women tend to be more concerned about disease (Díaz et al., 2016; Duncan et al., 2009; Levkovich & Shinan-Altman, 2021), it also highlighted that having a higher disposition in disease psychology did not necessarily lead to greater sensitivity to ecological change.

Additionally, the study did not find any significant effects of parental status on the level of disease avoidance motivation or how sensitively individuals calibrated their disease avoidance motivation. One possible explanation for this finding is that minor-aged children were not particularly vulnerable to COVID-19 infection—they have been less likely to experience severe symptoms and have had a lower fatality rate compared to adults (Dhochak et al., 2020; Ludvigsson, 2020). Thus, parents may not have perceived their children as being at high risk of infection, which could have resulted in no significant differences in disease avoidance motivation based on parental status. This finding highlights another nuance in how our psychological system manages ecological affordances and is particularly sensitive to the types of ecological threat or opportunity when calibrating our motivation. In this case, the lack of significant effects of parental status on disease avoidance motivation suggests that our psychology is attuned to specific types of ecological threats, such as those that pose a greater risk to vulnerable populations.

Finally, the current study investigated whether individuals became more sensitized or habituated to ecological disease changes over time. As hypothesized, the findings showed that individuals were initially more responsive to and affected by small changes in the COVID-19 environment. However, in later stages of the pandemic, they became less sensitive to these changes, indicating a process of habituation. As a result, greater changes were required to effectively calibrate disease avoidance motivation, COVID-specific vulnerability, and preventative behavior. Specifically, although the positive linear effect of COVID-19 cases was not found to be significant in predicting preventative behaviors, this may be due to the presence of a significant quadratic effect. These findings suggest that individuals may initially be more reactive to ecological changes, but over time they may become desensitized to them, potentially resulting in a decreased motivation to engage in disease avoidance behaviors. It is important to note that habituation is not uncommon in psychology and has been observed in various contexts (Badour et al., 2017; Coppola et al., 2013; Rankin et al., 2009). The repeated exposure to a stimulus can lead to a reduction in responsiveness over time (Dandeneau et al., 2007; Kelly et al., 2007; Radford et al., 2016). In the case of the COVID-19 pandemic, individuals may have become desensitized to changes in infection rates or public health recommendations as the pandemic persisted. These findings have important implications for public health messaging and interventions, as they suggest that sustained or enhanced efforts may be required to maintain individuals' motivation to engage in disease avoidance behaviors throughout the course of a prolonged public health crisis.

The current research explored within-person flexibility on disease psychology during the recent COVID-19 pandemic. The unique implications of pathogen risk may extend beyond the individual level to impact social and cultural norms (e.g., Fincher & Thornhill, 2012; Sng et al., 2018). It would be crucial to investigate whether the hypotheses put forward in the study have unique implications for the effects of pathogen risk compared to other ecological dimensions or challenges. Resource availability, physical violence, and other environmental stressors could all have different implications for within-person flexibility and the affordance management strategies individuals employ. For instance, although this study found that people tend to become desensitized and habituated to ecological pathogen risk, it is important to investigate how ecological cues of aggression and physical violence might sensitize or habituated individuals to potential threats. One possibility is that frequent exposure to mild levels of these cues may lead to increased vigilance and sensitivity to potential danger. This could help individuals quickly detect and identify threats, and take appropriate management strategy to mitigate the risks.

The current study had limitations that may have impacted the results. One limitation was the relatively small number of timepoints, with only six timepoints being used to examine within-person variability and sensitivity to ecological changes over time. This may have restricted the ability to capture more nuanced changes in individuals' disease psychology. Future research could consider the use of ecological momentary assessment (EMA) or intensive longitudinal designs, which involve collecting more frequent and repeated measures of individuals' disease psychology in real-time.

It would be important to consider the implications of within-person changes versus between-person differences in a particular psychological feature or characteristic. For example, if disease avoidance motivation is found to predict stereotypes towards the elderly, it is crucial to determine whether a one-unit increase in disease avoidance motivation within an individual (e.g., Time A vs. Time B) has the same effects on stereotypes as a one-unit difference in disease avoidance motivation between individuals (e.g., Person A vs. Person B). It is possible that the consequences of within-person changes and within-person variability may differ from between-person differences in some ways. This is because within-person changes typically have less variability compared to between-person differences. As a result, it may require a more significant ecological change to produce the same amount of difference within an individual as it would between individuals. This could lead to a one-unit changes in within-person having a stronger effect on stereotypes compared to a one-unit between-person differences. Therefore, future research should examine the potential differences between these two types of predictors and consider them when making predictions about psychological outcomes.

In conclusion, these findings provide compelling evidence that individuals possess the ability to flexibly adjust their psychology to minimize potential threats and maximize potential opportunities. Specifically, the study found that people upregulated their motivation to avoid disease and perceived themselves to be more vulnerable to COVID-19 infection during periods when the threat of COVID-19 infection was high. Furthermore, some individuals were more sensitive in calibrating their motivation, with political liberals and men being particularly responsive to ecological infection changes in adjusting their disease avoidance motivation. However, the current study also found that a higher level of disease psychology does not necessarily lead to greater sensitivity to ecological changes. Additionally, the study revealed that individuals exhibited greater sensitivity during the early stages of ecological changes and greater habituation during the later stages. These findings underscore the adaptive nature of human behavior in response to changing environmental circumstances and highlight the importance of considering both individual and contextual factors in understanding psychological flexibility.

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