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Perceived Nonverbal Disruption and Anxiety During COVID19: The Role of Expressive Autonomy

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Abstract

The COVID-19 pandemic substantially altered everyday nonverbal communication, including touch, physical proximity, and facial expressiveness, yet the psychological implications of these disruptions remain poorly understood. Across two cross-sectional studies conducted during distinct phases of the pandemic, the present research examined how nonverbal behavioral engagement (NBE) and perceived disruption to nonverbal expression (COVID-19 Nonverbal Impact Measure; CNIM) relate to mental health outcomes. Study 1 (N = 186; Spring 2021) compared the associations of NBE and CNIM with anxiety, loneliness, and life satisfaction while accounting for social connectedness and gender. CNIM emerged as a robust predictor of anxiety independent of NBE, whereas associations with loneliness and life satisfaction were weaker and less consistent. Gender differences were observed in patterns of nonverbal behavior and emotional well-being, although gender did not moderate the relationship between CNIM and psychological outcomes. Study 2 (N = 143; Fall 2021) extended these findings by testing a motivational mechanism within a Self-Determination Theory framework. Results indicated that autonomy frustration mediated the association between CNIM and anxiety, while NBE showed minimal effects. Together, these findings suggest that anxiety during periods of social constraint is shaped less by reductions in nonverbal behavior itself and more by perceived limits on expressive freedom within interaction. CNIM thus captures a psychologically meaningful dimension of social disruption, with autonomy frustration representing a key pathway linking disrupted nonverbal communication to emotional distress.

Keywords: nonverbal communication; COVID-19; expressive disruption; autonomy frustration; anxiety; gender

Perceived Nonverbal Disruption and Anxiety During COVID-19: The Role of Expressive Autonomy

Nonverbal communication is central to how individuals build relationships, regulate emotion, and interpret social meaning (Knapp et al., 2014). Behaviors such as facial expressions, interpersonal touch, and physical proximity provide continuous feedback during interaction and shape perceptions of warmth, trust, and emotional intent (Burgoon et al., 2016; Hall et al., 2011). These cues are often automatic and context-sensitive, making them especially important for maintaining smooth social coordination. Physical touch and proximity play a foundational role in affiliative bonding processes, with evidence linking them to neuroendocrine responses such as oxytocin release and reduced stress reactivity (Dunbar & Shultz, 2010; Uvnäs-Moberg, 2024). Because these cues typically operate outside conscious awareness, they are rarely noticed when functioning normally but may become psychologically salient when disrupted.

The COVID-19 pandemic disrupted these everyday channels of communication on a global scale (WHO, 2021). Public health measures such as masking, physical distancing, and restrictions on physical contact fundamentally altered how individuals expressed and interpreted nonverbal behavior in daily interactions (Marra et al., 2020; Mheidly et al., 2020). Much of the psychological literature examining COVID-19 has emphasized reduced social interaction, social isolation, and decreased face-to-face contact as primary drivers of emotional distress (Brooks et al., 2020; Loades et al., 2020). Even when social contact is maintained, interactions may feel constrained when familiar nonverbal behaviors (e.g., touch, proximity, or facial expressiveness) are restricted or rendered socially inappropriate, a limitation that has been highlighted in calls for mechanism-focused pandemic mental health research (Holmes et al., 2020). Accordingly, emotional distress may hinge *less* on *reduced behavioral frequency* and more on a *perceived loss* of *expressive freedom*.

Consistent with this view, existing research has often operationalized disruptions to social interaction in terms of behavioral frequency, such as *how often* individuals engage in physical contact or expressive gestures (Burgoon, 1993; Kim & Florack, 2021). While informative, this approach overlooks a critical psychological distinction: whether individuals *perceive* themselves *as free* to *express* familiar forms of nonverbal behavior within interaction. Behavioral frequency and perceived expressive constraint represent conceptually distinct experiences: one reflects *what individuals do*, while the other reflects *how constrained they feel in doing it* (Lazarus & Folkman, 1984). Failing to distinguish between these processes may obscure an important source of distress during periods of social restriction, particularly when interaction continues but expressive freedom is diminished.

To address this distinction, the present research focuses on two complementary but conceptually distinct constructs. The first is *Nonverbal Behavioral Engagement* (NBE), which reflects an individuals' *perceived frequency* of *engaging* in physical, affiliative nonverbal behaviors, such as handshakes, hugs, high-fives, and other forms of positive nonverbal touch. NBE captures the extent to which individuals report continuing to enact these behaviors during daily interaction, consistent with prior frequency-based approaches to nonverbal communication. The second construct is perceived nonverbal disruption, assessed using the *COVID-19 Nonverbal Impact Measure* (CNIM). CNIM indexes individuals' *subjective perceptions* of how the COVID-19 pandemic impacted their nonverbal communication, including experiences of disruption or alteration associated with pandemic-related conditions.

Importantly, both NBE and CNIM are assessed via self-report but capture distinct psychological experiences: NBE reflects perceived behavioral engagement, whereas CNIM reflects individuals' appraisal of disruption to their nonverbal communication environment. This distinction allows for a direct empirical comparison between behavioral change and subjective disruption.

Perceived disruptions in nonverbal communication may have important implications for psychological well-being because nonverbal behavior serves as a primary channel through which emotional intent is expressed and interpersonal understanding is maintained (Burgoon et al., 2016; Knapp et al., 2014). Facial expression, touch, and physical proximity provide instrumental cues that reduce ambiguity during interaction and facilitate coordinated social exchange (Burgoon et al., 2016; Hall, 2011). When these cues are constrained or unavailable, individuals may need to rely more heavily on explicit verbal communication or a reduced set of nonverbal signals, increasing uncertainty about social meaning and emotional intent. Research grounded in Expectancy Violations Theory (EVT) shows that deviations from expected nonverbal behaviors (e.g., changes in interpersonal distance) can heighten uncertainty and discomfort, even during non-crisis interactions (Burgoon, 1993).

This heightened uncertainty is particularly relevant for anxiety, which is sensitive to ambiguous, constrained, or unpredictable social environments (Carleton, 2016; Grupe & Nitschke, 2013). Anxiety is commonly characterized by heightened vigilance, concern about interpretation, and difficulty managing situations in which expectations for appropriate behavior are unclear. When familiar nonverbal cues are restricted, individuals may experience increased cognitive and emotional effort during interaction as they attempt to interpret others' intentions with fewer available signals (Burgoon et al., 2016; Grupe & Nitschke, 2013). Accordingly, perceived disruption to

nonverbal communication may be especially consequential for anxiety, even in the absence of reduced social contact.

Beyond anxiety, disruptions to nonverbal communication may also bear on broader indicators of psychological well-being. Loneliness reflects the subjective discrepancy between desired and actual social connection, whereas life satisfaction captures a global evaluation of one's life circumstances (Perlman & Peplau, 1981; Pavot & Diener, 2008). Both outcomes were widely affected during the COVID-19 pandemic (Brooks et al., 2020; Loades et al., 2020) and are therefore relevant for assessing whether perceived expressive disruption extends beyond momentary emotional arousal to more stable relational and evaluative judgments. However, because these constructs are shaped by multiple social and contextual factors (e.g., relationship availability, social support, and broader life stressors), the extent to which they are linked to perceived nonverbal disruption remains an open empirical question.

To account for baseline differences in relational resources, the present research includes general social connectedness as a covariate. Social connectedness reflects a stable sense of belonging and integration within one's social world and is a robust predictor of psychological adjustment (Lee & Robbins, 1995). Levels of social connectedness varied substantially during the COVID-19 pandemic and are strongly linked to anxiety, loneliness, and life satisfaction (Brooks et al., 2020; Loades et al., 2020). Including social connectedness as a covariate allows for a conservative test of whether perceived nonverbal disruption explains variance in psychological outcomes above and beyond individuals' broader relational resources.

Finally, gender is examined as an exploratory moderator. Prior research suggests systematic gender differences in nonverbal expressiveness and affiliative behavior, which may have been particularly salient during pandemic-related restrictions on touch and expressive behavior (Hall & Gunnery, 2013; Hall et al., 2019). These differences raise the possibility that disruptions to nonverbal communication may be experienced differently across genders. However, because prior research has not directly examined gender differences in perceived nonverbal disruption, any moderation effects are treated as exploratory, and gender is not central to the primary theoretical contribution of the present research.

Collectively, these considerations suggest that perceived expressive disruption may have selective psychological consequences, with particularly strong implications for anxiety and more variable associations with

broader indicators of well-being. These considerations provide a foundation for empirically evaluating whether perceived disruption to nonverbal communication explains psychological distress beyond changes in behavioral engagement and social connectedness.

Overview. The present research employs a two-study design to examine the psychological consequences of pandemic-related disruptions to nonverbal communication. Across both studies, we distinguish between NBE and CNIM, allowing us to evaluate whether emotional distress is better explained by changes in nonverbal behavior frequency or by individuals' appraisals of how their nonverbal communication and expressive experience were impacted.

Study 1 adopts an exploratory approach to examine whether CNIM is more strongly associated with psychological outcomes than NBE alone. Study 1 assesses associations with anxiety, loneliness, and life satisfaction while accounting for broader relational resources such as social connectedness. Anxiety is treated as the primary outcome given its sensitivity to social uncertainty and communicative disruption, whereas loneliness and life satisfaction are included as broader indicators of psychological well-being. Gender is examined as an exploratory moderator to assess potential variability in these associations. Study 2 extends these findings by examining a psychological mechanism underlying the association between CNIM and anxiety. Drawing on Self-Determination Theory (SDT), Study 2 tests whether perceived nonverbal disruption is linked to anxiety through diminished autonomy, defined as the experience of volitional, self-endorsed expression (Ryan & Deci, 2000; Ryan & Deci, 2024). Importantly, CNIM does not assess autonomy directly; rather, autonomy is examined as a motivational process through which perceived expressive disruption may influence emotional well-being.

Given prior evidence linking social uncertainty and communicative disruption to emotional distress, anxiety was specified as the primary outcome. Anxiety is particularly sensitive to ambiguous and constrained social environments. Accordingly, we advanced the following hypothesis:

H1: Higher perceived CNIM will be associated with greater anxiety.

Associations between CNIM and broader indicators of well-being were treated as exploratory. Although loneliness and life satisfaction may be affected by pandemic-related social changes, their relationship to perceived nonverbal disruption is less theoretically specified. Therefore, we asked:

RQ1: How is CNIM associated with loneliness and life satisfaction?

In addition, we examined whether NBE alone is associated with psychological outcomes. Because prior research has emphasized frequency-based indicators of social interaction, it remains unclear whether NBE adequately captures the psychological impact of nonverbal disruption. Accordingly, associations involving NBE were treated as exploratory:

RQ2: How is NBE associated with anxiety, loneliness, and life satisfaction?

Finally, to assess potential variability across individuals, we examined whether gender moderated these associations. Given limited prior research on gender differences in perceived nonverbal disruption, moderation analyses were treated as exploratory:

RQ3: Does gender moderate the relationship between NBE and anxiety (RQ3a), loneliness (RQ3b), and life satisfaction (RQ3c)?

RQ4: Does gender moderate the relationship between CNIM and anxiety (RQ4a), loneliness (RQ4b), and life satisfaction (RQ4c)?

Study 1

Method

Participants

One hundred eighty-six participants were recruited for the present study. Thirty-seven were recruited through *ResearchMatch*, a secure, university-affiliated platform that connects volunteers with research opportunities. The remaining 149 participants were undergraduate students from a large northeastern university, who received research credit in exchange for participation. The final sample was 56.7% female and 43.3% male, with ages ranging from 18 to 79 years (M = 22.05, SD = 6.71). Preliminary analyses indicated no meaningful differences between participants recruited via *ResearchMatch* and those recruited from the university sample on primary study variables; therefore, data were pooled for all analyses. Ethnic composition: 48.3% Caucasian, 23.0% Asian American, 11.8% African American, 8.4% Latino/a, 1.7% Indian, 6.7% other. Informed consent was obtained from all participants, and all procedures were approved by the University's Institutional Review Board.

Design

Study 1 employed a cross-sectional survey design conducted in March 2021 during the COVID-19 pandemic. The study examined two conceptually distinct aspects of nonverbal communication (NBE and CNIM). Participants also completed measures of anxiety, loneliness, life satisfaction, and social connectedness.

Procedure

All participants provided informed consent prior to beginning the survey. First, participants completed self-report measures of NBE, CNIM, anxiety, loneliness, life satisfaction, and social connectedness. Participants then completed a demographic questionnaire (age, gender, ethnicity, education level) and a COVID-19 screening form. Participants were then debriefed and dismissed.

Materials

Nonverbal Communication Measures

COVID-19 Nonverbal Behavioral Engagement (NBE)

Participants rated their frequency of engaging in nonverbal behaviors on a 7-point scale. Higher scores reflect greater NBE: $\alpha = .80$; $M = 2.34$, $SD = 1.30$.

Participants responded to the following items:

1. Compared with times prior to COVID-19, during COVID-19, how frequently do you use *handshakes* when interacting with others socially?
2. Compared with times prior to COVID-19, during COVID-19, how frequently do you *hug* others when interacting socially?
3. Compared with times prior to COVID-19, during COVID-19, how frequently do you *high-five* others when interacting socially?
4. Compared with times prior to COVID-19, during COVID-19, how frequently do you engage in overall *positive nonverbal touch* when interacting with others socially?

COVID-19 Nonverbal Impact Measure (CNIM)

The COVID Nonverbal Impact Measure (CNIM) is a single-item index designed to assess individuals' subjective perceptions of disruption to their nonverbal communication during the COVID-19 pandemic. Participants rated the extent to which the pandemic impacted their day-to-day nonverbal communication on a 7-point scale (e.g., "Overall, considering all the possible ways your life may have been impacted by COVID-19, how much has the pandemic impacted your nonverbal communication in your day-to-day life?"), with higher scores indicating greater perceived disruption ($M = 4.76$, $SD = 1.77$).

Rather than measuring specific nonverbal behaviors or emotional states, CNIM captures individuals' global appraisal of how pandemic-related conditions altered familiar and expected patterns of nonverbal expression in social interaction. Although CNIM is a single-item measure, prior research indicates that single-item scales can

effectively assess broad experiential constructs (e.g., self-esteem, life satisfaction, happiness, loneliness), particularly when the construct of interest reflects an overall evaluative judgment (Abdel-Khalek, 2006; Cheung & Lucas, 2014; Hughes et al., 2004; Robins et al., 2001).

Psychological Outcomes

Generalized Anxiety Disorder Scale (GAD-7)

Participants were asked to report symptoms of generalized anxiety using the 7-item *GAD-7* (Spitzer et al., 2006), rated on a 4-point scale. Higher scores indicate greater anxiety severity. Sample item: "Feeling nervous, anxious, or on edge.": $\alpha = .89$; $M = 15.88$, $SD = 5.01$.

UCLA Loneliness Scale

Participants perceived loneliness was measured using the 20-item *UCLA Loneliness Scale* (Russell et al., 1980), rated on a 4-point scale. Higher scores reflect greater loneliness. Sample item: "I am no longer close to anyone.": $\alpha = .79$; $M = 43.79$, $SD = 7.69$.

Satisfaction With Life Scale (SWLS)

Participants' life satisfaction was assessed using the 5-item *SWLS* (Pavot & Diener, 2008), rated on a 7-point scale. Higher scores reflect greater satisfaction. Sample item: "In most ways, my life is close to my ideal.": $\alpha = .85$; $M = 19.67$, $SD = 6.87$.

Social Connectedness Scale

Participants perceived social connectedness was measured using the 8-item scale (Lee & Robbins, 1995), rated on a 6-point scale with reverse-coded items. Higher scores indicate greater connectedness. Sample item: "I catch myself losing all sense of connectedness with society.": $\alpha = .92$; $M = 30.03$, $SD = 10.07$.

COVID-19 Screening Questionnaire

Participants were asked whether they had contracted COVID-19, with response options of "Yes," "No," or "Prefer not to answer." This variable was considered as a potential covariate in exploratory analyses, but was not retained, as it did not meaningfully alter results.

Results

We first examined descriptive statistics and zero-order correlations among NBE, CNIM, anxiety, loneliness, life satisfaction, and social connectedness. To test the primary distinction between NBE and CNIM, we

then conducted hierarchical multiple regression analyses examining whether NBE and CNIM independently predicted mental health outcomes. Next, exploratory moderation analyses (Hayes, 2022) were conducted to examine whether gender influenced the associations between NBE and CNIM and psychological outcomes.

Descriptive Statistics and Correlations

Pearson correlations for all variables (NBE, CNIM, anxiety, loneliness, life satisfaction, social connectedness) are presented in Table 1.

Table 1. *Pearson Correlations Among Study Variables.*

Variable	1	2	3	4	5	6	7	8	9	10
1. Handshakes	—									
2. Hugs	.45**	—								
3. High-fives	.50**	.43**	—							
4. Positive NV Touch	.39**	.66**	.53**	—						
5. NBE	.75**	.82**	.77**	.82**	—					
6. CNIM	−.08	.02	−.16*	−.06	−.09	—				
7. Social Connectedness	.05	.03	.14	−.00	.07	−.00	—			
8. Anxiety	−.10	.23**	.06	.11	.09	.21**	−.38**	—		
9. Life Satisfaction	.01	−.06	−.08	−.01	−.04	.10	.41**	−.29**	—	
10. Loneliness	−.06	.08	.01	.14	.05	.05	−.33**	.19*	−.23**	—

Note. N = 178–179. NBE = Nonverbal Behavioral Engagement composite (handshakes, hugs, high-fives, positive nonverbal touch). *p < .05. ** p < .01 (two-tailed).

To examine the relationships between CNIM, NBE, and psychological outcomes, hierarchical multiple regression analyses were conducted. Gender and social connectedness were entered in the first step as covariates, followed by the simultaneous entry of CNIM and NBE in the second step.

H1: CNIM predicting anxiety

Consistent with H1, *CNIM* significantly predicted *anxiety* after controlling *gender* and *social connectedness*. *Social connectedness* was a significant negative predictor of *anxiety* ($\beta = –.37$, $p < .001$; $R^2 = .146$), and the inclusion of *CNIM* and *NBE* significantly improved model fit ($\Delta R^2 = .065$, total $R^2 = .211$). *CNIM* ($\beta = .23$, $p = .001$) was a significant positive predictor of *anxiety*, as was *NBE* ($\beta = .14$, $p = .040$), while *social connectedness* remained a significant negative predictor ($\beta = –.39$, $p < .001$). Across models, *NBE* was significantly associated with *anxiety* when entered alongside *CNIM* but was not associated with *loneliness* or *life satisfaction* (RQ2; see Table 2).

RQ1: CNIM predicting loneliness and life satisfaction

For both *loneliness* and *life satisfaction*, *social connectedness* emerged as the primary predictor. *Social connectedness* was associated with lower *loneliness* ($\beta = -.33$, $p < .001$; $R^2 = .11$) and higher *life satisfaction* ($\beta = .41$, $p < .001$; $R^2 = .16$). The addition of *CNIM* and *NBE* did not significantly improve model fit for *loneliness* ($\Delta R^2 = .01$) or *life satisfaction* ($\Delta R^2 = .02$), and neither *CNIM* nor *NBE* significantly predicted either outcome.

Table 2. *Hierarchical Regressions Predicting, Anxiety, Loneliness, and Life Satisfaction.*

Predictor	*B*	*SE*	*β*	*t*	*p*
Outcome: Anxiety					
Social Connectedness	–0.19	0.03	–0.39	–5.80	<.001***
NBE	0.54	0.26	0.14	2.07	.040*
CNIM	0.64	0.19	0.23	3.32	.001**
Outcome: Loneliness					
Social Connectedness	–0.26	0.05	–0.40	–4.75	<.001***
NBE	0.47	0.42	0.08	1.12	.266
CNIM	0.25	0.31	0.06	0.79	.429
Outcome: Life Satisfaction					
Social Connectedness	0.28	0.05	0.41	5.95	<.001***
NBE	–0.33	0.37	–0.06	–0.90	.367
CNIM	0.38	0.27	0.10	1.41	.160

Note. *p < .05, **p < .01, ***p < .001, two-tailed. NBE = frequency of nonverbal behaviors (handshakes, hugs, high-fives, positive touch); CNIM = COVID-19 Nonverbal Impact Measure. Step 1: $R^2 = .004$, Adjusted $R^2 = –.006$ for NBE; Step 2: $R^2 = .011$, Adjusted $R^2 = –.003$ for NBE. Step 1: $R^2 = .15$, Adjusted $R^2 = .14$ for Anxiety; Step 2: $R^2 = .21$, Adjusted $R^2 = .20$. Step 1: $R^2 = .11$, Adjusted $R^2 = .11$ for Loneliness; Step 2: $R^2 = .12$, Adjusted $R^2 = .11$. Step 1: $R^2 = .16$, Adjusted $R^2 = .16$ for Life Satisfaction; Step 2: $R^2 = .18$, Adjusted $R^2 = .17$.

Exploratory Gender moderation; NBE & Mental Health

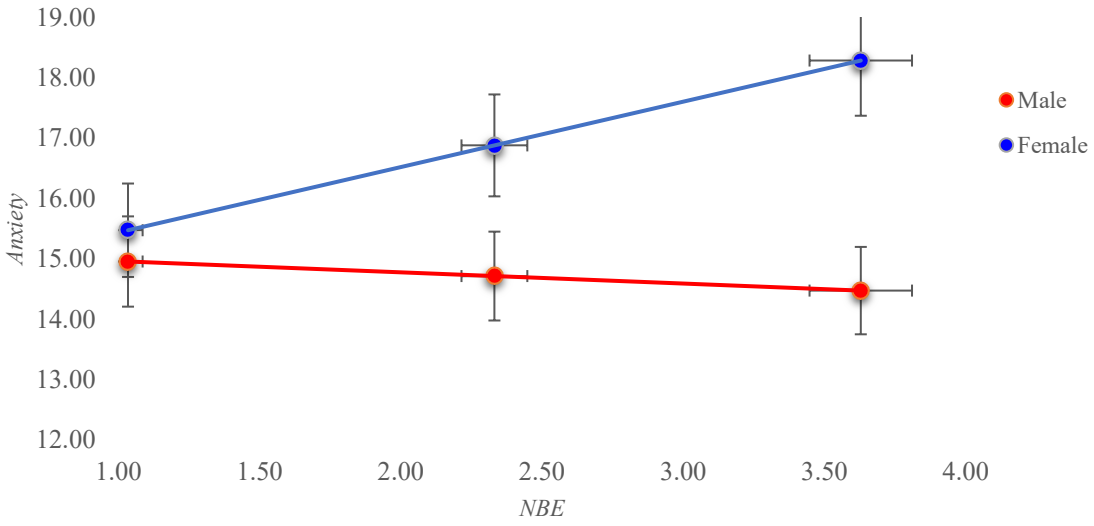
A series of exploratory moderated regression analyses (PROCESS Model 1; Hayes, 2022) were conducted to examine whether gender moderates the associations between NBE, CNIM, and psychological outcomes, controlling for social connectedness.

RQ3a: Anxiety

The overall model was significant, F (4, 173) = 13.15, $p < .001$, $R^2 = .23$. There was a significant interaction between *NBE* and *gender*, $b = 1.27$, $SE = 0.52$, $t = 2.43$, $p = .016$, 95% *CI* [0.24, 2.30]. Simple slopes analyses indicated that *NBE* was not significantly associated with *anxiety* for men, $b = −0.19$, $SE = 0.39$, $t = −0.48$, $p = .634$, 95% *CI* [−0.96, 0.58], whereas for women, *NBE* was positively associated with *anxiety*, $b = 1.08$, $SE = 0.35$, $t = 3.13$, $p = .002$, 95% *CI* [0.40, 1.77]. *Social connectedness* remained a significant negative predictor of *anxiety*, $b = −0.18$, $SE = 0.03$, $t = −5.31$, $p < .001$, 95% *CI* [−0.24, −0.11].

Figure 1

Interaction between NBE and gender predicting anxiety. Predicted values are plotted across the observed continuous range of NBE for males and females, with social connectedness included as a covariate. Error bars represent ±1 SE of the predicted values.



RQ3b: Loneliness

The interaction between *NBE* and *gender* was not significant, F (1, 173) = 2.11, p = .148, ΔR^2 = .01.

RQ3c: Life Satisfaction

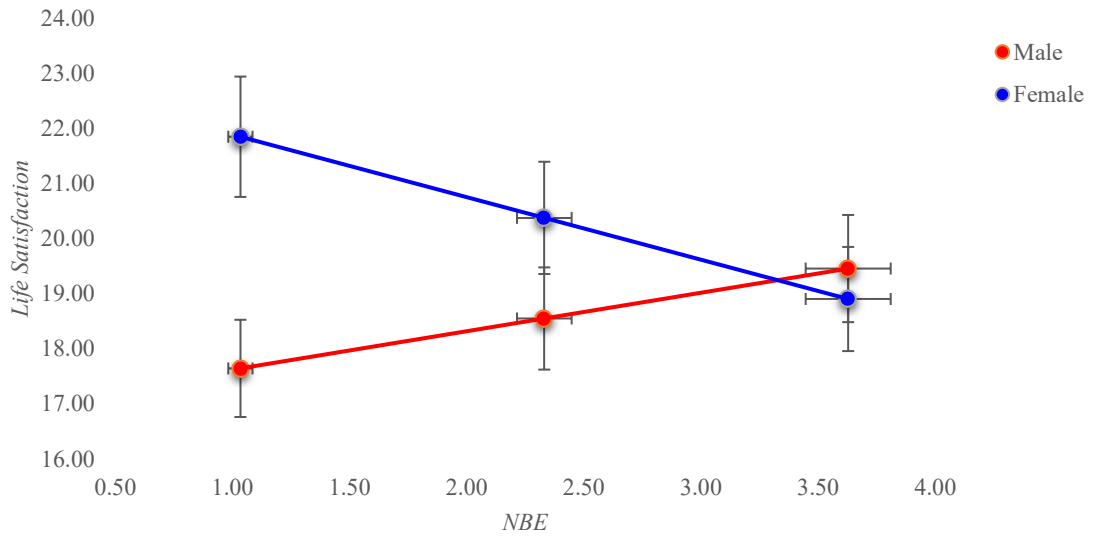
The interaction between *NBE* and *gender* was significant, F (1, 173) = 6.40, p = .012, ΔR^2 = .03. Simple slopes analyses indicated that *NBE* was not a significant predictor of *life satisfaction* for men, b = 0.70, *SE* = 0.54, p = .199, 95% *CI* [−0.37, 1.77], whereas for women, higher *NBE* was associated with lower *life satisfaction*, b = −1.13, *SE* = 0.48, p = .019, 95% *CI* [−2.08, −0.19].

Social connectedness remained a strong positive predictor of *life satisfaction*, b = 0.27, *SE* = 0.05, p < .001, 95% CI [0.18, 0.36]. *Gender* also showed a significant main effect, b = 6.10, *SE* = 1.94, p = .002, 95% *CI* [2.27, 9.93]. Predicted values shown in Figure 2.

Figure 2

Interaction between NBE and gender predicting life satisfaction. Predicted values are plotted across the observed continuous range of NBE for males and females, with social connectedness included as a covariate. Error bars

represent ±1 SE of the predicted values.



Exploratory Gender Moderation; CNIM & Mental Health

Gender did not moderate the association between *CNIM* and any psychological outcome. The *CNIM* × *gender* interaction was not significant for *anxiety* (*RQ4a*), F (1, 173) = 1.69, p = .195, ΔR^2 = .008, *loneliness (RQ4b)*, F (1, 173) = 0.03, p = .869, ΔR^2 < .001, or *life satisfaction (RQ4c)*, F (1, 173) = 1.58, p = .210, ΔR^2 = .007. *CNIM* did not significantly predict *loneliness* or *life satisfaction* for either men or women. Across models, *social connectedness* remained a robust predictor of *loneliness* (b = −0.25, SE = 0.05, p < .001) and *life satisfaction* (b = 0.28, SE = 0.05, p < .001). *Gender* did not demonstrate a reliable main effect for any outcome, though the main effect approached significance for *life satisfaction* (b = 4.84, SE = 2.71, p = .076).

Given the exploratory nature of gender analyses, these null moderation effects should be interpreted with appropriate caution.

Study one Discussion

Study 1 examined how CNIM and NBE were associated with anxiety, loneliness, and life satisfaction during a period of sustained COVID-19 social constraints. CNIM was more reliably associated with psychological distress than NBE, predicting greater anxiety, whereas NBE showed weaker and more context-dependent associations. Importantly, neither construct robustly predicted loneliness nor life satisfaction.

The present results suggest that CNIM, rather than NBE alone, is most strongly associated with anxiety. Importantly, this emerged even when individuals reported continued engagement in nonverbal behaviors, indicating that anxiety was not simply a function of reduced behavioral output. Instead, the present findings are consistent with theoretical accounts emphasizing the psychological importance of individuals' perceived capacity to act and express themselves flexibly within social environments, particularly under conditions of external constraint (Lazarus & Folkman, 1984; Ryan & Deci, 2000). In this context, distress appears to arise less from how much individuals engage behaviorally and more from how pandemic-related changes were appraised in relation to their expressive experience. Consistent with this interpretation, CNIM remained a significant predictor of anxiety even when NBE was included in the model, indicating that perceived disruption to expressive communication is not reducible to behavioral frequency. This suggests that disruptions to nonverbal communication may be more closely tied to immediate emotional processes than to broader relational evaluations. By comparison, although NBE was positively associated with anxiety, it did not reliably predict loneliness or life satisfaction. Continued engagement in nonverbal behaviors during periods of social constraint may not be uniformly protective and, in some cases, may even be psychologically taxing.

In contrast, loneliness and life satisfaction were not significantly predicted by either CNIM or NBE, once social connectedness was accounted for. This finding is consistent with prior work conceptualizing loneliness as a function of perceived relational adequacy rather than momentary interaction quality (Perlman & Peplau, 1981), and life satisfaction as a global evaluative judgment shaped by a broad constellation of life circumstances (Pavot & Diener, 2008).

Gender moderation analyses indicated that NBE operated differently across groups. Among women, higher levels of NBE were associated with greater anxiety and lower life satisfaction, whereas no such associations emerged for men. One plausible contextual explanation is that men were less likely than women to adhere to public health guidelines related to masking, physical distancing, and limits on physical contact, which may have reduced the extent to which their nonverbal behaviors were experienced as constrained or effortful (Ferrín, 2022; Galasso et al., 2020; Okten et al., 2020). Importantly, because gender did not moderate the relationship between CNIM and psychological outcomes, these findings suggest that perceived expressive disruption may represent a shared psychological experience, whereas behavioral engagement may be more sensitive to role- and norm-based differences across groups. However, given the cross-sectional nature of the data, these interpretations necessarily

remain tentative. NBE was not uniformly protective or harmful but varied in its association with psychological outcomes as a function of gender and context.

Implications

These findings contribute to a growing literature on social functioning under conditions of constraint by highlighting the importance of perceived nonverbal disruption as a psychological dimension distinct from behavioral engagement. Whereas prior research has emphasized social isolation, reduced interaction, or diminished contact quantity as primary drivers of distress during the COVID-19 pandemic (Brooks et al., 2020; Loades et al., 2020), the present results suggest that meaningful variation in psychological distress can arise even when individuals remain socially engaged. Specifically, anxiety appears to be shaped less by how often individuals interact and more by whether they perceive their expressive options within interaction to be constrained. By identifying perceived expressive disruption as a proximal experiential dimension of social constraint, these findings refine existing accounts and underscore the importance of subjective expressive experience for understanding anxiety under socially restrictive conditions.

Methodologically, the results support the utility of the CNIM as a brief self-report index capturing perceived disruption to nonverbal communication that is not reducible to behavioral engagement alone. Rather than assessing specific behaviors or emotional states, CNIM reflects individuals' global appraisals of how contextual conditions alter everyday nonverbal expression. As such, CNIM may be particularly useful for future research examining communication in contexts where social behavior remains present but is altered in form, clarity, or meaning, such as during public health crises, technologically mediated interaction, or other environments characterized by expressive constraint.

Practically, these findings suggest that psychological distress during periods of social constraint may be shaped less by how frequently individuals interact and more by how disrupted they perceive their nonverbal communication to be in everyday exchanges. This has implications for efforts aimed at mitigating distress during public health emergencies and other forms of social disruption. Interventions that focus solely on maintaining interaction frequency may be insufficient if individuals continue to experience their expressive capacities as constrained or ambiguous. Attention to preserving clarity, flexibility, and perceived freedom in nonverbal expression - even when behavioral restrictions are necessary - may therefore play an important role in supporting emotional well-being under conditions of sustained social constraint.

Limitations and Future Directions

Several limitations should be acknowledged. First, this study employed a cross-sectional design, which preclude causal inference and make it impossible to determine whether CNIM leads to heightened anxiety or whether anxious individuals are more likely to appraise social interactions as constrained. Longitudinal and experimental designs will be necessary to establish temporal ordering and to more directly test causal mechanisms linking expressive disruption, autonomy, and emotional distress. Second, all key variables were assessed via self-report, which may be influenced by recall biases and individual differences in subjective interpretation of both nonverbal engagement and perceived disruption.

In addition, although general social connectedness was included as a covariate, other contextual factors such as occupational stress, caregiving responsibilities, health concerns, and broader pandemic-related disruptions, may also have contributed to psychological outcomes. The sample size and demographic composition further limit generalizability, and effect sizes were generally modest, suggesting that CNIM represents one contributing factor among many shaping psychological distress rather than a comprehensive account. Finally, data were collected during a specific transitional phase of the COVID-19 pandemic (March 2021), when public health restrictions remained in place but social norms surrounding masking, distancing, and physical contact were evolving. Patterns of association may differ in contexts where expressive norms are more stable or where constraints take different forms.

Future research would benefit from examining perceived expressive disruption in a broader range of contexts characterized by constraints on communication or social behavior, including institutional settings, technologically mediated interaction, and environments governed by rigid professional, cultural, or safety norms. Investigating whether similar associations with anxiety emerge under these conditions would help clarify the generalizability of the present findings and further delineate when and why constraints on expressive behavior become psychologically consequential.

Study 2: Examining Psychological Mechanisms

Although Study 1 establishes a reliable association between CNIM and anxiety, it does not explain *why* such disruption is psychologically consequential. CNIM captures individuals' subjective appraisals of how the COVID-19 pandemic impacted their nonverbal communication, but it does not assess the underlying motivational or psychological processes through which these experiences may influence emotional distress. Accordingly, the

findings from Study 1 point to an important unanswered question: *What psychological mechanism links perceived nonverbal disruption to heightened anxiety?*

Study 2 addresses this question by drawing on SDT to examine whether perceived nonverbal disruption is associated with anxiety because it undermines basic psychological need satisfaction (Ryan & Deci, 2000; Ryan & Deci, 2024). SDT posits that psychological well-being depends on the satisfaction of three fundamental needs (autonomy, competence, and relatedness) and that frustration of these needs increases vulnerability to distress. Of particular relevance to nonverbal communication is autonomy, defined as the experience of volitional, self-endorsed action and expression within social interaction. Because nonverbal cues play a central role in enabling individuals to communicate naturally and in accordance with their intentions, disruptions to nonverbal communication may be experienced as constraints on expressive autonomy.

In the context of the COVID-19 pandemic, public health restrictions altered the normative conditions under which nonverbal communication occurs, including masking, physical distancing, and limits on physical contact. Although CNIM does not assess psychological needs directly, higher CNIM may reflect experiences in which familiar modes of nonverbal expression were altered, constrained, or rendered ambiguous in everyday interaction. From a SDT perspective, such conditions may be distressing not simply because behavior changes, but because they interfere with individuals' sense of expressive autonomy. Accordingly, Study 2 focuses on autonomy as the primary psychological mechanism linking perceived nonverbal disruption to anxiety.

Based on this framework, we propose the following hypotheses:

H1: Higher CNIM will be associated with lower autonomy.

H2: Autonomy will mediate the relationship between CNIM and anxiety, such that higher CNIM will be associated with greater anxiety.

In addition to autonomy, competence and relatedness were included as psychological need variables given their established relevance to social functioning under conditions of constraint. Because theory offers less specific guidance regarding how disruptions to nonverbal communication should relate to these needs, associations involving competence and relatedness were treated as exploratory.

Study 2

Method

Participants

One hundred and forty-three undergraduates from a large northeastern university participated (52.9% female; M = 21.11, SD = 6.95). Ethnic composition: 55.9% Caucasian, 25.0% Asian American, 6.6% African American, 6.6% Latino/a, 1.5% Indian, 4.4% other. All participants received research credit in exchange for their participation. Informed consent was obtained from all participants, and all procedures were approved by the University's Institutional Review Board.

Design

Study 2 employed a cross-sectional survey design conducted in September 2021. The study examined associations among CNIM, NBE, psychological need frustration, and psychological well-being outcomes, with anxiety as the primary outcome of interest. All variables were measured at a single time point. We take note that data collection occurred in September 2021, during a period of partial social reopening and increased vaccine availability, and prior to the global recognition of the SARS-CoV-2 Omicron variant as a variant of concern by the World Health Organization in late November 2021 (WHO, 2021).

Procedure

Participants completed an online survey in the following order: (1) open-ended SDT prompts assessing autonomy, competence, and relatedness; (2) NBE; (3) psychological outcome measures (anxiety, loneliness, life satisfaction); (4) CNIM; and (5) demographic and COVID-19 screening items. The mental health outcome measures (anxiety, loneliness, and life satisfaction), as well as the order of items within each scale, were counterbalanced across participants to reduce potential order and fatigue effects. Participants were debriefed upon completion.

Nonverbal Communication Measures

Nonverbal Behavioral Engagement (NBE)

NBE was assessed as a composite measure of participants' self-reported frequency of engaging in positive nonverbal behaviors, including hugs, high-fives, handshakes, and other forms of positive interpersonal touch (α = .77; M = 2.58, SD = 1.22).

COVID Nonverbal Impact Measure (CNIM)

The CNIM was assessed using a single-item indicator capturing participants perceived overall impact of the COVID-19 pandemic on their nonverbal communication in day-to-day life (M = 4.47, SD = 1.50).

Measures

Psychological Outcomes

Anxiety

Anxiety was measured using the Generalized Anxiety Disorder Scale (GAD-7; Spitzer et al., 2006; α = .81; M = 12.86, SD = 4.21).

Loneliness

Loneliness was assessed using the UCLA Loneliness Scale (Russell et al., 1980; α = .87; M = 38.67, SD = 8.71).

Life Satisfaction

Life satisfaction was measured using the Satisfaction With Life Scale (SWLS; Pavot & Diener, 2008; α = .83; M = 22.51, SD = 6.09).

Psychological need coding (SDT)

To assess satisfaction and frustration of basic psychological needs in the context of pandemic-related nonverbal communication, participants responded to four open-ended prompts designed to capture experiences relevant to autonomy, competence, and relatedness, consistent with SDT (Deci & Ryan, 2000). Prompts asked participants to reflect on how COVID-19-related conditions (e.g., masking, physical distancing, limitations on touch) affected their nonverbal communication during everyday social interactions. Separate questions assessed autonomy, competence, and relatedness (with *close* and *non-close)* interaction partners.

Participants' open-ended responses were content-coded using a 5-point ordinal scale ranging from −2 (*extreme need frustration*) to +2 (*extreme need satisfaction*). Autonomy coding reflected participants' perceived volition and self-direction in nonverbal expression (e.g., feeling free or restricted in how one communicates nonverbally). Competence coding reflected participants perceived effectiveness in navigating nonverbal communication under pandemic-related constraints (e.g., feeling capable in expressing desired nonverbal behaviors). Relatedness coding captured participants perceived sense of connection and interpersonal closeness, assessed separately for *close* and *non-close* relationships.

Coding was conducted independently by two trained raters, one of whom was blind to the study hypotheses. Prior to coding, raters were trained using a coding manual specifying construct definitions, criteria, and examples for each psychological need. A subset of responses was jointly reviewed during training to ensure consistent application of the coding rubric. Each coder evaluated an overlapping subset of 60 responses per prompt for reliability estimation. Intercoder reliability was assessed using Krippendorff's alpha, indicating good agreement

for autonomy (α = .84), acceptable agreement for competence (α = .68), and excellent agreement for relatedness with both *close* interaction partners (α = .88) and *non-close* interaction partners (α = .90). Discrepancies were resolved through discussion and consensus prior to analysis. In total, 572 open-ended responses were coded across the four psychological need prompts.

Results

We first examined zero-order associations among nonverbal variables and psychological outcomes (Table 3). Consistent with Study 1, *CNIM* was significantly and positively associated with *anxiety*, such that greater *CNIM* was related to higher *anxiety*. In contrast, *NBE* was not significantly associated with *anxiety*, *loneliness*, or *life satisfaction*. *CNIM* was also not significantly related to *loneliness* or *life satisfaction*, suggesting that its effects may be more specific to *anxiety*.

To examine the proposed SDT mechanism, we next assessed associations between psychological need variables and key study variables using Spearman rank-order correlations due to the ordinal coding of need measures (Table 4). In addressing H1, *CNIM* was significantly and negatively associated with both *autonomy* and *competence*, indicating that greater *CNIM* was associated with lower perceived *autonomy*, and to a lesser extent, lower perceived *competence.* Thus, H1 was supported.

Most notably, *autonomy* was significantly and negatively associated with *anxiety*, such that lower perceived *autonomy* was related to higher *anxiety*. *Relatedness* with *close others* was also negatively associated with *anxiety*. In contrast, psychological need variables were not significantly associated with *loneliness* or *life satisfaction*.

Table 3. *Pearson Correlations Among Study Variables.*

Variable	1	2	3	4	5
1. NBE	—				
2. CNIM	−.24**	—			
3. Anxiety	.06	.22**	—		
4. Life Satisfaction	−.03	.12	−.21*	—	
5. Loneliness	.06	.06	.50**	−.54**	—

Note. †p ≤ .10 *p ≤ .05. **p ≤ .01. ***p ≤ .001 (two-tailed).

Table 4. *Spearman Correlations Between Psychological Needs and Key Variables.*

Variable	Autonomy	Competence	Relatedness (Close)	Relatedness (Non-close)
CNIM	−.23**	−.22**	−.13	−.04
Anxiety	−.34**	−.15	−.24**	−.05
Loneliness	−.12	−.07	−.03	−.05

Life Satisfaction	−.07	−.13	−.00	−.13
NBE	.02	−.03	−.07	−.01

Note. Spearman's ρ reported. $^{*}p < .05$, $^{**}p < .01$.

Hierarchical regression analyses were conducted to examine whether *CNIM* and *NBE* independently predicted psychological outcomes. *CNIM* was a significant positive predictor of *anxiety* ($\beta = .26$, $p = .004$). In contrast, *NBE* was not a significant predictor of *anxiety*. Neither *CNIM* nor *NBE* significantly predicted *loneliness* or *life satisfaction*.

These results further support the relative specificity of *CNIM* in predicting *anxiety*. This provides a basis for testing psychological need frustration as an explanatory mechanism.

Table 5. *Regression Analyses Predicting Mental Health Outcomes*.

Predictor	***B***	***SE***	***β***	***t***	***p***
Outcome: Anxiety					
NBE	0.43	0.30	0.13	1.45	.149
CNIM	0.72	0.24	0.26	2.96	.004**

Note. †p ≤ .10 *p ≤ .05. **p ≤ .01. ***p ≤ .001 (two-tailed).

Psychological Need Mediation Analyses

To test the proposed SDT mechanism, we conducted parallel multiple mediation analyses (Hayes, 2022) using PROCESS Model 4 (10,000 bootstrap samples), examining whether psychological needs (*autonomy*, *competence*, *relatedness* with *close* others, and *non-close* others) mediated the relationship between *CNIM* and *anxiety*, controlling for *gender*.

CNIM

H2: Autonomy will mediate the relationship between CNIM and Anxiety

The overall model predicting *anxiety* was significant ($R^2 = .264$, $p < .001$). *Autonomy* emerged as a significant negative predictor of *anxiety* ($b = -0.738$, $p < .01$), indicating that greater perceived *autonomy* was associated with lower *anxiety*. *Gender* was also a significant covariate, with women reporting higher *anxiety*.

Mediation analyses revealed a significant total indirect effect of *CNIM* on *anxiety* (indirect effect = 0.177, 95% *CI* [0.010, 0.365]). This indirect effect was primarily driven by *autonomy* (indirect effect = 0.136, 95% *CI* [0.015, 0.323]), such that greater *CNIM* was associated with reduced *autonomy*, which in turn was associated with higher *anxiety*.

The direct effect of *CNIM* on *anxiety* was not significant when psychological need variables were included in the model (95% *CI* [−0.035, 0.837]), suggesting that the association between *CNIM* and *anxiety* was accounted for by indirect pathways. Indirect effects through *competence* and *relatedness* were not significant, suggesting that *autonomy* represents the primary psychological pathway linking perceived *CNIM* to *anxiety*.

Table 6. *Parallel Mediation Model Testing Autonomy as a Mediator of the Relationship Between CNIM and Anxiety (Controlling for Gender)*

Predictor	***b***	***SE***	***95% CI***
CNIM Model (R^2 = .264, F (6, 129) = 7.72, p < .001)			
Direct effect (CNIM → Anxiety)	0.401	0.220	[−0.035, 0.837]
Autonomy	−0.738**	0.265	[−1.263, −0.213]
Total indirect effect	0.177*	0.090	[0.010, 0.365]
Indirect via autonomy	0.136*	0.079	[0.015, 0.323]

Note. Indirect effects estimated using 10,000 bootstrap samples; confidence intervals are bias-corrected. Gender was included as a covariate in all models. Competence and relatedness (non-close others) were nonsignificant and omitted for clarity. *p < .05. **p < .01.

Together, these findings indicate that *CNIM* is associated with *anxiety* primarily through its relationship with diminished *autonomy*, supporting the proposed mechanism advanced in Study 2.

Study two Discussion

Study 2 extended the findings of Study 1 by examining a psychological mechanism linking CNIM to anxiety. CNIM was associated with higher anxiety, whereas NBE showed limited predictive value once perceived disruption was accounted for.

A central finding of Study 2 was that autonomy emerged as the primary psychological mechanism linking perceived nonverbal disruption to anxiety. Individuals reporting greater perceived disruption to their nonverbal communication also reported lower autonomy in social expression, which in turn was associated with higher anxiety. This is consistent with SDT, which posits that experiences of constrained volitional action undermine psychological well-being and increase vulnerability to distress (Ryan & Deci, 2000; Ryan & Deci, 2024). This interpretation is further supported by experimental evidence showing that autonomy deficits function as a vulnerability factor for anxiety under conditions of constraint (Kunst et al., 2019), as well as by meta-analytic findings indicating that autonomy thwarting is a particularly robust predictor of distress outcomes across student populations (Howard et al., 2025).

Competence and relatedness did not emerge as significant mediators of the relationship between CNIM and anxiety. Although both needs are central to social functioning, their lack of indirect effects suggests that perceived nonverbal disruption may be psychologically consequential primarily insofar as it interferes with expressive autonomy, rather than with feelings of social effectiveness or interpersonal connection per se - consistent with distinctions in SDT research between autonomy frustration and related but conceptually distinct experiences (Olafsen et al., 2021). This specificity is theoretically meaningful, as anxiety is particularly sensitive to experiences of constraint and uncertainty (Carleton, 2016; Grupe & Nitschke, 2013). In contexts characterized by altered or ambiguous nonverbal norms, diminished autonomy in social expression may therefore represent a particularly proximal pathway through which perceived expressive disruption contributes to heightened anxiety.

Although Study 1 identified gender differences in nonverbal behavior and emotional outcomes, gender did not moderate the mediation pathways in Study 2. This suggests that while individuals may differ in baseline levels of anxiety or nonverbal engagement, the psychological process linking perceived nonverbal disruption to anxiety through reduced autonomy operates similarly across genders. Collectively, Studies 1 and 2 indicate that the emotional consequences of social disruption arise less from changes in observable nonverbal behavior and more from *how* contextual constraints are *appraised* as affecting everyday expressive freedom.

Future Directions

Future research should extend these findings using longitudinal and experimental designs to establish temporal ordering and to more directly test causal mechanisms linking perceived nonverbal disruption, autonomy frustration, and emotional distress. Designs that manipulate communicative constraints or track changes in CNIM and autonomy over time would be especially valuable for clarifying directionality and dynamic processes.

Examining more diverse populations will also be important for assessing the generalizability of these effects across cultural, occupational, and relational contexts. Norms governing nonverbal expression vary widely across cultures and social roles (Matsumoto, 1990; Matsumoto et al., 2008), and future work should investigate whether perceived expressive disruption has similar psychological implications in settings where nonverbal practices, expectations, or constraints differ.

Future research may also benefit from examining perceived expressive disruption and autonomy frustration in neurodivergent populations, for whom social communication often involves heightened monitoring, effort, or reliance on explicit norms. In such contexts, disruptions to familiar communicative structures or expectations may

carry disproportionate consequences for perceived expressive autonomy, with downstream implications for anxiety. Investigating these processes could help clarify how constraints on expressive freedom operate across neurodiverse social environments.

In addition, moment-by-moment, behavioral, or real-world assessments of nonverbal communication may offer deeper insight into how autonomy-related processes unfold during everyday social interaction. Methods such as experience sampling and observational approaches can capture changes across situations and interactions that are difficult to detect using one-time, global self-report measures (Bakeman & Gottman, 1997; Bolger & Laurenceau, 2013; Mehl & Conner, 2012; Shiffman et al., 2008). Such approaches could help distinguish situational fluctuations in expressive freedom from more stable perceptions of communicative constraint, thereby advancing understanding of how perceived nonverbal disruption operates across timescales and contexts.

General Discussion

Across two independent samples collected during distinct phases of the COVID 19 pandemic, the present research examined how perceived disruptions to everyday nonverbal communication relate to emotional well-being. Across both studies, greater CNIM was associated with higher anxiety, independent of NBE and broader relational resources. These findings indicate that psychological distress during periods of social constraint is shaped less by interaction frequency and more by how changes to expressive experience are appraised.

Study 1 established this pattern descriptively, showing that CNIM was more strongly associated with anxiety than NBE, while neither construct robustly predicted loneliness nor life satisfaction once social connectedness was accounted for. Study 2 extended these findings by identifying a psychological mechanism underlying this association.

Although the present findings emerged in the context of the COVID-19 pandemic, they align with broader literatures demonstrating that anxiety increases in social environments characterized by ambiguity, disrupted cue availability, and constrained expressive norms. Prior research on uncertainty-based models of anxiety, nonverbal cue processing in social anxiety, and expressive flexibility shows that distress can arise even when social interaction is maintained, particularly when individuals have difficulty interpreting or enacting social signals (Davis et al., 2016; Gilboa-Schechtman & Shachar-Lavie, 2013; Maccallum et al., 2021; Shangguan et al., 2024). The present research extends this work by identifying CNIM as a psychologically consequential dimension of social constraint, helping to explain why anxiety increased during the pandemic even in the absence of reduced social contact. Rather than

reflecting relational loss, anxiety appears to stem from how changes in nonverbal communication were experienced and appraised.

The present findings should also be understood in the context of the timing of data collection (March and September 2021), which corresponded to a transitional phase of the COVID-19 pandemic. At this point, vaccine rollout had begun, but many public health measures remained in place, including mask mandates, physical distancing requirements, and restrictions on physical contact and gathering (American Heart Association, 2021; NASHP, 2021). As a result, social norms surrounding touch and physical proximity were in flux, and decisions about nonverbal behavior often carried heightened social and health-related ambiguity. In this context, CNIM may have captured a particularly salient psychological experience tied to navigating evolving and uncertain communicative norms.

At the same time, the present findings clarify important boundary conditions. Although behavioral engagement and baseline anxiety levels may vary across individuals, the psychological process linking perceived nonverbal disruption to anxiety through reduced autonomy operated similarly across genders. Moreover, competence and relatedness did not account for the association between CNIM and anxiety, suggesting that distress in this context was not driven by perceived social ineffectiveness or weakened interpersonal bonds, but by constraints on volitional self-expression. These results highlight the value of distinguishing between observable social behavior and subjective experiences of expressive freedom.

Taken together, the present research underscores the importance of attending to *perceived expressive freedom* - not just interaction frequency - when understanding emotional adjustment in socially constrained environments. By integrating CNIM with motivational theory, this work clarifies how changes in everyday social expression translate into anxiety and identifies autonomy as a key psychological pathway through which expressive constraints become emotionally consequential.

Conclusion

Across two independent samples, the present research demonstrates that psychological distress during periods of social disruption is more closely tied to perceived constraints on nonverbal expression than to reductions in social interaction frequency. Individuals who experienced greater perceived disruption to everyday nonverbal communication consistently reported higher anxiety, and this association was explained by diminished autonomy in

social expression. These findings highlight the importance of perceived expressive autonomy as a psychological resource in socially constrained environments.

Beyond the context of the COVID-19 pandemic, this work underscores the value of attending not only to whether individuals remain socially connected, but to how freely they feel able to express themselves within interaction. By distinguishing between behavioral engagement and the subjective experience of expressive constraint, the present research contributes to a more precise understanding of how social disruption becomes psychologically consequential.

Data Availability Statement:

The studies were not preregistered. Data and materials for both studies are available on the Open Science Framework (OSF): https://osf.io/j4xts/overview?view_only=20526f0ca6c7438dbfcd95161f5d6f32

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Conflicts of Interest:

The authors declare no conflict of interest.

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