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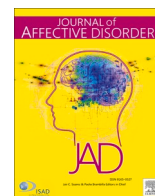
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## Emotion-related impulsivity predicts increased anxiety and depression during the COVID-19 pandemic

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### ABSTRACT

**Introduction:** Emotion-related impulsivity, defined by poor constraint in the face of emotion, is related to internalizing symptoms, cross-sectionally and longitudinally. Internalizing symptoms, though, are profoundly tied to stress reactivity, and little is known about how emotion-related impulsivity relates to stress reactivity.

**Method:** Taking advantage of a sample that had completed measures of depression, anxiety, suicidal ideation, and two forms of emotion-related impulsivity before the pandemic, we asked participants to complete three weekly follow-up internalizing assessments early in the pandemic.

**Results:** Among the 150 participants, pre-pandemic emotion-related impulsivity scores predicted higher depression, anxiety, general distress, and suicidal ideation during the COVID-19 pandemic. Controlling for pre-pandemic scores, one form of emotion-related impulsivity (Feelings Trigger Action) predicted increased anxiety and general distress. We also examined how pre-pandemic emotion-related impulsivity was moderated by weekly COVID-related stress. One form of emotion-related impulsivity (Pervasive Influence of Feelings) predicted internalizing symptoms at low stress levels, and a different form (Feelings Trigger Action) predicted internalizing symptoms at higher stress levels.

**Limitations:** Limitations include the small sample size, the absence of repeat measures of impulsivity, the attrition of individuals with more internalizing symptoms, and the reliance on self-rated measures.

**Conclusions:** Forms of emotion-related impulsivity predict increases in anxiety and distress over time, but the interactions with stress levels appear to vary. Emotion-related impulsivity can be addressed with accessible intervention tools, suggesting the promise of broader screening for those at risk for internalizing symptoms during periods of high stress.

A large body of research suggests that impulsivity is best conceptualized as an umbrella term, with multiple facets of impulsivity, including sensation-seeking, lack of perseverance, lack of planning, and emotion-related impulsivity, that are statistically separable and relate differentially to outcomes (Whiteside and Lynam, 2001). Here, we focus on emotion-related impulsivity, defined as tendencies to engage in rash and regrettable speech and behavior and unconstrained cognition during periods of high emotion (Carver and Johnson, 2018). The construct is most commonly measured using the Negative Urgency scale, which captures a trait-like tendency to respond to heightened negative emotions with rash speech and behavior (e.g., “When I am upset, I often do things without thinking”; Whiteside et al., 2005). A parallel Positive Urgency scale captures tendencies to respond to positive emotions with

rash speech and behavior (Johnson et al., 2007). Large-scale studies suggest that Negative Urgency and Positive Urgency scales are closely correlated and form a higher order factor that is statistically distinct from other forms of impulsivity (Billieux et al., 2021; Carver et al., 2011; Cyders and Smith, 2007). We refer to this trait-like tendency to respond impulsively to emotions (of either valence) as emotion-related impulsivity.

The literature on emotion-related impulsivity has burgeoned, with over 1000 peer-reviewed publications (Psycinfo, 6/3/2021). Higher Negative Urgency scores are related to more severe anxiety symptoms (Dickson et al., 2017; Pawluk and Koerner, 2013), diagnoses of major depressive disorder (Carver et al., 2013; Dekker and Johnson, 2018), and suicidal ideation and attempts (Auerbach et al., 2017; Klonsky and

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**Table 1**  
Sample demographic and clinical characteristics (N= 150).

Variable	M or%	SD or n
Age (yrs)	28.75	8.99
Education	15.65	2.32
Income		
Less than \$10,000	16%	24
\$10,000 - \$19,999	7%	10
\$20,000 - \$29,999	16%	24
\$30,000 - \$39,999	5%	7
\$40,000 - \$49,999	8%	12
\$50,000 - \$59,999	9%	14
\$60,000 - \$69,999	6%	9
\$70,000 - \$79,999	7%	11
\$80,000 - \$89,999	3%	5
\$90,000 - \$99,999	3%	4
\$100,000 - \$149,999	9%	13
More than \$150,000	11%	17
Gender		
Female	75%	113
Male	23%	34
Nonbinary	2%	3
Site		
California	58%	87
Florida	42%	63
Race		
White	51%	76
Asian	21%	31
Black/African American	13%	20
Other/Multiple Races	11%	17
Unknown	3%	5
Native Hawaiian/Pacific Islander	1%	1
Asian American Status		
Not Asian	76%	114
Asian	22%	31
Unknown	3%	5
Hispanic/Latinx Status		
Not Hispanic/Latinx	76%	115
Hispanic/Latinx	24%	37
Major Depressive Disorder	76%	114
Anxiety Disorders	65%	98
OCD	13%	19
Sought mental health or substance treatment	86%	129

Note. Anxiety Disorders = Past or Current Panic Disorder, Social Anxiety Disorder, or Generalized Anxiety Disorder; OCD = Current Obsessive-Compulsive Disorder; Major depressive disorder = Past or current.

May, 2010), with relatively large effect sizes documented in a meta-analysis of depression, anxiety, and composite measures of suicidality,  $r$ 's = 0.45, 0.40, and 0.25, respectively (Berg et al., 2015). Perhaps more surprisingly, higher Positive Urgency scores are tied to depressive symptoms (Carver et al., 2013; King et al., 2011; Marmorstein, 2013), anxiety (Spechler et al., 2020), and suicide attempts (Johnson et al., 2017a), suggesting that lack of constraint is key, and

**Table 2**  
Descriptive statistics for key variables (N= 150).

Measures	Baseline			COVID Week 1			COVID Week 2			COVID Week 3			Test-Retest Correlations	
	M	SD	$\omega$	M	SD	$\omega$	M	SD	$\omega$	M	SD	$\omega$	ICC	95% CI
MASQ														
General Distress	13.80	8.75	0.93	17.62	8.74	0.92	15.55	9.02	0.93	15.10	9.60	0.94	0.71	[0.65, 0.76]
Anhedonic Depression	26.04	6.80	0.92	26.02	7.40	0.92	25.67	8.05	0.94	26.46	8.25	0.94	0.66	[0.60, 0.72]
Anxious Arousal	5.95	5.26	0.86	7.83	6.95	0.89	7.18	6.50	0.89	6.44	6.02	0.87	0.73	[0.68, 0.78]
C-SSRS Suicidal Ideation Score														
Past Year	0.99	1.66												
Past Week				0.24	0.77		0.24	0.73		0.25	0.76		0.60	[0.53, 0.67]
Impulsivity														
PIF	3.48	0.86	0.71											
FTA	2.63	0.79	0.78											
COVID-Related Stress (Past Week)				3.56	1.06		3.23	1.04		3.18	1.11		0.65	[0.58, 0.71]

Note. C-SSRS = Columbia MASQ = Mood and Anxiety Symptom Questionnaire; PIF = Pervasive Influence of Feelings; FTA = Feelings Trigger Action.

Only 111 individuals completed the pre-pandemic C-SSRS.

ICC = Intraclass correlation coefficients across COVID-19 follow-up assessments (based on single-rating, absolute agreement, two-way mixed effects models).

that the effects of Negative Urgency are not simply an artifact of neuroticism. These effects of emotion-related impulsivity have also been observed in longitudinal studies of depression (Hasegawa et al., 2018; Riley and Smith, 2017) and suicide attempts (Kasen et al., 2011; Yen et al., 2009). In sum, emotion-related impulsivity appears related to internalizing symptoms.

Emotion-related impulsivity may be a particularly critical predictor of internalizing symptoms within the context of stressful life events, for two reasons. First, emotion-related impulsivity captures maladaptive responses to negative emotions, which are often triggered by stress. Second, internalizing symptoms are robustly triggered by stress exposure (Brown & Harris, 1989). The COVID-19 pandemic represents a salient stressor to examine these relationships. Because the weekly effects of the pandemic varied for many individuals (e.g., loss of employment; illness exposure; homeschooling demands), the pandemic also provided an opportunity to study dynamic changes in stress. The goal of this study was to examine how emotion-related impulsivity assessed pre-pandemic would predict increases in anxiety, depression, and suicidal ideation during the early months of the pandemic.

Large-scale community-based studies document high rates of anxiety, depression, and suicidal ideation in response to the pandemic (Dozois, 2020; Fullana et al., 2020; Hyland et al., 2020; Qiu et al., 2020). Indeed, as many as two-thirds of people in the general population reported at least some anxiety or depression symptoms during the early phases of the pandemic (Fullana et al., 2020), and it has been estimated that the number of people reporting significant anxiety or depression doubled to quadrupled from 2019 to 2020 (Dozois, 2020; Twenge and Joiner, 2020). However, these rates also appeared to decline across the globe as the pandemic became protracted (Belz et al., 2021; Brunoni et al., 2021; Fancourt et al., 2021), making the early months of the pandemic—when the current study was conducted—ideal for understanding initial stress reactivity. Accordingly, the early phase of the COVID-19 pandemic provides an opportunity to understand risk factors for anxiety and depression during periods of high stress.

Some work has identified individual differences that correlated with anxious and depressive responses to the pandemic, including loneliness, anxiety sensitivity, and inability to tolerate uncertainty (Horigian et al., 2021; Rettie and Daniels, 2020; Rogers et al., 2021). Nonetheless, we are unaware of studies examining how emotion-related impulsivity predicts symptoms in response to the pandemic. Hence, our goal was to examine how emotion-related impulsivity, measured pre-pandemic in a sample of individuals with significant levels of internalizing symptoms, predicted increases in symptoms of anxiety, depression, and suicidal ideation during the initial months of the pandemic.

To study dynamic fluctuations with stress exposure during the pandemic, participants were asked to complete three weekly surveys during the pandemic to assess anxiety, depression, suicidal ideation, and COVID-related stress exposure. All participants had completed a pre-

Table 3

Zero order and repeated measure correlations [with 95% confidence intervals] between key variables and covariates (N= 150).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. COVID MASQ General Distress															
2. COVID MASQ Anhedonic Depression	0.38***														
	[0.28, 0.48]														
3. COVID MASQ Anxious Arousal	0.44***	0.13*													
	[0.34, 0.53]	[0.02, 0.25]													
4. COVID Suicidal Ideation (past week)	0.18**	0.10	0.08												
	[0.07, 0.30]	[−0.02, 0.22]	[−0.04, 0.19]												
5. Feelings Trigger Action	0.35**	0.01	0.30**	0.12											
	[0.20, 0.48]	[−0.15, 0.17]	[0.15, 0.44]	[−0.04, 0.27]											
6. Pervasive Influence of Feelings	0.43**	0.25**	0.29**	0.21**	0.43**										
	[0.29, 0.55]	[0.10, 0.40]	[0.14, 0.43]	[0.06, 0.36]	[0.29, 0.55]										
7. COVID-Related Stress (past week)	0.31***	0.18**	0.18**	−0.10	0.08	0.13									
	[0.20, 0.41]	[0.07, 0.30]	[0.07, 0.29]	[−0.22, 0.02]	[−0.08, 0.24]	[−0.03, 0.28]									
8. Pre-COVID MASQ General Distress	0.53**	0.17*	0.35**	0.37**	0.28**	0.57**	0.03								
	[0.40, 0.64]	[0.01, 0.32]	[0.20, 0.49]	[0.22, 0.50]	[0.12, 0.42]	[0.45, 0.67]	[−0.13, 0.19]								
9. Pre-COVID MASQ Anhedonic Depression	0.25**	0.45**	0.11	0.19*	0.13	0.34**	−0.03	0.49**							
	[0.09, 0.39]	[0.31, 0.57]	[−0.05, 0.27]	[0.03, 0.34]	[−0.03, 0.29]	[0.19, 0.47]	[−0.19, 0.13]	[0.36, 0.61]							
10. Pre-COVID MASQ Anxious Arousal	0.46**	0.11	0.61**	0.30**	0.25**	0.39**	0.18*	0.59**	0.20*						
	[0.32, 0.58]	[−0.05, 0.27]	[0.50, 0.71]	[0.14, 0.44]	[0.09, 0.39]	[0.25, 0.52]	[0.02, 0.33]	[0.48, 0.69]	[0.04, 0.35]						
11. Pre-COVID Suicidal Ideation (past year)	0.29**	0.14	0.28**	0.34**	0.20*	0.42**	−0.05	0.49**	0.34**	0.47**					
	[0.11, 0.46]	[−0.04, 0.32]	[0.10, 0.44]	[0.16, 0.49]	[0.02, 0.37]	[0.26, 0.57]	[−0.23, 0.14]	[0.34, 0.62]	[0.16, 0.49]	[0.30, 0.60]					
12. Age	−0.27**	−0.10	−0.16	0.04	−0.02	−0.25**	0.02	−0.21*	−0.02	−0.19*	−0.19*				
	[−0.41, −0.11]	[−0.26, 0.06]	[−0.31, 0.00]	[−0.12, 0.20]	[−0.18, 0.14]	[−0.40, −0.09]	[−0.14, 0.18]	[−0.36, −0.05]	[−0.18, 0.14]	[−0.34, −0.03]	[−0.36, −0.00]				
13. Gender	−0.13	−0.05	−0.15	−0.03	−0.02	−0.23**	−0.06	−0.06	−0.01	−0.13	−0.04	0.16*			
	[−0.29, 0.03]	[−0.20, 0.11]	[−0.30, 0.01]	[−0.19, 0.13]	[−0.18, 0.14]	[−0.38, −0.07]	[−0.37, −0.06]	[−0.22, 0.10]	[−0.17, 0.15]	[−0.28, 0.03]	[−0.22, 0.15]	[0.00, 0.31]			
14. Site	−0.15	−0.14	−0.17*	−0.16	−0.19*	−0.27**	−0.07	−0.33**	−0.19*	−0.29**	−0.22*	−0.05	−0.13		
	[−0.30, 0.01]	[−0.30, 0.02]	[−0.32, −0.01]	[−0.31, 0.00]	[−0.34, −0.03]	[−0.42, −0.12]	[−0.23, 0.09]	[−0.47, −0.18]	[−0.34, −0.03]	[−0.43, −0.14]	[−0.39, −0.03]	[−0.21, 0.11]	[−0.29, 0.03]		

(continued on next page)

Table 3 (continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
15. Asian American Status	-0.07	0.00	0.00	-0.10	-0.21**	-0.22***	0.01	-0.16*	0.03	-0.12	-0.26**	0.14	0.09	0.20*	
	[-0.23, 0.09]	[-0.16, 0.16]	[-0.16, 0.16]	[-0.26, 0.06]	[-0.36, -0.05]	[-0.37, -0.06]	[-0.15, 0.17]	[-0.32, -0.00]	[-0.13, 0.20]	[-0.27, 0.05]	[-0.43, -0.08]	[-0.03, 0.29]	[-0.07, 0.24]	[0.05, 0.35]	
16. Days Between Pre-COVID and COVID Surveys	-0.25**	-0.10	-0.18*	0.09	-0.17*	-0.07	-0.16	-0.07	-0.03	-0.08	-0.10	0.24**	0.02	-0.03	0.00
	[-0.39, -0.09]	[-0.26, 0.06]	[-0.33, -0.02]	[-0.07, 0.25]	[-0.32, -0.01]	[-0.23, 0.09]	[-0.31, 0.00]	[-0.23, 0.09]	[-0.19, 0.13]	[-0.24, 0.09]	[-0.28, 0.09]	[0.08, 0.38]	[-0.14, 0.18]	[-0.19, 0.13]	[-0.16, 0.16]

Note. We used repeated measure correlations to evaluate associations between pairs of variables assessed at multiple timepoints (variable # 1, 2, 3, 4, 7). We used zero-order correlations to examine associations between (a) pairs of variables assessed at a single timepoint (# 5–6, 8–16) and (b) between repeated-measure and single-measure variables, using the individual's average for each repeated measure across all timepoints. For relations with binary variables, we used point biserial correlations.

\*  $p < .05$ .

\*\*  $p < .01$ .

\*\*\*  $p < .001$ .

pandemic measure of two forms of emotion-related impulsivity: Feelings Trigger Action (FTA), which covers regrettable speech and behavior during periods of high emotion, and Pervasive Influence of Feelings (PIF), which covers unconstrained motivational and cognitive responses to mostly negative emotions (Carver et al., 2011). Previous work has shown that FTA is robustly related to internalizing and externalizing syndromes, whereas PIF is more specifically and robustly related to internalizing syndromes (Johnson et al., 2017b, 2013).

We hypothesized that:

H1. High emotion-related impulsivity will relate to larger increases in internalizing symptoms during the pandemic, controlling for pre-pandemic internalizing scores.

H2. COVID-related stress exposure will moderate the effects of emotion-related impulsivity on internalizing, such that the effect of emotion-related impulsivity on internalizing symptoms would be greater on weeks with higher COVID-related stress.

Although we expected both emotion-related impulsivity scales to be predictive, we expected significantly larger effects for PIF compared to FTA for both hypotheses.

### 1. Method

All procedures were approved by the university IRBs (UC Berkeley IRB protocol 2016–05–8748; University of Miami IRB protocol 20,160,776) before data collection began. Informed consent procedures were completed before study participation and repeated online before the follow-up. Participants were paid at an hourly rate (\$30 per hour in Berkeley; \$25 in Miami, based on differential costs of living in the two cities). Hypotheses, measures, and analyses for this study were pre-registered (<https://osf.io/ajq7n>).<sup>1</sup> De-identified data is available at [https://osf.io/bqa3j/?view\\_only=a633faad26864651a92b2b73adf63ce7](https://osf.io/bqa3j/?view_only=a633faad26864651a92b2b73adf63ce7).

#### 1.1. Participants

The study sample is composed of adult community members recruited in metropolitan regions of Northern California and Southern Florida via outreach to mental health clinics and community advertising to identify persons who were struggling with or seeking treatment with internalizing or externalizing symptoms. Inclusion criteria were mental health-related impairment in the past 6 months as indicated by a Sheehan Disability Scale score  $\geq 5$  (Sheehan and Sheehan, 2008) or receipt of mental disability benefits. Exclusion criteria included head trauma with loss of consciousness  $> 5$  min or lasting effects, low cognitive abilities as assessed by an Orientation Memory Concentration test (Katzman et al., 1983) score  $< 7$ , neurological disorders, daily antipsychotic medication or street drug use, use of sedating medications on the day of testing, inability to independently complete study measures (e.g., language difficulties, uncorrectable vision problems), or medical conditions or medications that could interfere with diagnostic assessment (e.g., untreated endocrine disorders, HIV or syphilis, interferon, and past-year electroshock treatment). At one site, most participants were screened for MRI safety contraindications (e.g., ferrous metal in body, pregnancy, seizure disorders). Because of the broader study goal of gathering MRI data, the age range was restricted to 18 to 55. Potential participants completed a diagnostic interview to assess exclusion criteria of alcohol or substance use disorders in the past 6 months, lifetime psychotic disorders, or lifetime manic episode per the SCID-5.

<sup>1</sup> The preregistration includes hypotheses regarding response inhibition that will be presented in a separate paper.

**Table 4**

*Hypothesis 1 results:* Parameter estimates (e.g., betas and 95% confidence intervals) for four hierarchical linear regressions, evaluating emotion-related impulsivity as a predictor of changes in the mean level of internalizing symptoms during COVID-19 follow-up assessments, relative to pre-pandemic values.

	COVID Avg General Distress			COVID Avg Anxious Arousal			COVID Avg Anhedonic Depression			COVID Avg Suicidal Ideation		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<b>Estimated Effects</b>												
Feelings Trigger Action			0.23** [0.08, 0.38]			0.18* [0.04, 0.33]			-0.09 [-0.27, 0.08]			0.00 [-0.22, 0.22]
Pervasive Influence of Feelings			-0.01 [-0.20, 0.18]			-0.02 [-0.19, 0.15]			0.05 [-0.15, 0.25]			0.12 [-0.14, 0.38]
Pre-COVID General Distress		0.46*** [0.31, 0.60]	0.41*** [0.24, 0.57]									
Pre-COVID Anxious Arousal					0.59*** [0.45, 0.73]	0.56*** [0.41, 0.70]						
Pre-COVID Anhedonic Depression								0.42*** [0.27, 0.57]	0.42*** [0.26, 0.58]			
Pre-COVID Suicidal Ideation											0.32** [0.12, 0.51]	0.28* [0.07, 0.49]
Age	-0.22** [-0.39, -0.06]	-0.13 [-0.28, 0.02]	-0.15* [-0.29, -0.00]	-0.10 [-0.27, 0.07]	-0.00 [-0.14, 0.14]	-0.02 [-0.16, 0.12]	-0.08 [-0.25, 0.10]	-0.07 [-0.23, 0.08]	-0.06 [-0.22, 0.10]	0.01 [-0.19, 0.21]	0.04 [-0.15, 0.24]	0.06 [-0.14, 0.26]
Gender - Males (ref: females)	-0.16 [-0.35, 0.02]	-0.12 [-0.28, 0.05]	-0.13 [-0.29, 0.04]	-0.23* [-0.42, -0.04]	-0.12 [-0.28, 0.04]	-0.13 [-0.29, 0.03]	-0.15 [-0.35, 0.05]	-0.11 [-0.29, 0.07]	-0.09 [-0.28, 0.10]	-0.16 [-0.39, 0.07]	-0.13 [-0.35, 0.09]	-0.10 [-0.33, 0.14]
Gender - Nonbinary (ref: females)	-0.11 [-0.65, 0.43]	-0.13 [-0.61, 0.35]	-0.08 [-0.55, 0.39]	-0.14 [-0.70, 0.43]	-0.11 [-0.57, 0.36]	-0.07 [-0.53, 0.38]	0.29 [-0.29, 0.86]	0.20 [-0.32, 0.72]	0.19 [-0.33, 0.72]	-0.31 [-0.90, 0.28]	-0.33 [-0.89, 0.23]	-0.30 [-0.87, 0.27]
Site (ref: CA)	-0.26** [-0.42, -0.10]	-0.10 [-0.25, 0.05]	-0.08 [-0.24, 0.07]	-0.22* [-0.39, -0.05]	-0.03 [-0.17, 0.12]	-0.01 [-0.16, 0.14]	-0.21* [-0.38, -0.04]	-0.13 [-0.29, 0.03]	-0.13 [-0.30, 0.01]	-0.20 [-0.40, 0.01]	-0.14 [-0.34, 0.06]	-0.10 [-0.31, 0.12]
Asian-American Status (ref: Asian-American)	0.16 [-0.04, 0.35]	0.15 [-0.02, 0.33]	0.20* [0.02, 0.37]	0.10 [-0.11, 0.31]	0.09 [-0.09, 0.26]	0.12 [-0.05, 0.29]	0.13 [-0.08, 0.34]	0.11 [-0.09, 0.30]	0.09 [-0.11, 0.29]	-0.11 [-0.36, 0.13]	-0.02 [-0.26, 0.22]	-0.02 [-0.27, 0.22]
Days Between Pre-COVID and COVID Surveys	-0.20* [-0.35, -0.04]	-0.18* [-0.32, -0.04]	-0.14* [-0.28, -0.00]	-0.14 [-0.31, 0.02]	-0.12 [-0.25, 0.01]	-0.09 [-0.22, 0.05]	-0.07 [-0.24, 0.09]	-0.06 [-0.21, 0.09]	-0.08 [-0.24, 0.07]	0.09 [-0.10, 0.29]	0.10 [-0.08, 0.29]	0.12 [-0.07, 0.31]
<b>Model Summary</b>												
Adjusted R <sup>2</sup>	0.15	0.33	0.36	0.07	0.38	0.40	0.03	0.20	0.20	0.01	0.10	0.09
ΔR <sup>2</sup>		0.18**	0.03**		0.31***	0.02*		0.17***	0.00		0.09**	0.00
F		38.99	5.02		71.25	3.30		30.27	0.60		10.30	0.52

*Note.* For each dependent variable, covariates were included in Model 1, corresponding pre-COVID-19 internalizing symptoms were added in Model 2, and emotion-related impulsivity scores were added in Model 3.

Due to missing data,  $n = 147$  for MASQ analyses and  $n = 111$  for C-SSRS suicidal ideation analyses. For categorical variables (i.e., gender, site, and Asian-American status), reference groups are denoted in parentheses.

- \*  $p < .05$ .
- \*\*  $p < .01$ .
- \*\*\*  $p < .001$ .

**1.2. Measures**

**1.2.1. Measures of inclusion criteria**

**Structured Clinical Interview for DSM-5 (SCID-5; (First et al., 2015).** The SCID is a widely used semi-structured interview to assess psychological diagnoses. Interviewers completed didactic and interactive training and showed adequate inter-rater reliability before administering the SCID-5 to participants. Throughout the study, we held reliability meetings to protect against rater drift. The average kappa between the rater and gold standard diagnostic score was 0.815.

**Functional Impairment.** The Sheehan Disability Scale (Leon et al., 1997) is a well-validated interview used to assess functional impairment in three domains: work/school, social life, and family life. Potential participants were asked to select the worst month in the past six months in terms of mental health symptoms, and then to rate the interference of these symptoms on a scale of none (0) to very severe (10) in each domain. Scores reflect the worst impairment across domains.

**1.2.2. Pre-COVID-19 measures**

**Three Factor Impulsivity Scale (Carver et al., 2011).** The Three Factor Impulsivity Scale measures trait-like tendencies toward unconstrained actions, thoughts or motivational states in response to emotion. We used the two emotion-related impulsivity factors. The Pervasive Influence of Feelings (PIF) factor assesses overly broad influences of feelings on cognition and motivation (e.g., “My feelings greatly affect how I see the world”). The Feelings Trigger Action (FTA) factor measures tendencies toward regrettable speech or behavior in response to emotional states (e.g., “When I feel a desire, I act on it immediately”), and is comprised of items from the Negative Urgency scale, the Positive Urgency scale, and 3 items reflecting reflexive responses to emotion. Response options were on a scale from 1-*I agree a lot* to 5-*I disagree a lot*. Each subscale is scored as the mean of items and each factor is scored as a mean of the relevant subscales. PIF and FTA scores are related to depression, anxiety, and suicidality (Carver et al., 2013; Johnson et al., 2017a).

**Mood and Anxiety Symptoms Questionnaire—30-item version**

**Table 5**

*Hypothesis 2 results (N = 150, k = 426):* Parameter estimates (e.g., betas and 95% confidence intervals) for four hierarchical linear models, evaluating emotion-related impulsivity and its interactions with weekly ratings of COVID-related stress as predictors of weekly fluctuations in internalizing symptoms during COVID.

	COVID General Distress (weekly)			COVID Anxious Arousal (weekly)			COVID Anhedonic Depression (weekly)			COVID Suicidal Ideation (weekly)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<b>Estimated Fixed Effects</b>												
Feelings Trigger Action (FTA)		0.20**	0.18**		0.22**	0.20**		-0.10	-0.12		0.02	0.01
		[0.06, 0.34]	[0.05, 0.30]		[0.06, 0.37]	[0.06, 0.34]		[-0.26, 0.05]	[-0.27, 0.04]		[-0.14, 0.17]	[-0.14, 0.17]
Pervasive Influence of Feelings (PIF)		0.21**	0.20**		0.10	0.09		0.22*	0.22*		0.18*	0.18*
		[0.05, 0.36]	[0.05, 0.34]		[-0.07, 0.27]	[-0.07, 0.25]		[0.05, 0.39]	[0.05, 0.39]		[0.01, 0.35]	[0.02, 0.35]
COVID-Related Stress (weekly)			0.27***			0.20***			0.12*			-0.06
			[0.19, 0.35]			[0.11, 0.28]			[0.02, 0.21]			[-0.16, 0.04]
FTA x COVID-Related Distress			0.24**			0.16			0.12			0.03
			[0.06, 0.42]			[-0.03, 0.34]			[-0.08, 0.32]			[-0.18, 0.24]
PIF x COVID-Related Distress			-0.18*			-0.01			-0.04			0.01
			[-0.36, -0.00]			[-0.19, 0.17]			[-0.24, 0.17]			[-0.20, 0.22]
Age	-0.22**	-0.18**	-0.20**	-0.10	-0.08	-0.11	-0.08	-0.03	-0.04	0.02	0.06	0.07
	[-0.36, -0.08]	[-0.31, -0.04]	[-0.33, -0.08]	[-0.25, 0.05]	[-0.23, 0.07]	[-0.25, 0.03]	[-0.23, 0.07]	[-0.18, 0.12]	[-0.19, 0.11]	[-0.12, 0.17]	[-0.08, 0.21]	[-0.08, 0.22]
Gender - Males (ref: females)	-0.14	-0.08	0.01	-0.20*	-0.17*	-0.12	-0.12	-0.06	-0.02	-0.02	0.03	0.01
	[-0.30, 0.02]	[-0.23, 0.07]	[-0.14, 0.15]	[-0.37, -0.03]	[-0.34, -0.00]	[-0.28, 0.05]	[-0.29, 0.05]	[-0.23, 0.11]	[-0.23, 0.15]	[-0.18, 0.15]	[-0.14, 0.20]	[-0.16, 0.18]
Gender - Nonbinary (ref: females)	-0.09	-0.00	0.00	-0.12	-0.05	-0.04	0.26	0.29	0.29	-0.22	-0.17	-0.18
	[-0.55, 0.37]	[-0.43, 0.43]	[-0.40, 0.40]	[-0.61, 0.38]	[-0.52, 0.43]	[-0.48, 0.41]	[-0.23, 0.75]	[-0.20, 0.77]	[-0.19, 0.77]	[-0.70, 0.26]	[-0.65, 0.30]	[-0.65, 0.30]
Site (ref: CA)	-0.21**	-0.11	-0.10	-0.20**	-0.13	-0.13	-0.17*	-0.11	-0.11	-0.13	-0.07	-0.08
	[-0.35, -0.07]	[-0.24, 0.03]	[-0.23, 0.03]	[-0.35, -0.05]	[-0.29, 0.02]	[-0.27, 0.01]	[-0.31, -0.02]	[-0.26, 0.04]	[-0.26, 0.04]	[-0.28, 0.01]	[-0.22, 0.08]	[-0.23, 0.08]
Asian-American Status (ref: Asian-American)	0.13	0.17*	0.15	0.08	0.12	0.11	0.12	0.10	0.09	-0.07	-0.07	-0.06
	[-0.04, 0.30]	[0.01, 0.33]	[-0.00, 0.30]	[-0.10, 0.27]	[-0.06, 0.30]	[-0.06, 0.28]	[-0.07, 0.30]	[-0.08, 0.28]	[-0.09, 0.27]	[-0.25, 0.11]	[-0.25, 0.11]	[-0.24, 0.12]
Days Between Pre-COVID and COVID Surveys	-0.18**	-0.14*	-0.09	-0.13	-0.09	-0.06	-0.07	-0.09	-0.07	0.07	0.07	0.06
	[-0.32, -0.05]	[-0.27, -0.01]	[-0.21, 0.02]	[-0.28, 0.01]	[-0.23, 0.05]	[-0.19, 0.07]	[-0.22, 0.07]	[-0.23, 0.05]	[-0.21, 0.07]	[-0.07, 0.20]	[-0.07, 0.21]	[-0.08, 0.20]
<b>Model Summary</b>												
Marginal R <sup>2</sup> / Conditional R <sup>2</sup>	0.15 / 0.69	0.25 / 0.69	0.34 / 0.72	0.09 / 0.73	0.15 / 0.73	0.21 / 0.72	0.06 / 0.66	0.09 / 0.66	0.11 / 0.67	0.03 / 0.60	0.06 / 0.60	0.06 / 0.61
AIC	401.75	382.22	335.61	388.18	378.80	356.45	445.33	442.82	439.72	477.15	475.40	479.79
BIC	442.29	430.88	396.43	428.72	427.45	417.27	485.88	491.48	500.54	517.67	524.02	540.57
Log Likelihood	-190.87	-179.11	-152.81	-184.09	-177.40	-163.23	-212.66	-209.41	-204.86	-228.57	-225.70	-224.90
χ <sup>2</sup>		23.53***	52.61***		13.38**	28.34***		6.51*	9.10*		5.75	1.60

Note. For each dependent variable, we compared linear random-intercept mixed-effects models, where only covariates were included in Model 1, emotion-related impulsivity domains were added in Model 2, and COVID-related stress and its interactions with emotion-related impulsivity domains were added in Model 3. For categorical variables (i.e., gender, site, and Asian-American status), reference groups are denoted in parentheses.

\* p < .05.  
 \*\* p < .01.  
 \*\*\* p < .001.

(MASQ-D30; Wardenaar et al., 2010a). The 30-item version of the MASQ (10 items per subscale) has been shown to have similar psychometric properties as the full 90-item measure, good internal consistency, and acceptable convergent validity with measures of the same constructs (Wardenaar et al., 2010a). The Anhedonic depression and Anxious arousal subscales were designed to differentiate anxious and depressive symptoms (e.g., feeling withdrawn from others vs. physiological arousal), and the two subscales show expected low inter-correlations (Wardenaar et al., 2010a). The General distress (GD) subscale represents affective symptoms that are common to depression and anxiety (e.g., “I felt irritable”). Responses were rated on a scale from 0-Not at all to 4-Extremely covering severity in the past 2 weeks. Items are summed to create the three subscores.

**Columbia Suicide Severity Rating Scale (C-SSRS; Posner et al., 2011).** Participants completed the self-rated C-SSRS, a commonly used and well-validated measure of suicidal ideation and behavior (Posner

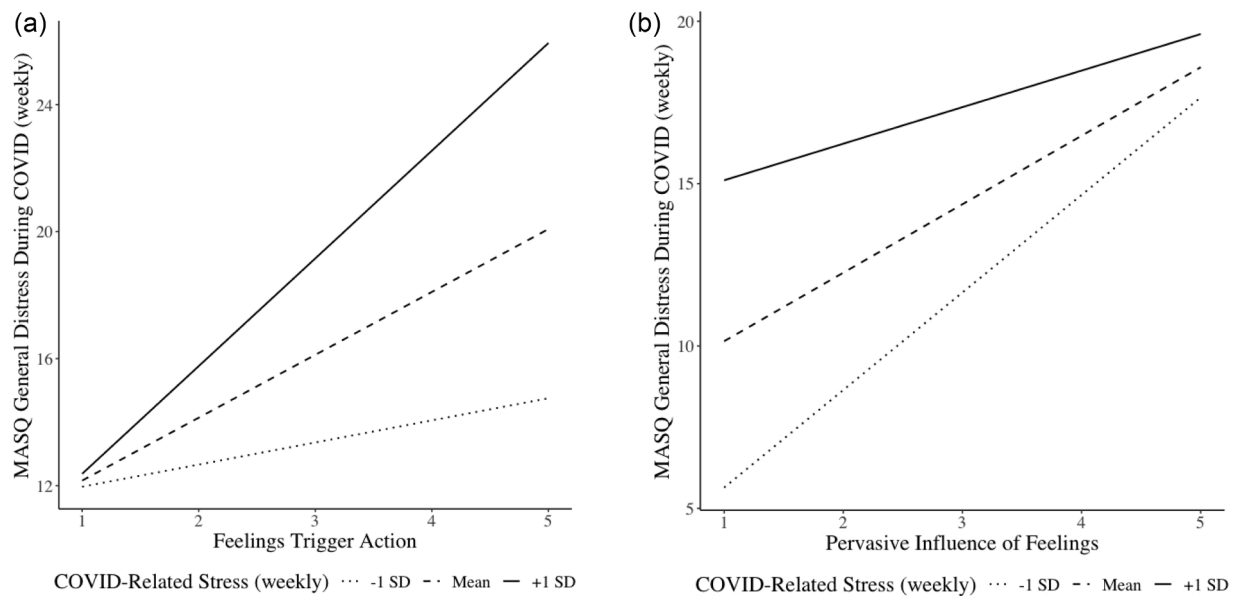
et al., 2011). We used the five-item ideation severity subscale, which reflects the most severe ideation item endorsed of the following: (0) no ideation, (1) wish to be dead, (2) non-specific active suicidal thoughts, (3) suicidal thoughts with methods, (4) suicidal intent, or (5) suicidal intent with plan. Suicidal ideation scores were based on the most severe ideation item endorsed (0 to 5).

1.3. COVID-19 follow-up measures

Each week of the pandemic assessment, as with the pre-pandemic study, participants completed MASQ-D30 and the C-SSRS but focused on the past week. Participants also completed the following at each weekly pandemic assessment:

**COVID-Related Stress.** We administered a single item assessing current stress regarding COVID-19, rated on a scale from 1-No distress to 6-So much distress that it is almost unbearable to cope with.





**Fig. 1.** Interaction between weekly ratings of COVID-related stress with emotion-related impulsivity (Fig. 1a: Feelings Trigger Action; Fig. 1b: Pervasive Influence of Feelings) predicting weekly fluctuations in general internalizing symptoms during COVID-19 (i.e., MASQ General distress subscale), adjusting for age, gender, site, Asian-American status, and days between pre-pandemic and follow-up surveys.

**COVID-Related Disruption.** We assessed the extent to which participants experienced COVID-related disruption across multiple domains, including illness exposure (whether they or anyone they knew had tested positive), employment (became unemployed since the pandemic or believed there was over a 50% likelihood that they would lose their job due to COVID), financial (COVID-related events affected ability to pay rent or mortgage over the next few months), and social (5 items concerning diminished quality of social interactions).

#### 1.4. Procedures

Potential participants took part in a phone interview to complete verbal consent and assess basic eligibility criteria. Participants who met criteria completed self-report measures between March 2017 and March 2020, and also completed behavioral and neuroimaging tasks not relevant to this paper. Participants who passed more than half the catch trials in self-report scales (e.g., select “I agree” as your response for this item) and had above chance performance on behavioral tasks in the pre-pandemic assessments were invited to participate in the COVID-19 follow-up study (190 participants).

At follow-up, participants completed three weekly online assessments that each included demographic questions, a cognitive task not relevant here, and questionnaires. The week 1 COVID-19 follow-up assessments were conducted between April 20 and June 18, 2020, two to five months after the World Health Organization declared a global pandemic on March 11, 2020 ( $M$  days after = 48.12,  $SD = 6.17$ ), and an average of 474.7 days after the pre-pandemic assessment ( $SD = 314.95$ , range = 13 to 1149 days). Participants were sent links to the week 2 assessment one week after completing the week 1 assessment, and to the week 3 assessment one week after completing the week 2 assessment. Participants were instructed to complete each assessment within 24 h of receiving the link, if possible. The week 1 battery required 30 min to complete, and the week 2 and 3 batteries took 15–20 min.

Catch trials were inserted throughout follow-up measures. After week 1 and 2, participants who demonstrated adequate data quality were invited to complete the next assessment. Data quality criteria were assessed using the R Careless package (Yentes and Wilhelm, 2018) and included passing at least 25% of attention checks, spending at least five minutes on the survey, demonstrating some response variance (i.e., responses were not identical to all items), and having adequate even-odd

correlations (Meade and Craig, 2012).

#### 1.5. Data analytic plan

In preliminary analyses, we confirmed that most individuals reported their lives had been disrupted by COVID-19, and we assessed variable distributions. To assess possible attrition biases and confounds, we examined site and demographic variables (age, gender, race—with a specific contrast for Asian status given COVID-related discrimination, Hispanic/Latinx status, education, income). We also examined variables related to follow-up completion and timing as potential confounds (date of first follow-up assessment, number of follow-up assessments completed, number of days between pre-pandemic and Week 1 assessments, and number of days in follow-up). Those that were significantly correlated with key variables were included as covariates in hypothesis testing. We examined bivariate associations using repeated measure and zero-order correlations (Bakdash and Marusich, 2017).

To test hypothesis 1, we used four parallel hierarchical linear regressions evaluating the relations of pre-pandemic emotion-related impulsivity (FTA, PIF) with increases in the mean internalizing symptoms (MASQ General distress, Anxious arousal, Anhedonic depression, and C-SSRS suicidal ideation) across the COVID-19 follow-up assessments. (Analyses using the maximum score across follow-up assessments are provided in the supplement). In each regression, we compared three nested models including: (1) only covariates, (2) adding corresponding pre-pandemic internalizing scores so as to examine change, and (3) adding FTA and PIF as predictors.

To test hypothesis 2, we used four parallel hierarchical generalized linear mixed-effects models examining pre-pandemic emotion-related impulsivity (FTA, PIF), weekly ratings of COVID-related stress, and their interactions as predictors of weekly fluctuations in internalizing psychopathology during the pandemic (MASQ General distress, Anxious arousal, Anhedonic depression, and C-SSRS Suicidal ideation severity). For each dependent variable, we used likelihood ratio tests to compare three nested models with the following fixed effects: (1) covariates only, (2) adding emotion-related impulsivity (FTA, PIF), and (3) adding weekly ratings of COVID-related stress and its interactions with emotion-related impulsivity. We allowed intercepts to vary by participant (i.e., random effect), accounting for individual differences in average internalizing symptoms. For each significant interaction in

these models, we evaluated simple slopes for moderator values one standard deviation above and below the mean, in addition to examining Johnson-Neyman intervals (Bauer and Curran, 2005). We assessed mixed-effects models via the lme4 package in R (Bates et al., 2015), using maximum likelihood estimation for nested model comparisons (Bolker et al., 2009). We also estimated marginal (i.e., variance of fixed effects) and conditional  $R^2$  values (i.e., variance taking into account both fixed and random effects), following Nakagawa et al. (2017) recommendations.

## 2. Results

Of the 190 participants (77.25% female,  $M_{age} = 29.03$  years) invited to participate in the follow-up, 22 did not complete the week 1 survey and 15 were excluded due to data checks, leaving 153 valid responses at week 1, 143 participants at week 2 (93.5% of week 1 sample), and 137 at week 3 (95.8% of week 2 sample). Attrition between COVID-19 weekly batteries was partially due to experimenter error (i.e., failure to send participants timely surveys), late survey completion, and participant drop-out. Three follow-up participants were missing pre-pandemic data on emotion-related impulsivity and so were not included in analyses. Our final sample was comprised of 150 participants.

### 2.1. Missing data

Of the 150 participants included in analyses, 3 were missing pre-pandemic MASQ subscales, and because the C-SSRS was added to the parent study part way through data collection, 39 were missing pre-pandemic C-SSRS data. Participants with missing pre-pandemic data were excluded from analyses of hypothesis 1 but not hypothesis 2. Participants missing pre-pandemic suicidal ideation data did not differ significantly from the rest of the sample in demographic, impulsivity, or MASQ variables with the exception of a trend-level difference in Pervasive Influence of Feelings, confirming that pre-pandemic C-SSRS data appeared to be missing at random (see supplement for details).

### 2.2. Extent of COVID-related disruption

Most participants (92%,  $n = 138$ ) reported disruption due to COVID-19 in at least one domain (i.e., illness exposure, employment, financial, or social) and over half (56%,  $n = 88$ ) indicated disruption across multiple domains. Specifically, one participant tested positive for COVID-19 and 37% personally knew someone who tested positive. 23% of participants had become unemployed since the pandemic. Among employed participants, 25% believed that there was over a 50% likelihood that they would lose their job due to COVID-19 and 42% believed that COVID-19 would make it more difficult for them to pay their rent/mortgage. 71% of participants indicated that their social interactions had worsened.

### 2.3. Attrition

The follow-up sample did not differ on most demographic or symptom variables, but had significantly lower pre-pandemic Anxious Arousal (MASQ) [ $M = 5.95$ ,  $M_{Pre-pandemic-only} = 7.52$ ,  $t(304.14) = 2.39$ ,  $p = .02$ ], lower FTA scores [ $M = 2.63$ ,  $M_{Pre-pandemic-only} = 2.88$ ,  $t(308.72) = 2.88$ ,  $p = .004$ ], and higher education levels [ $M = 15.61$ ,  $M_{Pre-pandemic-only} = 14.93$ ,  $t(316.70) = 2.69$ ,  $p = .008$ ] relative to those who did not complete any follow-up surveys. Among those who participated in the follow-up, there were no significant differences between those who completed all three assessment batteries and those who attrited after completing the Week 1 follow-up.

### 2.4. Preliminary analyses

As shown in Table 1, roughly 3/4 of participants met diagnostic criteria

for current or past major depressive disorder, and 2/3 for a current or past anxiety disorder per the SCID. Table 2 shows descriptive statistics, internal consistency, and test-retest reliability of measures.

Table 3 shows correlations among key variables and potential confounds. Older, male, and Florida participants, as well as those who had taken the pre-pandemic assessment later (e.g., fewer days between pre-COVID-19 and COVID-19 assessments) obtained lower emotion-related impulsivity scores and lower follow-up MASQ scores. Asian-American participants reported significantly lower PIF and FTA.

Higher PIF scores were strongly linked with elevated scores on all internalizing domains (i.e., higher MASQ General distress, Anhedonic depression, Anxious arousal, and C-SSRS suicidal ideation) and across all timepoints. Higher FTA scores correlated with greater MASQ General distress and Anxious arousal across all assessments. Greater weekly COVID-related stress related to higher scores on all three MASQ subscales, although the small to medium effect sizes indicate substantial heterogeneity in responses to COVID-related stress. Finally, pre-COVID-19 internalizing symptoms correlated significantly with corresponding scores during the follow-up.

### 2.5. Hypothesis 1

As detailed in the analysis plan, we conducted four hierarchical linear regressions evaluating the relations between emotion-related impulsivity and increases in internalizing symptoms during the pandemic. As shown in Table 4 Model 3, FTA predicted significant increases in MASQ General distress and Anxious arousal during the pandemic, controlling for pre-COVID-19 values and covariates. Although PIF scores were correlated with follow-up internalizing symptoms in bivariate analyses (see Table 3), regression analyses indicated that PIF scores did not account for increases in internalizing symptoms, contrary to our hypothesis. Neither measure of emotion-related impulsivity predicted increases in Anhedonic depression or Suicidal ideation severity during the pandemic.

### 2.6. Hypothesis 2

As detailed in the analysis plan, we conducted four mixed effects models to examine how emotion-related impulsivity (FTA, PIF), weekly ratings of COVID-related stress, and their interactions predicted weekly fluctuations in the four internalizing variables controlling for covariates. As shown in Table 5 (model 2), no predictors significantly improved model fit beyond covariates for suicidal ideation during the pandemic. In contrast, PIF and FTA predicted all MASQ subscales beyond covariates alone. In particular, participants with higher FTA scores reported significantly higher General distress and Anxious arousal during the pandemic, and those with higher PIF scores reported significantly higher General distress and Anhedonic depression.

As shown in Table 5 (model 3), as anticipated, on weeks with more COVID-related stress, participants reported significantly more MASQ General distress, Anxious arousal, and Anhedonic depression. In addition, weekly fluctuations in COVID-related stress significantly moderated the relation between emotion-related impulsivity and MASQ General distress for both FTA and PIF. Weekly fluctuations in COVID-related stress did not moderate the effects of either form of emotion-related impulsivity on MASQ Anxious arousal or Anhedonic depression scores.

As illustrated in Fig. 1a and evaluating simple slopes, participants with higher FTA scores obtained significantly greater MASQ General distress scores on weeks with high COVID-related stress (i.e., one standard deviation above the mean),  $\beta = 0.30$ ,  $SE = 0.08$ ,  $p < .001$ , and, to a lesser degree, on weeks with average levels of COVID-related stress,  $\beta = 0.18$ ,  $SE = 0.07$ ,  $p < .01$ . In contrast, the relation between FTA and General distress scores was not significant on weeks with low COVID-related stress (i.e., one standard deviation below the mean),  $\beta = 0.05$ ,  $SE = 0.08$ ,  $p > .05$ . Using the Johnson-Neyman technique, FTA

significantly predicted General distress on weeks when COVID-related stress was higher than  $-0.16$  standard deviations from the mean, but not significant for lower values.

For PIF, we observed the opposite pattern, wherein the positive relation between PIF and MASQ General distress was strongest on weeks with lower COVID-related stress. As shown in Fig. 1b, contrary to hypothesis, participants with higher PIF scores consistently endorsed elevated MASQ General distress during the pandemic regardless of weekly COVID-related stress scores, whereas among participants with lower PIF scores, MASQ General distress scores were higher when concurrent weekly ratings of COVID-related stress were high. Simple slope analyses indicated that on weeks with low COVID-related stress (i.e., one standard deviation below the mean), and to a slightly lesser degree on weeks with average levels of COVID-related stress, PIF scores related to significantly greater MASQ General distress scores;  $\beta = 0.29$ ,  $SE = 0.09$ ,  $p < .001$ ;  $\beta = 0.20$ ,  $SE = 0.07$ ,  $p < .01$ , respectively). In contrast, the relation between PIF and MASQ General distress scores was not significant on weeks with high COVID-related stress (i.e., one standard deviation above the mean),  $\beta = 0.10$ ,  $SE = 0.09$ ,  $p > .05$ . Using the Johnson-Neyman procedure, PIF was significantly related to higher general internalizing symptoms on weeks when COVID-related stress was less than  $0.26$  standard deviations above the mean, but not significant for higher values.

### 3. Discussion

Although emotion-related impulsivity has been shown to be robustly related to internalizing symptoms, little work has considered how this trait relates to stress reactivity. The pandemic provided a novel opportunity to develop an integrative model of how emotion-related impulsivity would predict increases in internalizing symptoms during a period of major stress. Within a well-characterized sample of individuals with high rates of internalizing diagnoses, we were able to use measures of impulsivity gathered pre-pandemic to predict symptoms of anxiety, depression, and suicidal ideation during the pandemic. Strengths of the study included the carefully defined baseline sample, our ability to examine how pre-pandemic personality predicted symptom change during the pandemic, and the use of multivariable models. We were careful to consider demographic variables, attrition, and timing as potential confounds, and our findings do not appear to be explained by these issues. Although most participants reported objective disruptions from the pandemic, they varied considerably in stress ratings and internalizing symptoms. Our goal was to understand how emotion-related impulsivity explained this heterogeneity.

We expected that PIF scores, which capture unconstrained cognitive and motivational responses to negative emotions, would be particularly tied to internalizing symptoms, as compared to FTA scores, which reflect tendencies toward impulsive speech and behavior in response to positive and negative emotions. As hypothesized, in bivariate analyses, higher PIF scores related to significantly higher internalizing psychopathology during the pandemic across all domains (i.e., MASQ General distress, Anhedonic depression, Anxious arousal, and C-SSRS Suicidal ideation severity), whereas FTA scores correlated with Anxious arousal and General distress during the pandemic.

Despite the significant bivariate effects, emotion-related impulsivity did not relate to increases in Anhedonic depression or suicidal ideation during COVID-19 within multivariable models. The smaller number of participants with suicidal ideation data and the rarity of ideation may have limited the statistical power of these analyses. Other researchers who relied on relatively short follow-up periods have also failed to observe predictive effects of emotion-related impulsivity on changes in ideation (King et al., 2019). Regarding the effect observed for anxiety rather than depression, previous research has shown that anxiety, as compared to depression, is particularly likely to increase in the face of stressors that involve ambiguity regarding the future (Finlay-Jones and Brown, 1981)—which was certainly true of the pandemic.

Turning to the significant effects of multivariable models of change in symptoms over time, an unexpected and intriguing divergence emerged in the PIF and FTA scales across analyses of hypothesis 1 and 2. PIF scores did not predict a greater increase in symptoms during the pandemic controlling baseline scores, nor higher symptoms during more stressful weeks of the follow-up. In contrast, FTA scores showed a more classic stress reactivity profile, in that they predicted increases in internalizing (General distress and anxious arousal) during the pandemic and higher General distress during more stressful weeks of the pandemic. PIF scores, but not FTA scores, predict higher internalizing (General distress) during weeks with lower stress.

One speculative interpretation is that those with high PIF more chronically experience their emotions coloring their world view regardless of the source of the emotion (i.e., with or without stressors), such that the pervasiveness or "spreading" of emotions to internalizing symptoms may be present during difficult times, but perhaps more importantly, during less stressful times. That is, PIF may be a harbinger for internalizing symptoms in periods without major stress, reflecting a more chronic vulnerability. FTA, though, may predict heightened sensitivity to stress. Although previous work has not considered the interactions of stress with PIF or FTA, some research has considered the Urgency scales, which are core components of FTA. The Urgency scales have been shown to be related to greater affective reactivity to personal narratives involving stress (Owens et al., 2018) and to more severe PTSD symptoms in those with early adversity (Kim & Choi, 2020). Thus, the finding that FTA is tied to greater distress during more stressful weeks is consistent with related work; replication remains warranted given that these effects were only observed for distress. Given the gaps of previous work examining PIF and stress reactivity, and that the absence of stress reactivity was unexpected, replication is warranted.

We note several limitations. As with any longitudinal study, attrition was of concern. Participants who had higher anxiety and impulsivity were less likely to take part in the follow-up assessment. Although we used interviews to demonstrate high rates of internalizing diagnoses and functional impairment in our sample, we used self-rated measures of impulsivity, internalizing and stress. The current study also failed to re-assess impulsivity levels; this concern is mitigated by the relatively high levels of test-retest reliability of the Urgency scales,  $r_s = 0.85$ ,  $0.86$  (Weaver et al., 2013). Our sample size was also small, particularly for testing interaction effects (Cohen, 1998). Perhaps of more import, though, the scope of this study was limited—undoubtedly, many individual differences predict stress reactivity, and our study focused narrowly on impulsivity.

Nonetheless, current findings have potential public health significance. As health care systems strain under the weight of the dramatic increases in anxiety and depression (Dozois, 2020), there is a profound need to understand how to allocate resources. Multiple authors have discussed the need for routine screening in primary care (Kanzler and Ogbeide, 2020). Our tentative findings highlight that one form of emotion-related impulsivity could help identify people who are likely to struggle during periods of high stress, and another form of emotion-related impulsivity could predict heightened vulnerability even with less stress present. As emotion-related impulsivity is easily assessed, there is potential to screen more widely for these traits, which opens a path towards interventions targeted at emotion-related impulsivity. We have shown that emotion-related impulsivity is reduced after brief, easily accessible interventions involving teaching individuals to recognize emotions, to engage in self-calming techniques in response to emotion states, and to pre-plan coping strategies to cope with highly emotional states (Johnson et al., 2020). Such techniques might be profitably added to mental health approaches typically used for stress reduction, such as mindfulness and techniques for promoting social connection (Polizzi et al., 2020).

## Contributors

SLJ and KT conceptualized and designed the study, with input from other authors. PP conducted analyses, with consultation from SLJ and JP. KM and AD coordinated the data collection and drafted the method section. SLJ drafted the manuscript, with significant input from KT. All authors reviewed and approved the final manuscript.

## Declaration of Competing Interest

The authors have no conflicts of interest to disclose.

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## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.jad.2022.01.037](https://doi.org/10.1016/j.jad.2022.01.037).

## References

- Auerbach, R.P., Stewart, J.G., Johnson, S.L., 2017. Impulsivity and suicidality in adolescent inpatients. *J. Abnorm. Child Psychol.* 45, 91–103. <https://doi.org/10.1007/s10802-016-0146-8>.
- Bakdash, J.Z., Marusich, L.R., 2017. Repeated measures correlation. *Front. Psychol.* 8, 456. <https://doi.org/10.3389/fpsyg.2017.00456>.
- Bates, D., Mächler, M., Bolker, B., Walker, S., 2015. Fitting linear mixed-effects models using lme4. *J. Stat. Softw.* 67 (1), 1–48. <https://doi.org/10.18637/jss.v067.i01>.
- Bauer, D.J., Curran, P.J., 2005. Probing interactions in fixed and multilevel regression: inferential and graphical techniques. *Multivariate Behav. Res.* 40 (3), 373–400. [https://doi.org/10.1207/s15327906mbr4003\\_5](https://doi.org/10.1207/s15327906mbr4003_5).
- Belz, M., Hessmann, P., Vogelsgang, J., Schmidt, U., Ruhleder, M., Signerski-Krieger, J., Radenbach, K., Trost, S., Schott, B.H., Wiltfang, J., Wolff-Menzler, C., Bartels, C., 2021. Evolution of psychosocial burden and psychiatric symptoms in patients with psychiatric disorders during the Covid-19 pandemic. *Eur. Arch. Psychiatry Clin. Neurosci.* 3, 1–12. <https://doi.org/10.1007/s00406-021-01268-6>. Epub ahead of print.
- Berg, J.M., Litzman, R.D., Bliwise, N.G., Lilienfeld, S.O., 2015. Parsing the heterogeneity of impulsivity: a meta-analytic review of the behavioral implications of the UPPS for psychopathology. *Psychol. Assess.* 27, 1129–1146. <https://doi.org/10.1037/pas0000111>.
- Billieux, J., Heeren, A., Rochat, L., Maurage, P., Bayard, S., Bet, R., Besche-Richard, C., Challet-Bouju, G., Carré, A., Devos, G., Flayelle, M., Gierski, F., Grall-Bronnec, M., Kern, L., Khazaal, Y., Lançon, C., Lannoy, S., Michael, G.A., Raffard, S., Romo, L., Van der Linden, M., Wéry, A., Canale, N., King, D.L., Schimmenti, A., Baggio, S., 2021. Positive and negative urgency as a single coherent construct: evidence from a large-scale network analysis in clinical and non-clinical samples. *J. Pers.* <https://doi.org/10.1111/jopy.12655>.
- Bolker, B.M., Brooks, M.E., Clark, C.J., Geange, S.W., Poulsen, J.R., Stevens, M.H.H., White, J.-S.S., 2009. Generalized linear mixed models: a practical guide for ecology and evolution. *Trends Ecol. Evol. (Amst.)* 24 (3), 127–135. <https://doi.org/10.1016/j.tree.2008.10.008>.
- Brunoni, A.R., Suen, P.J.C., Bacchi, P.S., Razza, L.B., Klein, I., Dos Santos, L.A., de Souza Santos, I., da Costa Lane Valiengo, L., Gallucci-Neto, J., Moreno, M.L., Pinto, B.S., de Cássia Silva Félix, L., de Sousa, J.P., Viana, M.C., Forte, P.M., de Altisim Oliveira Cardoso, M.C., Bittencourt, M.S., Pelosof, R., de Siqueira, L.L., Fatori, D., Bellini, H., Bueno, P.V.S., Passos, I.C., Nunes, M.A., Salum, G.A., Bauermeister, S., Smoller, J.W., Lotufo, P.A., Benseñor, I.M., 2021. Prevalence and risk factors of psychiatric symptoms and diagnoses before and during the COVID-19 pandemic: Findings from the ELSA-Brasil COVID-19 mental health cohort. *Psychol. Med.* 21, 1–12. <https://doi.org/10.1017/S0033291721001719>.
- Carver, C.S., Johnson, S.L., 2018. Impulsive reactivity to emotion and vulnerability to psychopathology. *Am. Psychol.* 1067–1078. <https://doi.org/10.1037/amp0000387> in press.
- Carver, C.S., Johnson, S.L., Joormann, J., 2013. Major depressive disorder and impulsive reactivity to emotion: Toward a dual-process view of depression. *Br. J. Clin. Psychol.* 52, 285–299. <https://doi.org/10.1111/bjc.12014>.
- Carver, C.S., Johnson, S.L., Joormann, J., Kim, Y., Nam, J.Y., 2011. Serotonin transporter polymorphism interacts with childhood adversity to predict aspects of impulsivity. *Psychol. Sci.* 22, 589–595. <https://doi.org/10.1177/0956797611404085>.
- Cohen, J., 1998. *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed. Lawrence Erlbaum Associates, Hillsdale, NJ.
- Cyders, M.A., Smith, G.T., 2007. Mood-based rash action and its components: Positive and Negative urgency. *Pers. Individ. Dif.* 43, 839–850. <https://doi.org/10.1016/j.paid.2007.02.008>.
- Dekker, M.R., Johnson, S.L., 2018. Major depressive disorder and emotion-related impulsivity: are both related to cognitive inhibition? *Cognit. Ther. Res.* 42, 398–407. <https://doi.org/10.1007/s10608-017-9885-2>.
- Dickson, J.M., Johnson, S., Huntley, C.D., Peckham, A., Taylor, P.J., 2017. An integrative study of motivation and goal regulation processes in subclinical anxiety, depression and hypomania. *Psychiatry Res.* 256, 6–12. <https://doi.org/10.1016/j.psychres.2017.06.002>.
- Dozois, D.J.A., 2020. Anxiety and depression in Canada during the COVID-19 pandemic: A national survey. *Can. Psychol.* <https://doi.org/10.1037/cap0000251>.
- Fancourt, D., Steptoe, A., Bu, F., 2021. Trajectories of anxiety and depressive symptoms during enforced isolation due to COVID-19 in England: A longitudinal observational study. *Lancet Psychiatry* 8 (2), 141–149. [https://doi.org/10.1016/S2215-0366\(20\)30482-X](https://doi.org/10.1016/S2215-0366(20)30482-X).
- Finlay-Jones, R., Brown, G.W., 1981. Types of stressful life event and the onset of anxiety and depressive disorders. *Psychol. Med.* 11, 803–815. <https://doi.org/10.1017/S0033291700041301>.
- First, M.B., Williams, J.B.W., Karg, R.S., Spitzer, R.L., 2015. *Structured Clinical Interview for DSM-5—Research Version (SCID-5 for DSM-5, Research Version; SCID-5-RV)*. American Psychiatric Association, Arlington, VA.
- Fullana, M.A., Hidalgo-Mazzei, D., Vieta, E., Radua, J., 2020. Coping behaviors associated with decreased anxiety and depressive symptoms during the COVID-19 pandemic and lockdown. *J. Affect. Disord.* <https://doi.org/10.1016/j.jad.2020.06.027>.
- Hasegawa, A., Kunisato, Y., Morimoto, H., Nishimura, H., Matsuda, Y., 2018. Depressive rumination and urgency have mutually enhancing relationships but both predict unique variance in future depression: A longitudinal study. *Cogent Psychol.* 5 (1), 1450919 <https://doi.org/10.1080/23311908.2018.1450919>.
- Horigian, V.E., Schmidt, R.D., Feaster, D.J., 2021. Loneliness, mental health, and substance use among US young adults during COVID-19. *J. Psychoactive Drugs* 53, 1–9. <https://doi.org/10.1080/02791072.2020.1836435>.
- Hyland, P., Shevlin, M., McBride, O., Murphy, J., Karatzias, T., Bentall, R.P., Martinez, A., Vallières, F., 2020. Anxiety and depression in the Republic of Ireland during the COVID-19 pandemic. *Acta Psychiatr. Scand.* 13219 <https://doi.org/10.1111/acps.13219>.
- Johnson, S.L., Carver, C.S., Joormann, J., 2013. Impulsive responses to emotion as a transdiagnostic vulnerability to internalizing and externalizing symptoms. *J. Affect. Disord.* 150, 872–878. <https://doi.org/10.1016/j.jad.2013.05.004>.
- Johnson, S.L., Carver, C.S., Tharp, J.A., 2017a. Suicidality in bipolar disorder: the role of emotion-triggered impulsivity. *Suicide Life-Threat. Behav.* 47, 177–192. <https://doi.org/10.1111/sltb.12274>.
- Johnson, S.L., Tharp, J.A., Peckham, A.D., Carver, C.S., Haase, C.M., 2017b. A path model of different forms of impulsivity with externalizing and internalizing psychopathology: towards greater specificity. *Br. J. Clin. Psychol.* 56, 235–252. <https://doi.org/10.1111/bjc.12135>.
- Johnson, S.L., Zisser, M.R., Sandel, D.B., Swerdlow, B.A., Carver, C.S., Sanchez, A.H., Fernandez, E., 2020. Development of a brief online intervention to address aggression in the context of emotion-related impulsivity: evidence from a wait-list controlled trial. *Behav. Res. Ther.* 134, 103708 <https://doi.org/10.1016/j.brat.2020.103708>.
- Kanzler, K.E., Ogbode, S., 2020. Addressing Trauma and Stress in the COVID-19 Pandemic: challenges and the Promise of Integrated Primary Care. *Psychol. Trauma Theory, Res. Pract. Policy* 12, S177. <https://doi.org/10.1037/tra0000761>.
- Kasen, S., Cohen, P., Chen, H., 2011. Developmental course of impulsivity and capability from age 10 to age 25 as related to trajectory of suicide attempt in a community cohort. *Suicide Life Threat. Behav.* 41, 180–192. <https://doi.org/10.1111/j.1943-278X.2011.00017.x>.
- Katzman, R., Brown, T., Fuld, P., Peck, A., Schechter, R., Schimmel, H., 1983. Validation of a short orientation-memory-concentration test of cognitive impairment. *Am. J. Psychiatry* 140, 734–739. <https://doi.org/10.1176/ajp.140.6.734>.
- King, C.A., Grupp-Phelan, J., Brent, D., Dean, J.M., Webb, M., Bridge, J.A., Spirito, A., Chernick, L.S., Mahabee-Gittens, E.M., Mistry, R.D., Rea, M., Keller, A., Rogers, A., Shenoi, R., Cwik, M., Busby, D.R., Casper, T.C., 2019. Predicting 3-month risk for adolescent suicide attempts among pediatric emergency department patients. *J. Child Psychol. Psychiatry Allied Discip.* 60, 1055–1064. <https://doi.org/10.1111/jcpp.13087>.
- King, K.M., Karyadi, K.A., Luk, J.W., Patock-Peckham, J.A., 2011. Dispositions to rash action moderate the associations between concurrent drinking, depressive symptoms, and alcohol problems during emerging adulthood. *Psychol. Addict. Behav.* 25, 446–454. <https://doi.org/10.1037/a0023777>.
- Klonsky, E.D., May, A., 2010. Rethinking impulsivity in suicide. *Suicide Life-Threat. Behav.* 40, 612–619. <https://doi.org/10.1521/suli.2010.40.6.612>.
- Leon, A.C., Olsson, M., Portera, L., Farber, L., Sheehan, D.V., 1997. Assessing psychiatric impairment in primary care with the Sheehan Disability Scale. *Int. J. Psychiatry Med.* 27, 93–105. <https://doi.org/10.2190/TSEM-C8YH-373N-IUWD>.
- Marmorstein, N.R., 2013. Associations between dispositions to rash action and internalizing and externalizing symptoms in children. *J. Clin. Child Adolesc. Psychol.* 42, 131–138. <https://doi.org/10.1080/15374416.2012.734021>.
- Meade, A.W., Craig, S.B., 2012. Identifying careless responses in survey data. *Psychol. Methods* 17 (3), 437–455. <https://doi.org/10.1037/a0028085>.
- Nakagawa, S., Johnson, P.C.D., Schielzeth, H., 2017. The coefficient of determination R<sup>2</sup> and intra-class correlation coefficient from generalized linear mixed-effects models revisited and expanded. *J. R. Soc., Interface* 14 (134), 20170213. <https://doi.org/10.1098/rsif.2017.0213>.
- Pawlut, E.J., Koerner, N., 2013. A preliminary investigation of impulsivity in generalized anxiety disorder. *Pers. Individ. Dif.* 54, 732–737. <https://doi.org/10.1016/j.paid.2012.11.027>.

- Polizzi, C., Lynn, S.J., Perry, A., 2020. Stress and coping in the time of COVID-19: pathways to resilience and recovery. *Clin. Neuropsychiatry* 17 (2), 59–62.
- Posner, K., Brown, G.K., Stanley, B., Brent, D.A., Yershova, K.V., Oquendo, M.A., Currier, G.W., Melvin, G.A., Greenhill, L., Shen, S., Mann, J.J., 2011a. The Columbia-suicide severity rating scale: initial validity and internal consistency findings from three multisite studies with adolescents and adults. *Am. J. Psychiatry* 168, 1266–1277. <https://doi.org/10.1176/appi.ajp.2011.10111704>.
- Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., Xu, Y., 2020. A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen. Psychiatry*. <https://doi.org/10.1136/gpsych-2020-100213>.
- Rettie, H., Daniels, J., 2020. Coping and Tolerance of Uncertainty: predictors and Mediators of Mental Health During the COVID-19 pandemic. *Am. Psychol.* undefined. <https://doi.org/10.1037/amp0000710> undefined.
- Riley, E.N., Smith, G.T., 2017. Childhood drinking and depressive symptom level predict harmful personality change. *Clin. Psychol. Sci.* 5, 85–97. <https://doi.org/10.1177/2167702616661716>.
- Rogers, A.H., Bogiaizian, D., Salazar, P.L., Solari, A., Garey, L., Fogle, B.M., Schmidt, N. B., Zvolensky, M.J., 2021. COVID-19 and anxiety sensitivity across two studies in Argentina: associations with COVID-19 worry, symptom severity, anxiety, and functional impairment. *Cognit. Ther. Res.* 1–11. <https://doi.org/10.1007/s10608-020-10194-1>.
- Sheehan, K.H., Sheehan, D.V., 2008. Assessing treatment effects in clinical trials with the Discan metric of the Sheehan Disability Scale. *Int. Clin. Psychopharmacol.* 23, 70–83. <https://doi.org/10.1097/YIC.0b013e3282f2b4d6>.
- Spechler, P.A., Stewart, J.L., Kuplicki, R., Paulus, M.P., 2020. Parsing impulsivity in individuals with anxiety and depression who use Cannabis. *Drug Alcohol Depend.* 217 <https://doi.org/10.1016/j.drugalcdep.2020.108289>.
- Twenge, J.M., Joiner, T.E., 2020. Mental distress among U.S. adults during the COVID-19 pandemic. *J. Clin. Psychol.* 76, 2170–2182. <https://doi.org/10.1002/jclp.23064>.
- Wardenaar, K.J., van Veen, T., Giltay, E.J., de Beurs, E., Penninx, B.W., Zitman, F.G., 2010a. Development and validation of a 30-item short adaptation of the Mood and Anxiety Symptoms Questionnaire (MASQ). *Psychiatry Res.* 179 (1), 101–106.
- Whiteside, S.P., Lynam, D.R., 2001. The five factor model and impulsivity: using a structural model of personality to understand impulsivity. *Pers. Individ. Dif.* 30, 669–689. [https://doi.org/10.1016/S0191-8869\(00\)00064-7](https://doi.org/10.1016/S0191-8869(00)00064-7).
- Whiteside, S.P., Lynam, D.R., Miller, J.D., Reynolds, S.K., 2005. Validation of the UPPS impulsive behaviour scale: a four-factor model of impulsivity. *Eur. J. Pers.* 19, 559–574. <https://doi.org/10.1002/per.556>.
- Yen, S., Shea, M.T., Sanislow, C.A., Skodol, A.E., Grilo, C.M., Edelen, M.O., Stout, R.L., Morey, L.C., Zanarini, M.C., Markowitz, J.C., McGlashan, T.H., Daversa, M.T., Gunderson, J.G., 2009. Personality traits as prospective predictors of suicide attempts. *Acta Psychiatr. Scand.* 120, 222–229. <https://doi.org/10.1111/j.1600-0447.2009.01366.x>.
- Yentes, R.D., Wilhelm, F. (2018). Careless: procedures for computing indices of careless responding (R packages version 1.2.0) [Computer software]. url: <https://github.com/ryentes/careless>.