Momentary Dynamics of Emotion-Based Impulsivity: Exploring Associations with Dispositional
Measures of Externalizing and Internalizing Psychopathology

Sarah H. Sperry^{*1, 2}, Brinkley M. Sharpe^{*3}, and Aidan G. C. Wright³

¹ University of Illinois at Urbana-Champaign, Champaign, IL, USA

² Vanderbilt University Medical Center, Nashville, TN, USA

³ University of Pittsburgh, Pittsburgh, PA, USA

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* First authorship is shared between S. H. Sperry and B. M. Sharpe.

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Correspondence concerning this article should be addressed to Sarah Sperry, Department of Psychiatry, University of Michigan, 4250 Plymouth Road, Ann Arbor, MI, 48109, Email: sperrys@med.umich.edu.

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Abstract

Emotion-based impulsivity has emerged as an important transdiagnostic risk factor for both internalizing and externalizing psychopathology. However, it is unclear how this dynamic process unfolds within individuals. We measured urgency within-persons as the momentary association between impulsivity and contemporaneous negative and positive affect in four ecological momentary assessment samples ($N=233[16,202\text{ observations}]$; $N=302[11,360]$; $N=311[17,517]$; $N=291[20,297]$) that span clinical, community, and student populations. Based on reflexive responding to emotion (RRE) and urgency frameworks, we hypothesized a) that significant individual differences in the dynamic association between affect and impulsivity would emerge, and b) that individual differences in positive and negative urgency pathways would be associated with externalizing and internalizing psychopathology. Within-person associations between negative affect and impulsivity consistently emerged; however, the association between positive affect and impulsivity was inconsistent across samples. Although average effects were small, significant individual differences existed in both urgency pathways. Consistent with prior studies, within-person urgency pathways were unassociated with global or dispositional measures of impulsivity. Contrary to expectation, within-person urgency was also unassociated with between-person measures of either internalizing or externalizing psychopathology. Yet, robust associations were seen between the same measures and average levels of momentary impulsivity and negative affect. We discuss results in terms of their relevance to both urgency and RRE frameworks and propose future directions to help disentangle emotion-based impulsivity and psychopathology in the moment.

Keywords: Impulsivity, urgency, ecological momentary assessment, multilevel structural equation modeling

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1 *General Scientific Summary:* The tendency to respond to negative and positive emotions with risky
2 or impulsive behaviors is a common symptom across many forms of psychopathology. This study
3 shows that this dynamic process can be captured in daily life – when some people have high levels
4 of negative emotion they are more likely to respond by doing something impulsive. However,
5 higher levels of baseline psychopathology was mostly unrelated to one’s tendency to respond to
6 negative emotions with impulsivity.

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Emotion-based impulsivity is increasingly recognized as an important facet of response inhibition that is related to a wide range of maladaptive behaviors and psychopathology. Urgency, a predominant model of emotion-based impulsivity proposed by Whiteside and Lynam (2001), reflects rash action in the face of strong emotions. Negative urgency is characterized by a tendency to engage in impulsive action in reaction to intense negative affect whereas positive urgency reflects impulsive action in reaction to intense positive affect (e.g., celebration/elation; Cyders & Smith, 2007, 2008)¹. As defined, urgency is primarily thought of as a correlate of externalizing psychopathology (Settles et al., 2012). Numerous empirical studies have established that negative urgency is robustly associated with suicidality, borderline personality traits, eating disorders, and substance use disorders (Berg et al., 2015). Positive urgency has also been linked to various externalizing behaviors such as substance use (Berg et al., 2015), risky sexual behaviors, and pathological gambling (Cyders & Smith, 2007; Zapolski et al., 2009). However, both negative and positive urgency are also associated with internalizing psychopathology (e.g., depression/anxiety; Berg et al., 2015; Carver et al., 2011; Johnson et al., 2013; Johnson et al., 2017; Marmorstein, 2013; Smith et al., 2013). This may seem counterintuitive given that internalizing psychopathology is characterized not by rash action, but by a failure to pursue goals or obtain reinforcement (Jacobsen et al., 2001), high levels of threat sensitivity, fear, and avoidance (Kotov et al., 2017). A potential explanation for this finding can

¹ The extent to which negative and positive urgency reflect distinct forms of emotion-based impulsivity versus an overall dimension of urgency is currently under debate (Sharpe et al., 2020; Smith & Cyders, 2016; Sperry et al., 2018).

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1 be drawn from an alternative but complimentary model of emotion-based impulsivity, reflexive
2 responding to emotion (RRE; Carver et al., 2008).

3 In contrast to models of urgency, RRE proposes that individuals can respond to intense
4 emotion (regardless of valence) with both impulsive action and/or *inaction* (Carver et al., 2008).

5 Building on dual-process theory (e.g., Norman, 1986; Shastri & Ajjanagadde, 1993; Strack &
6 Deutsch, 2004), RRE reflects an automatic (vs. effortful), reflexive, and bottom-up form of
7 processing. Individuals characterized by *reactive undercontrol* are more likely to respond to
8 intense emotions with approach related behaviors, or overt impulsive action – and are described
9 as having a sensitive reactive approach system and insensitive reactive avoidance system (Carver
10 et al. 2008). For example, an individual experiencing intense anger may respond with aggression.

11 In contrast, some individuals characterized by sensitive reactive avoidance are more likely to
12 respond to intense emotions with avoidance related behaviors, or impulsive and ill-advised
13 inaction (Carver et al., 2017). For example, an individual experiencing health-related anxiety
14 may fail to answer their doctors phone call with important test results with the intention to
15 bypass their fear. Notably, the RRE model argues that this still reflects a lack of control over
16 responses to intense emotion, highlighting lack of constraint and effortful control as a key
17 mechanism underlying emotion-based impulsivity and internalizing and externalizing
18 psychopathology (Carver & Johnson, 2018). As such, the RRE model proposes that a sensitive
19 approach system, in the absence of effortful control, gives rise to externalizing psychopathology
20 (Carver et al., 2011; Carver et al., 2017) whereas a sensitive avoidance system, in the absence of
21 effortful control, gives rise to internalizing psychopathology (Carver et al., 2008; Carver et al.,
22 2011; Johnson et al., 2013; Johnson et al., 2017; Smith et al., 2013). In an effort to examine the
23 relationship between RRE and negative urgency, King and colleagues (2018) found that across

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four samples, individuals high in negative urgency were more likely to report using reflexive (action - approach) or disengagement (inaction - avoidance) emotion-regulation strategies in the face of intense negative affect or stress.

Taken together, both empirical and theoretical work points to an overall model of emotion-based impulsivity in which individuals engage in impulsive action or *inaction* in the face of strong negative or positive affect. Furthermore, different forms of reflexive responding seem to be associated with unique forms of psychopathology (e.g., internalizing and externalizing). However, the extant literature has focused on only one method of measurement when drawing conclusions regarding the construct of emotion-based impulsivity: dispositional self-report measures including the UPPS-P Negative and Positive Urgency subscales (Lynam et al., 2006) and the Pervasive Influence of Feelings and Feelings Trigger Action subscales of the Three Factor Impulsivity Index (Carver et al., 2011). Although this is an important first step, emotion-based impulsivity refers to an *if...then* process (“*If* I feel really unpleasant (or pleasant) emotions, *then* I will engage in risky behaviors.”) which dispositional trait scales can, at best, only approximate (Wright & Hopwood, 2016). Assessing emotion-based impulsivity in real-world contexts using ecological momentary assessment (EMA) should enhance our understanding of these dynamic processes and their associations with various form of psychopathology.

Preliminary evidence suggests that within-person urgency processes can be captured in daily life using EMA. Sperry and colleagues (2016) reported, in undergraduates oversampled for high scores on the Hypomanic Personality Scale (HPS; Eckblad & Chapman, 1986), that individuals were more likely to report getting in trouble for their behaviors when experiencing more intense levels of dysphoria and irritability. Replicating and extending this work, Sperry and

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colleagues (2018) reported significant within-person associations between negative affect (irritability, dysphoria, stress) and positive affect (happy, energetic) with a six-item momentary impulsivity index in a large sample of undergraduates oversampled for high scores on negative and positive urgency. Of note, this study included impulsivity items that tapped both impulsive action (e.g., “Doing something risky”, “Acted without thinking”) and *inaction* (e.g., “There is something I should be doing that I’m not”). Both negative and positive urgency, as measured by the UPPS-P, were associated with momentary impulsive action and inaction in the moment. In a clinical sample of patients with personality disorders, Sharpe and colleagues (2020) further assessed negative and positive urgency in daily life using Trigger-Symptom Contingency Models (Miskewicz et al., 2015). They tested a cascade through which stressful experiences led to affective reactions, which in turn led to both impulsive actions and urges. At the daily level, within-person associations between negative and positive affect with impulsivity were significant, even after accounting for the affective reactivity pathways. Most recently, Feil and colleagues (2020) reported significant within-person associations between negative affect and acting on impulse at the momentary level in a sample of adolescents (high school students) and young adults (college students) who reported at least weekly alcohol or marijuana use. All four studies noted significant individual differences in the strength of these within-person urgency pathways.

Although it is clear individual differences exist in within-person urgency processes, there is mixed evidence as to whether these within-person emotion-based impulsivity processes map on to dispositional measures of impulsivity. Sperry and colleagues (2018) and Sharpe and colleagues (2020) found that within-person negative urgency pathways (but not positive urgency) were amplified in those with higher levels of dispositional impulsivity; however, the

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effect sizes were modest. In contrast, Sperry and colleagues (2016) and Feil and colleagues (2020) reported that within-person associations between affect and impulsivity were not associated with UPPS-P Negative Urgency, calling into question whether process and trait measures of emotion-based impulsivity capture different phenomena. Alternatively, individual differences in momentary associations between affect and impulsivity may be more closely linked to internalizing and externalizing psychopathology as proposed by the RRE model rather than dispositional/global impulsivity.

Current Study

The present study comprehensively examined whether within-person associations between negative or positive affect and impulsivity were associated with dispositional measures of impulsivity, measures of externalizing behaviors and psychopathology (i.e., beyond impulsivity), and measures of internalizing psychopathology consistent with an RRE framework. Specifically, we had four primary questions: 1) Is there a within-person association between affect (regardless of valence) and impulsivity at the momentary level (i.e., momentary urgency), and are individual differences in momentary urgency associated with 2) dispositional impulsivity, 3) externalizing psychopathology, and 4) internalizing psychopathology? All hypotheses were made a priori and are detailed in a pre-registration on the Open Science Framework (<https://osf.io/9ygfu>).

Given that emotion-based impulsivity is proposed to be an individual difference present in both the general population and among individuals with significant psychopathology, we tested hypotheses in four large EMA samples: an unselected student sample, a student sample oversampled for high scores on the HPS, community adults oversampled for externalizing personality pathology (i.e., narcissism), and a clinical/community sample stratified across

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1 severity of interpersonal problems and mental health treatment status. By having four diverse
2 samples in terms of sample characteristics and symptom severity, we can be confident that the
3 conclusions drawn are specific to emotion-based impulsivity as a construct, rather than a specific
4 clinical disorder. Furthermore, testing hypotheses across four samples will improve confidence
5 in our estimates and reduce chances of conclusions based on Type I error.

6 In order to comprehensively assess externalizing and internalizing psychopathology, we
7 organized assessments based on the Hierarchical Taxonomy of Psychopathology (HiTOP; Kotov
8 et al., 2017, 2021; Ringwald et al., in press). HiTOP is a classification system of mental illness
9 quantitative empirically derived structures of personality pathology and clinical mental disorders.
10 HiTOP builds up from symptoms and specific maladaptive traits, relying on observed
11 covariations to form each successive abstraction, or level of the hierarchy. At the model's
12 penultimate level, psychopathology is divided into a number of spectra including Internalizing
13 and Externalizing. Following this model, we examined within-person urgency with not only
14 internalizing (e.g., depression and anxiety) and externalizing syndromes (e.g., bipolar spectrum
15 psychopathology and alcohol use) but also the pathological personality traits which similarly fall
16 on these spectra. Consistent with Sellbom and colleagues (2020), we examine relationships
17 among within-person urgency and the maladaptive traits of Negative Affect and Detachment as
18 internalizing, and treat Antagonism and Disinhibition as indicators of externalizing
19 psychopathology. The fifth pathological trait factor, Psychoticism, characterizes the separate
20 Thought Disorder spectrum which is not theoretically implicated by either the urgency or RRE
21 model of emotion-based impulsivity and thus is not included in the present analyses. See Table 1
22 for a full list of dispositional measures included in analyses for each sample.

Methods

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Participants

Full demographic information for all samples is provided in Supplemental Table S1.

Student Sample A (SA)

Undergraduate students over the age of 18 ($n = 352$) at the University of Illinois at Urbana-Champaign were recruited to participate in a study of bipolar spectrum psychopathology and emotion in daily life. Students either participated through open enrollment for course credit or were invited to participate if they scored 1.5 standard deviations above the mean of the HPS in departmental pre-screening. Note that college students with elevated HPS scores are at heightened risk for developing bipolar disorders (Kwapil et al., 2000; Walsh, et al., 2015).

Participants were excluded from analyses for the following reasons: technical difficulties with EMA data collection ($n = 49$), withdrawal due to time constraints ($n = 5$), and invalid responding ($n = 4$). To ensure reliable estimates of within-individual processes, participants who completed fewer than 20 momentary assessments per week (40 total) were excluded ($n = 61$). Of the remaining 233 participants, 70.8% ($n = 165$) were women and 51.9% ($n = 121$) were White. All participants were 18 or older ($Age_M = 18.81$; $Age_{SD} = 1.04$) at the time of baseline. For additional information and non-overlapping analyses in S3, see Sperry and Kwapil (2020).

Student Sample B (SB)

Undergraduate students over the age of 18 ($n = 523$) enrolled in introductory psychology courses at the University of Pittsburgh were recruited to participate in a study of personality in daily life. All participants were English-speaking and primary users of an Apple iPhone. Participants were excluded for the following reasons: non-completion of baseline assessments ($n = 30$), invalid responding ($n = 13$), and lack of comprehension of EMA procedures ($n = 113$,

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including 19 participants who did not complete the comprehension quiz).² Additionally, some otherwise eligible participants did not enroll in the EMA portion of this study ($n = 7$) or respond to a single momentary assessment prompt ($n = 23$). Exclusion of participants who responded to fewer than 20 surveys ($n = 28$) resulted in a final sample size of 302 ($Age_M = 18.61$; $Age_{SD} = .95$; 61.3% female, 82.5% White). This sample has been previously reported on in Ringwald and colleagues (2020).

Community Sample (C)

Individuals aged 18 to 40 ($n = 615$) were recruited to participate in a study of personality and daily life both online and through flyers posted throughout Pittsburgh, Pennsylvania. The original study aim was to recruit a community sample of individuals experiencing low, moderate, and high levels of narcissism. Individuals who were currently enrolled in a full-time undergraduate program were ineligible. In order to ensure representations of narcissistic traits across both genders, individuals were pre-screened using items from the NEO-Personality Inventory – Revised (Costa & McCrae, 1992) and were recruited based on an approximate ratio of 2:1:1 of low, moderate, and high modesty scores and equal gender representation.

Participants were excluded for the following reasons: non-completion of baseline assessments ($n = 55$), invalid responding ($n = 25$), and lack of comprehension of EMA procedures ($n = 148$, including 26 participants who did not complete the comprehension quiz). Additionally, some otherwise eligible participants did not enroll in the EMA portion of this study ($n = 33$) or respond to a single momentary assessment prompt ($n = 12$). In order to ensure

² Due to an error in study set-up, participants were able to attempt the baseline questionnaires more than once. 392 participants made one attempt, 100 made two, 25 made three, six made four, and one participant made seven attempts, for 698 attempts in total. Only data from their most complete attempt was retained. In the case of multiple equally complete attempts, the first of these was retained ($n = 174$ removed).

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reliable estimates of within-individual processes, participants who completed fewer than 20 momentary assessments were also excluded ($n = 31$), resulting in a final sample size of 311 ($Age_M = 27.76$; $Age_{SD} = 4.99$; 52% female; 85.5% White). For further discussion and non-overlapping analyses see Ringwald and colleagues (2020).

Clinical/Community Sample (CC)

Individuals aged 18 to 40 ($n = 311$) were recruited both online and through flyers posted throughout Pittsburgh, Pennsylvania to participate in a study of personality, daily stress, and social interactions. Preliminary screening was used to recruit a sample balanced for gender and current (within the past year) mental health treatment status. To ensure adequate representation of a range of personality pathology and interpersonal problems, individuals were pre-screened using items from the Inventory of Interpersonal Problems – Personality Disorder Scales (Morse & Pilkonis, 2007) and were recruited in an approximately 1-1-1 representation of low, moderate, and high levels of interpersonal difficulties within gender, treatment status, and the overall sample. Individuals currently receiving treatment for or experiencing symptoms of psychosis or a psychotic disorder were ineligible to participate.

In order to ensure reliable estimates of within-individual processes, participants who completed fewer than 20 momentary assessments were excluded ($n = 20$), resulting in a final sample size of 291 ($Age_M = 28.05$; $Age_{SD} = 6.37$; 47.4% female; 71.1% White). All participants were interviewed by trained clinicians using a semi-structured protocol. Rates of diagnosis in the sample were 18.2% ($n = 53$) for anxiety disorders, 16.2% ($n = 47$) for an alcohol or substance use disorder, 15.5% ($n = 45$) for any personality disorder, 7.9% ($n = 23$) for a current episode of major depression or mania, 4.1% ($n = 12$) for obsessive-compulsive disorder, and < 1% ($n = 1$) for post-traumatic stress disorder. Reliabilities, based on a random review of 16 taped diagnostic

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interviews, were good for personality disorder symptoms ($ICC = .87$) and clinical syndromes ($\kappa s = .62-.73$).

Procedure

All study procedures and materials were approved by the relevant institutional review boards and all participants provided informed consent.

SA

In a one-hour information session, participants completed a baseline self-report battery and were instructed how to complete EMA protocols on their personal smartphones using either the smartphone application MetricWire (MetricWire Inc., 2019) or Expimetrics (now Expiwell; Expiwell Inc., 2019). Baseline questionnaires assessed bipolar spectrum psychopathology, emotional awareness, affective lability and intensity, neuroticism, depression, urgency, and demographic information. Participants then completed EMA questionnaires for 14 days in their normal daily environment. Participants were prompted eight times per day between the hours of 10 AM and 10 PM at random times within stratified intervals of 90 minutes.

Participants received course credit for participating in the study. In addition, those who completed at least 70% of the surveys were entered into a drawing for a \$100 Amazon gift card. Two gift cards were awarded at random.

SB and C

Participants in SB and C completed initial baseline questionnaires and a 10-day EMA protocol consisting of both randomly-initiated momentary prompts and scheduled daily diaries. The baseline questionnaires³ were completed online at the participant's own pace, typically in a single sitting. These questionnaires covered demographic information as well as basic and

³ Screening and baseline data collection for SB, C, and CC were managed using REDCap (Harris et al. 2009; Harris et al., 2019) electronic data capture tools hosted at the University of Pittsburgh.

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maladaptive personality traits. During the EMA portion of the study, participants were delivered seven⁴ (C) or five (SB) momentary prompts per day at blocked random intervals between 9 AM and 9 PM. In addition, participants were delivered a daily diary survey at 9 PM. Surveys were administered using the MetricWire smartphone application (MetricWire, Inc., 2019) and addressed stress, affect, and momentary and daily expression of personality.

C was drawn from a larger pool of participants who completed baseline questionnaires in return for entry into prize drawings for \$75 Amazon gift cards. One entry was drawn for every 100 participants that completed these questionnaires. Participants who completed 90% or more of the 80 surveys (70 momentary prompts, 10 daily prompts) were given \$100 Amazon gift cards. Gift cards of prorated value were given to those who completed less than 90% of the surveys. Participants also had the possibility of winning one of ten additional \$100 Amazon gift cards with chances of winning set proportionate to the amount of participation. In SB, participants completed both baseline questionnaires and the 10-day EMA protocol for course credit. Full credit was awarded to individuals who completed 60% or more of the 60 surveys (50 momentary prompts, 10 daily prompts) during the study period. No partial credit was given.

CC

CC was drawn from a multimodal study of personality, daily stress, and social interactions, involving not only baseline self-report and randomly-initiated EMA prompts but also scheduled daily diaries, experimental follow-up surveys to stressful events, video responses, passive sensing, and actigraphy. Participants completed baseline questionnaires as part of a three- to five-hour laboratory session which also included a semi-structured interview conducted by a trained clinician and instruction from a research assistant regarding EMA procedures and

⁴ Due to a set-up error, some participants ($n = 76$) received between 60 and 69 surveys across the study instead of the full 70.

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use of a passive sensing application and actigraphy device. These questionnaires covered demographic information, interpersonal relationships, stress, and adjustment, as well as basic and maladaptive personality traits.

The EMA portion of the study typically began the day after baseline assessment⁵. The length of the assessment period was initially set at 21 days ($n = 35$) but was later shortened to 14 days ($n = 256$)⁶. Participants were delivered six⁷ momentary surveys per day at blocked random intervals during their typical waking hours. Surveys were administered through the MetricWire smartphone application and addressed momentary and daily expression of general and maladaptive personality with particular attention paid to interpersonal interactions and stress.

All participants received \$50 for the baseline session. Those who answered 90% or greater of the randomly-initiated and scheduled daily surveys during the ambulatory assessment period earned an additional \$110. This amount was prorated by week for those who completed less than 90% of the surveys overall, with surveys completed in later weeks of the study valued higher in the prorated compensation model. Additionally, for every 100 participants, a drawing was conducted for an iPad Mini. Chances of winning increased with the number of surveys answered.

Measures

All samples are drawn from larger studies in which participants completed a variety of measures of personality and psychopathology, both at baseline and in daily life. Only measures used in the present study are addressed below. Reliability for included scales is demonstrated

⁵ All participants began EMA within one week of the laboratory session.

⁶ Due to a scheduling error, one participant completed only 13 days of the EMA protocol.

⁷ Due to set-up errors, one participant received eight surveys per day for five days of the study, and one received only 1 survey a day for two days.

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with McDonald's omega (ω ; Zinbarg et al., 2005) values (Supplementary Table S2), calculated using the *psych* (Revelle, 2020) package in R.

Dispositional Measures

Impulsivity. In SA, the 12-item negative urgency and 14-item positive urgency subscales of the UPPS-P Impulsive Behavior Scale (Whiteside & Lynam, 2001; Cyders et al., 2007) were administered to measure dispositional impulsivity in SA. Responses are based on a 4-point scale ranging from 1 (Agree Strongly) to 4 (Disagree Strongly). Given current debates about the overlap and differentiation of negative and positive urgency (e.g., Sperry et al., 2018), a total urgency score was also tested. Smith and Cyders (2016) proposed that when negative and positive urgency correlate highly with each other and do not differentially predict outcomes, the two subscales should be combined to create an overall urgency trait.

The Impulsivity facet (e.g., “*Even though I know better, I can't stop making rash decisions.*”) of the Personality Inventory for DSM-5 – Short Form (PID-5-SF; Maples et al., 2015) was used in SB and C to measure dispositional impulsivity. The PID-5-SF includes 100 items evenly distributed across 25 facets of personality. Responses options range from 0 (Very False or Often False) to 3 (Very True or Often True).

In CC, we measured dispositional impulsivity with the Computerized Adaptive Test of Personality Disorder – Static Form (CAT-PD-SF; Simms et al., 2011). The CAT-PD loosely maps on to the UPPS model of impulsivity such that Urgency is represented by Affective Lability; (lack of) Perseverance by Non-Perseverance; (lack of) Premeditation by Non-Planfulness; and Sensation Seeking by Risk Taking. Previous research (Griffin et al., 2018) has shown good convergence between these subscales and their counterparts in the UPPS with bivariate correlations ranging from $r = .44$ (Positive Urgency with Affective Lability) to $r = .80$

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(Lack of Perseverance with Non-Perseverance). Items (e.g., “*I jump into things without thinking.*”) were rated from 0 (Very Untrue of Me) to 4 (Very True of Me).

SB also included an additional measure of dispositional impulsivity—the Self-Harm factor of the Personality Assessment Inventory – Borderline Features (PAI-BOR; Morey, 1991). Despite its name, this factor is known to more broadly index impulsive behavior (Stepp et al., 2014). Items (e.g., “*I spend money too easily*”) were rated from 0 (Not True at All; False) to 3 (Very True).

Broader Externalizing Psychopathology.

Alcohol Use. In C and SB, participants completed nightly surveys in addition to random prompts. A total of 2,735 and 2,475 nightly surveys were completed in C and SB respectively (C: *Mdn* = 9, *M* = 8.85, *range* = 2-10 surveys; SB: *Mdn* = 9, *M* = 8.2, *range* = 1-10 surveys). Participants were asked to indicate the number of alcoholic drinks consumed in the past 24 hours.⁸ Alcohol consumption was calculated as the mean daily number of drinks consumed across the study period. In CC, the seven-item Patient-Reported Outcomes Measurement Information System (PROMIS) Alcohol Use – Short Form 7a (Pilkonis et al., 2013) was administered at baseline to participants who indicated drinking during the past 30 days.⁹ Items (e.g., “*In the past 30 days, I drank more than planned.*”) were rated on a 5-point scale from 0 (Never) to 4 (Almost Always). Alcohol use was not assessed in SA.

Antagonism. PID-5-SF Antagonism was assessed in C and SB. This factor is comprised of Manipulativeness, Deceitfulness, and Grandiosity facets. In CC, CAT-PD-SF scales were combined to form higher order domains. Specifically, scales were assigned to domains based on

⁸ In C, a single outlying response (1,000 drinks) was recoded as missing.

⁹ PROMIS items were added to the questionnaire battery after the study’s initial start and only available to 188 participants. Of these participants, 75% (*n* = 141) indicated drinking during the past 30 days and were administered this scale.

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their highest factor loading in Wright & Simms (2014). Using this methodology, CAT-PD-SF Antagonism was comprised of the Manipulativeness, Hostile Aggression, Domineering, Callousness, Norm Violation, Grandiosity, Rudeness, and Risk Taking scales.

Bipolar Spectrum Psychopathology. In SA, the HPS was used to assess bipolar spectrum psychopathology. This self-report scale consists of 48 true-false items. Note that while bipolar disorder/mania is purported in the HiTOP model to fall under the psychoticism/thought disorder and internalizing spectra (Kotov et al., 2017), the HPS as a measure of hypomanic personality more closely aligns with externalizing psychopathology (e.g., disinhibited externalizing, impulsivity) and is uncorrelated with major facets of internalizing (e.g., depressive symptoms and neuroticism; Walsh et al., 2015).

Disinhibition. PID-5-SF Disinhibition was assessed in C and SB. This factor is comprised of the previously described Impulsivity facet as well as the facets of Irresponsibility and Distractibility. In CC, CAT-PD-SF Disinhibition scores were derived from the scales of Irresponsibility, Non-Perseverance, Non-Planfulness, Submissiveness, Perfectionism (reverse-coded), Cognitive Problems, Workaholism (reverse-coded), and Anhedonia.

Internalizing Psychopathology.

Anxiety. Participants in C used the Beck Anxiety Inventory (BAI; Beck & Steer, 1993) to rate how much they had been bothered by 21 common anxiety symptoms over the past month from 0 (Not at All) to 3 (Severely – It Bothered Me A Lot). Item ratings were summed to a total score. 10.6% ($n = 33$) of participants met or exceeded the criteria for moderate anxiety (scores from 22 to 35), including eight (2.6% of sample) individuals with scores suggestive of a need for clinical intervention (36 or more).

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Depression. In SA, a short version of the Mood and Anxiety Symptom Questionnaire's Anhedonic Depression subscale (MASQ-AD; Watson et al., 1995; Bredemeier et al., 2010) was administered. Based on requirements of the Institutional Review Board, this eight-item scale was administered without the item on suicidality. Thus, participants completed a seven-item revised version of this subscale. In CC, depression was measured using the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977).¹⁰ The CES-D contains 20 items which ask participants to reflect on their feelings and behaviors over the past week. Ratings on items such as "*I talked less than usual*" are made on a four-point Likert-style scale from 0 (Rarely or None of the Time/Less Than 1 Day) to 3 (Most or All of the Time/5-7 Days). Possible total scores range from 0 to 60. Participants in C rated the 21 items of the Beck Depression Inventory (BDI; Beck et al., 1961), each of which has its own four rank-order options (e.g., Item 5; 0 – *I don't feel particularly guilty*, 1 – *I feel guilty a good part of the time*, 2 – *I feel quite guilty most of the time*, 3 – *I feel guilty all of the time*). Item ratings were summed to a total score. 25.1% ($n = 78$) of participants met or exceeded the cut off for mild depression (scores greater than 10), of which four participants (1.2% of sample) were categorized as severe (31 to 40). No participants scored in the "extreme" range (> 40).

Detachment. PID-5-SF Detachment was assessed in C and SB. This factor is comprised of Withdrawal, Anhedonia, and Intimacy Avoidance facets. In CC, CAT-PD-SF Detachment scores were derived from the scales of Social Withdrawal, Emotional Detachment, Exhibitionism (reverse-coded), and Romantic Disinterest.

Negative affectivity. PID-5-SF Negative Affect was assessed in C and SB. This factor is

¹⁰ CES-D items were added to the questionnaire battery after the study's initial start and were completed by 187 participants.

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comprised of Emotional Lability, Anxiousness, and Separation Insecurity facets. In CC, CAT-PD-SF Negative Affectivity scores were derived from the scales of Anger, Affective Lability, Anxiousness, Depressiveness, Mistrust, Rigidity, Relationship Insecurity, and Health Anxiety. The NEO Five Factor Inventory (NEO-FFI; Costa & McCrae, 1992) Neuroticism scale was administered in SA.

Ecological Momentary Assessment Measures

Impulsivity. In SA, we created a momentary impulsivity index by taking the mean of the following two items (Sperry et al., 2018), rated from 1 (Not at All) to 7 (Very Much): “*I am doing something right now that I may regret later.*” and “*Since the last beep, I acted without thinking.*” Given that these two items had different item stems, and thus, represented different momentary observations, we lagged the first impulsivity item (“...right now that I may regret later) to be on the same timeline as the other impulsivity item prior to averaging. In SB and SC, the Momentary Impulsivity Scale (MIS; Tomko et al., 2014) was included in the randomly-initiated prompts. Four statements (e.g., “*Since the last prompt, I said things without thinking.*”) were rated in from 0 (Not at All) to 4 (Extremely) with momentary impulsivity represented by their mean. In CC, impulsivity was measured with a single item: “*How would you describe your behavior right now?*” (0 – In Control to 100 – Impulsive; rescaled to 0 through 5 to facilitate interpretation of unstandardized results).

Affect. In SA, items were drawn from both the Positive and Negative Affect Schedule (PANAS; Watson et al. 1988) and the affective circumplex (Russell, 1980) to include high and low arousal forms of both negative and positive affect. Positive affect was indexed by the mean of *Content* and *Calm* (low arousal) and *Enthusiastic*, *Proud*, *Excited*, and *Determined* (high arousal). *Sad*, *Bored*, and *Sluggish* (low arousal) and *Angry*, *Nervous*, and *Irritable* (high arousal)

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represented negative affect. Participants were asked to rate their agreement to statements in the following form: “*Right now I feel ADJECTIVE.*” Ratings were made on a scale from 1 (Not at All) to 7 (Very Much).

For SB and C, ten adjectives were selected from the PANAS for the measurement of momentary affect. Positive affect was represented by the mean of ratings for *Happy, Proud, Content, Excited*, and *Relaxed*. Negative affect was represented by the mean of *Ashamed, Nervous, Hostile, Sad*, and *Angry*. Participants were asked questions in the following form: “*How ADJECTIVE do you feel right now?*” Ratings were made on a 101-point sliding scale from “Not at All” to “Extremely” but were rescaled to 0 through 5 to facilitate interpretation of unstandardized results. The same rating scale was used in CC with the positive affect items *Happy, Content, Excited*, and *Confident* and negative affect items *Ashamed, Nervous, Sad*, and *Angry*.

Analytic Plan

To test our model of within-person urgency, we used Mplus Version 8.3 (Muthén & Muthén, 1998-2019) and the *MplusAutomation* R package (Hallquist & Wiley, 2018) to estimate multilevel structural equation models (MSEMs). We specified random effects at the within-person level and added fixed effects of time¹¹ and day of the week (weekday vs. weekend) to adjust for potential linear trends and potential weekly cycles of behavior, respectively. The few cases of missing values within a survey were handled with listwise deletion. We used Bayesian estimation for all models. This was for practical reasons as opposed to because we were adopting a Bayesian philosophy. For instance, Bayesian approaches are preferred when specifying random effects in MSEM as they use latent decomposition for within- and between-person variance for

¹¹ Time was centered by calculating the duration between the first and last survey submission for each participant and dividing by two.

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both predictors and outcome variables. In addition, Bayesian estimation in Mplus can provide estimates of standardized effects for within-person parameters. Consistent with our pragmatic approach, we used uninformed priors for all parameters. Models were initially estimated using the potential scale reduction (PSR; Gelman & Rubin, 1992) as a convergence criterion, which generally was achieved in several hundred to a thousand iterations. Subsequently, all models were then repeated with a minimum of 10,000 iterations for convergence to ensure adequate estimation. R (R Core Team, 2020), RStudio (RStudio Team, 2020), and the *tidyverse* (Wickham et al., 2019) and *lubridate* (Grolemund & Wickham, 2011) packages were used for initial data manipulation and recoding.

Aligning variables in time. We modeled all within-person pathways as concurrent processes. In other words, we modeled the associations between affect (negative or positive) and impulsivity within the same moment. However, in samples SA, SB, and C, EMA items assessing impulsivity used the item stem “*Since the last prompt...*” whereas affect items used “*Right now...*”. In order to conceptually model all variables as concurrent assessments, we lagged (within-day) affect variables relative to impulsivity such that final momentary variables included (please note the subscripts) NA_{t-1} , PA_{t-1} , and IMP_t . Note that this results in the listwise deletion of the first observation of each day. For the remainder of the manuscript (including all figures and tables) we refer to these variables as NA , PA , and IMP to represent that, conceptually, we are examining concurrent moment associations, *not* lagged relationships. In CC, all momentary items used the “*Right now...*” stem and no lagging was necessary.

Within-subjects (Level 1). Theoretical conceptualizations of urgency describe a process ongoing within an individual. We modeled this within-person process by simultaneously regressing momentary impulsivity (IMP) on positive affect (PA) and negative affect (NA). PA

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and *NA* were allowed to correlate with each other. In the following text, we use *PU* (positive urgency) and *NU* (negative urgency) to refer to the momentary regressions of impulsivity on positive affect and negative affect, respectively. Within this model, we also examined whether individual differences were present in within-person processes. In order to do so, we included random intercepts to model between-individual means of *PA*, *NA*, and *IMP* and random slopes to model individual differences in the two pathways (*NU* and *PU*).

Between-subjects (Level 2). Associations of dispositional impulsivity, the broader spectra of externalizing problems, and internalizing psychopathology at Level 2 were of additional interest. Separate analyses were run with measures of dispositional impulsivity (UPPS-P Positive and Negative Urgency/Total Urgency¹² [SA]; PID-5-SF Impulsivity [SB]; PID-5-SF Impulsivity and PAI-BOR Self-Harm [C]; CAT-PD-SF Affective Lability, Non-Perseverance, Non-Planfulness, and Risk Taking [CC]), internalizing and broader externalizing psychopathology (HPS, MASQ Anhedonic Depression, and NEO-FFI Neuroticism [SA]; mean daily alcohol use and PID-5-SF Negative Affect, Detachment, Antagonism, and Disinhibition [SB]; BAI, BDI, mean daily alcohol use, and PID-5-SF Negative Affect, Detachment, Antagonism, and Disinhibition [C]; CES-D, PROMIS Alcohol Use Short Form 7a, and CAT-PD-SF Antagonism, Detachment, Disinhibition, and Negative Affectivity [CC]). All associative models included random intercepts measuring individual *IMP*, *NA*, and *PA*, along with individual differences in the slopes identified at Level 1 (*PU* and *NU*). Using Bayesian estimation, standardized associations (i.e., correlations) were estimated.

Results

¹² Unitary urgency and two-factor urgency were included in separate models.

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Measure means and standard deviations are listed in Supplementary Table S3. Zero-order correlations between dispositional measures can be found in Supplementary Tables S4 through S7. Bayesian estimation was used to provide standardized values (except where noted).

Within-Subjects (Level 1)

The standardized effects of both estimated paths (*PU* and *NU*) were significant at a 95% credibility interval (CI) in at least two samples (Table 2). The regression of impulsivity on negative affect (*NU*) was significant in all samples. While the magnitude of this effect was small in samples SA, SB, and C, in the clinical/community sample (CC), a one standard deviation increase in momentary negative affect was associated with nearly a one-third standard deviation increase in momentary impulsivity. Although a small effect for *PU* (*IMP* on *PA*) appeared in both student samples (SA and SB), this effect was not observed in either sample from the community (C or CC). Where strength of *NU* and *PU* differed (i.e., had non-overlapping 95% CIs; samples C and CC), the effect size for momentary association with impulsivity was stronger for negative affect than for positive affect. *PA* and *NA* were moderately negatively associated ($r_s = -.38$ to $-.49$). All estimated random effects were significant indicating the presence of individual variability in the effects (for fixed and random effects in unstandardized models, see Table 3).¹³

Between-Subjects (Level 2)

A number of associations between the within-subjects model and dispositional measures of psychopathology emerged. Correlations that were robust across all samples in which they

¹³ To account for the possibility that within-person urgency pathways are stronger when high arousal affect is experienced (e.g. Pearlstein et al., 2019), we re ran models separating negative and positive affect into two separate dimensions, high arousal and low arousal. We then ran two models, one which included high arousal negative and positive affect and one that included low arousal negative and positive affect. Results remained largely unchanged. A positive urgency pathway still did not emerge in clinical samples and effect sizes did not improve in student samples. Results of these models are provided on the OSF: (<https://osf.io/p6vy5>)

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were tested are discussed below alongside other select associations warranting further exploration (see Supplementary Tables S8-S11 for full results).

Dispositional Impulsivity

As expected, dispositional measures of impulsivity correlated with impulsivity in daily life, such that individuals with higher scores on UPPS-P urgency factors (either separately or as a single index), UPPS equivalent factors from CAT-PD-SF (Affective Lability, Non-Perseverance, Non-Planning, and Risk Taking), PID-5-SF Impulsivity, or PAI-BOR Self-Harm had greater mean momentary impulsivity ($r_s = .14$ for CAT-PD-SF Risk Taking in CC to $.41$ for UPPS-P Negative Urgency in SA). With the exception of CAT-PD-SF Risk Taking, dispositional impulsivity was also positively associated with mean momentary negative affect ($r_s = .20$ to $.42$). The relationship between dispositional impulsivity and the latent mean of positive affect was inconsistent between samples and measures. No significant associations between dispositional impulsivity and the random slopes of *NU* (i.e., within-subjects regression of *IMP* on *NA*) or *PU* (i.e., within-subjects regression of *IMP* on *PA*) were observed.

Externalizing Psychopathology

Mean momentary impulsivity was positively associated with numerous dispositional measures of the broader externalizing spectrum ($r_s = .16$ for PROMIS Alcohol Use in CC to $.44$ for PID-5-SF Disinhibition in C). In SB (but not C), *PU* was positively associated with both PID-5-SF Antagonism ($r = .49$, 95% CI = $.19$, $.77$) and Disinhibition ($r = .38$, 95% CI = $.08$, $.67$). No other associations emerged with either *PU* or *NU*. Both *PA* and *NA* were linked to greater bipolar spectrum pathology and PID-5-SF Antagonism. *NA* was also positively associated with disinhibition. No stable associations with daily alcohol consumption were observed.

Internalizing Psychopathology

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Dispositional measures of the internalizing spectrum were also associated with impulsivity in daily life. Specifically, greater *IMP* was significantly correlated with depression, anxiety, and negative affectivity ($r_s = .17$ for MASQ Anhedonic Depression in SA to $.37$ for PID-5-SF Negative Affect in C). The only observed association between the within-person pathways and the internalizing spectrum was the association of *PU* and PID-5-SF Detachment in SB ($r = .44$, 95% CI = $.14, .73$). This effect was not observed in C or for CAT-PD-SF Detachment in CC. The latent mean of momentary negative affect was associated with greater depression, anxiety, and dispositional negative affectivity. In contrast, greater mean momentary positive affect was associated with lower degrees of internalizing psychopathology (specifically depression, anxiety, and detachment).

The random slopes identified at Level 1—*PU* and *NU*—were not related at Level 2. However, the association between the random intercepts *NA* and *IMP* was uniformly strong ($r_s = .41$ to $.66$). Table 4 shows a summary results across dispositional impulsivity, externalizing, internalizing with all Level 1 outcomes across samples

Discussion

Emotion-based impulsivity, or RRE, has been widely linked to internalizing and externalizing psychopathology assessed using retrospective cross-sectional (i.e., static) methods. Despite historical measurement approaches, emotion-based impulsivity theoretically reflects a *dynamic* process in which heightened affect is accompanied by impulsive *action* or *inaction* in the moment. Yet, little is known about how these dynamic processes unfold within an individual in real world contexts or whether within-person urgency processes are associated with both internalizing and externalizing psychopathology. Building on previous work in this area (e.g., Sperry et al., 2018; Sharpe et al., 2020; and Feil et al., 2020), the current study examined

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emotion-based impulsivity in four large independent samples spanning a spectrum of personality and psychopathology, modeling negative and positive urgency as the respective within-subjects regressions of impulsivity on negative and positive affect. Three main takeaways emerged: (1) significant individual differences are present in within-persons links between affect (both negative and positive) and impulsivity, (2) dispositional measures of impulsivity poorly associate with momentary links between affect and impulsivity, and (3) broader measures of internalizing and externalizing psychopathology are largely unrelated to the momentary links between affect and impulsivity.

Within-Person Emotion-Based Impulsivity

Negative urgency, as originally conceptualized by Whiteside and Lynam (2001), is the disposition to engage in impulsive behaviors under conditions of negative affect. In contrast, in an RRE framework, it is expected that those who are highly reactive to the experience of negative affect are more likely to respond with ill-advised action or inaction (Carver et al., 2008). Both theoretical frameworks of emotion-based impulsivity put forth that these dispositions exist across a range of normal and pathological personality. As such, we hypothesized that momentary negative affect would associate positively with momentary impulsivity in all samples. Across samples and models, positive average (i.e., fixed) effects of *NU* emerged, supporting this hypothesis. These effects were small across all samples with the notable exception of the clinical/community sample (CC) where a moderate-to-large effect was observed. Additionally, there was significant variability in the size (and, aside from CC, direction) of effects across individuals (see Table 3, which provides SDs for calculation of distribution of effects). For example, the standard deviation of the random effect of *NU* in SA¹⁴ was .10 (fixed effect = .07)

¹⁴ In the model including UPPS-P Positive Urgency and Negative Urgency at Level 2.

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suggesting that for 68% (± 1 *SD*) of participants, the effect of *NU* (slope of the regression of *IMP* on *NA*) falls between -.03 and .17. Taken together, these findings suggest that on average individuals are slightly more likely to report higher impulsivity when reporting higher negative affect in the moment, but there is significant between-person variability in the strength of this association. Negative urgency appears to be a general process, common to individuals with and without significant psychopathology. However, relatively large effects observed in CC suggests that the link between negative affect and impulsivity may play a particularly salient role in the daily lives of those who seek treatment for psychological concerns or who experience interpersonal problems.

Positive urgency, as originally conceptualized by Cyders and Smith (2007), is the disposition to engage in impulsive behaviors under conditions of heightened positive affect. Positive urgency arose out of the observation that people engage in risky or rash action (e.g., drinking to excess, sexual behaviors, gambling) when in states of heightened positive affect (Cyders & Smith, 2008). RRE proposes that an individual could respond to intense positive affect with either action or inaction. Based on these conceptualizations, we hypothesized that momentary positive affect would be associated with momentary impulsivity. Contrary to our expectations, a significant fixed effect for *PU* did not consistently emerge across samples and models. In both student samples, but not C or CC, a small effect of *PU* was observed. On average, a one standard deviation increase in *PA* was associated with a .03 to .05 standard deviation increase in *IMP*. However, as with *NU*, we found significant between-person variability in the strength (and direction) of the *PU* path across all samples and models (see Table 3). For example, although there was no significant average (i.e., fixed) effect of *PU* in the

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clinical-community sample (CC), the standard deviation of the random effect was .28¹⁵ (Fixed effect = -.02, n.s.) suggesting that for 68% (± 1 SD) of participants the effect of *PU* (slope of the regression of *IMP* on *PA*) falls between -.30 and .26.

4 Dispositional Impulsivity

What accounts for individual differences in within-person assessed negative and positive urgency? It is possible that these pathways emerge more strongly for those higher in cross-sectionally (i.e., statically) assessed impulsivity. Sperry and colleagues (2018) reported that the within-person momentary associations of stress with impulsivity and stress with negative affect were stronger for those high in UPPS-P Negative Urgency. Furthermore, Sharpe and colleagues (2020) found that PID-5 Impulsivity scores were associated with a stronger pathway between negative affect and impulsivity at the daily level. Thus, we hypothesized that measures of dispositional impulsivity—PID-5-SF Impulsivity, the Negative Urgency and Positive Urgency subscales of the UPPS-P, an overall Urgency subscale which combines UPPS-P Negative and Positive Urgency, PAI-BOR Self Harm, and CAT-PD-SF facets representing the UPPS model—would associate with amplified *NU* and *PU* at the momentary level. Inconsistent with this prediction, none of the dispositional impulsivity measures were associated with *NU* or *PU* pathways. In other words, individuals who are high in dispositional impulsivity or urgency are no more (or less) likely to report momentary impulsivity when experiencing negative or positive affect. On the other hand, across measures of dispositional impulsivity, higher scores were generally associated with greater mean momentary impulsivity and mean momentary negative affect (but not mean momentary positive affect) consistent with the placement of urgency within the Neuroticism domain (i.e., dispositional negative affectivity) in five factor models of

¹⁵ In the model including CAT-PD-SF Affective Lability, Non-Perseverance, Non-Planfulness, and Risk Taking at Level 2.

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1 impulsivity (Whiteside & Lynam, 2001; Sharma et al., 2014). Exceptions to these trends were
2 only seen among the CAT-PD-SF scales and largely aligned with theoretically expected
3 associations—*NA* and Risk Taking were unrelated, mirroring the relationship between
4 momentary negative affect and UPPS Sensation Seeking (Sperry et al., 2016); and *PA* was
5 negatively associated with Affective Lability and Non-Perseverance.

6 These results suggest a discordance between dispositional measures of urgency and the
7 theorized dynamic nature of emotion-based impulsivity. One could argue that dispositional
8 measures of urgency may not be capturing their theorized construct. Although Sperry and
9 colleagues (2018) found that UPPS-P Negative Urgency moderated the within-person link
10 between negative affect and impulsivity, there is mounting evidence that this is not the case.
11 Consistent with the current study, Feil and colleagues (2020) recently examined the link between
12 global self-report measures of negative urgency and within-person links between negative affect
13 and momentary impulsive states and found that UPPS-P Negative Urgency did not moderate the
14 slope of the regression of momentary impulsivity on momentary negative affect. Extending
15 beyond Feil and colleagues (2020), we found that there is even larger discordance between
16 dispositional and within-person positive urgency processes. UPPS-P Positive Urgency fails to
17 predict both *PU* and *PA*, but instead predicts *NA*, consistent with Sperry and colleagues' (2018)
18 findings. Taken together, these results suggest that development of dispositional scales which
19 more closely capture the theorized processes of negative and positive urgency may be warranted.

20 An alternative explanation may be warranted. Some laboratory studies have found that
21 during mood induction, those high in negative urgency are more likely to respond impulsively to
22 tasks (e.g., Johnson et al., 2016; Owens et al., 2018). These results provide support for the
23 hypothesis that those high in dispositional negative urgency will report more impulsivity in the

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moment when experiencing within-person increases in negative affect. However, upon further examination of the literature, this does not typically seem to be the case. In a meta-analysis, Cyders and Coskunpinar (2011) reported a significant effect between negative urgency and prepotent response inhibition but no other types of behavioral or motor tasks of impulsivity. In addition, positive urgency was not significantly associated with any of the behavioral tasks. Two possibilities emerge. First, behavioral tasks of impulsivity show consistently weak associations with self-reported impulsivity, indicating that they measure distinct constructs (Creswell et al., 2019; Cyders & Coskunpinar, 2012; Sharma et al., 2014). As such, we would not hypothesize that results in the lab would be replicated in dynamic assessments in real-world contexts. Second, one study revealed that a negative mood induction did not affect the association between dispositional negative urgency and pre-potent response inhibition, except for those with low executive and working memory capacity (Gunn & Finn, 2015). Based on this research, it is possible that the hypothesized moderation of the within-person pathway between affect and impulsivity only emerges for those who in that moment have lack of constraint or poor cognitive control (Carver & Johnson, 2018). This reasoning is consistent with the RRE model and highlights the important need to investigate this potential mechanistic pathway in future daily life studies.

RRE Framework: Internalizing and Externalizing Psychopathology

Alternatively, as suggested by the RRE model, individual differences in the momentary association between affect and impulsivity may be linked with both externalizing and internalizing psychopathology. However, no dispositional measures reliably predicted momentary negative or positive urgency as hypothesized. In SB, PID-5-SF Negative Affect, Antagonism, Disinhibition and Detachment were all associated with a stronger *PU* pathway;

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1 however, this did not replicate in the community sample (C). Does this mean that within-person
2 emotion-based impulsivity is unrelated to externalizing and internalizing psychopathology? We
3 would argue no, as both measures of internalizing and externalizing psychopathology were
4 consistently, and quite strongly, related to average levels of clinically significant targets in the
5 moment, including impulsivity and affect. However, they failed to capture individual differences
6 in the dynamic processes which link affect and impulsivity together. Thus, this pattern is highly
7 similar to those observed with dispositional scales of impulsivity and momentary pathways.

8 Implications, Limitations, and Future Directions

9 We believe there is now clear evidence for the within-person association between
10 momentary negative affect and concurrent impulsivity, and that this is a reliable individual
11 difference. There is also clear evidence that retrospectively-rated urgency and impulsivity scales
12 predict important clinical outcomes and momentary-rated averages of behavior. However, what
13 has also become clear is that these two measurement approaches of the same putative constructs
14 do not consistently relate to each other. Although different measurement modalities commonly
15 have low to little association with each other (especially in the impulsivity domain; see e.g.,
16 Creswell et al., 2019; Sharma et al., 2014), this raises questions which must be addressed. For
17 one, future research must examine whether within-person links between affect and impulsivity
18 are associated with maladaptive outcomes or acute psychopathology beyond retrospectively rated
19 measures of urgency and impulsivity, and psychopathology more broadly (Carver & Johnson,
20 2018). Further, more attention to whether dispositional measures of urgency capture any specific
21 process beyond global distress and dysregulation is warranted given the strong associations with
22 other retrospectively-rated measures of the same (Oltmanns et al., 2018; Sharma et al., 2014;
23 Smith et al., 2020). As such, we outline four important paths forward for the study of within

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1 person emotion-based impulsivity and psychopathology: 1) assess potential mechanisms linking
2 affect and impulsivity in the moment, 2) measure specific and objective risk behaviors in the
3 moment, 3) examine the relationship between affect and impulsivity at different timescales, and
4 4) capture this phenomenon in different clinical populations.

5 *Assess mechanisms linking affect and impulsivity in the moment.*

6 Conclusions drawn from these results depend on the assumption that we are adequately
7 capturing “urgency” or “reflexive responding to emotion” processes in the moment. However,
8 we could be missing integral aspects of this dynamic process in daily life. Perhaps the most
9 salient missing element in our models is an explicit measurement of impulsive *inaction*. While
10 some momentary impulsivity items in the present study may have been reasonably endorsed in
11 the case of inaction (e.g., an individual who does not negotiate the price on an expensive
12 purchase may subsequently endorse “*I spent more money than I meant to*” on the MIS) none
13 were designed to do so. We are unable to distinguish between and separately model the within-
14 person associations of affect with reflexive action and inaction. There may also be an
15 intermediate step in the within-person dynamics of emotion-based impulsivity that we are
16 missing—attributions and cognitive mechanisms that link affect and impulsivity. For example, it
17 is not clear that individuals who tend to take risky actions in the face of positive affect engage in
18 impulsive behavior in such a goal-driven manner, either explicitly or implicitly. In Whiteside and
19 Lynam’s (2001) seminal work on the construct, the authors emphasize the instrumentality of
20 negative urgency, suggesting that individuals who score highly on the Urgency factor of their
21 UPPS scale are likely to “engage in impulsive behaviors in order to alleviate negative emotions”
22 (p. 685). Furthermore, King and colleagues (2018) reported that negative urgency (measured at
23 both a trait level and a momentary level) was associated with specific reflexive and

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1 disengagement emotion-regulation strategies. Recent work on emotion-based impulsivity has
2 emphasized the role of arousal in within-subject analyses of response inhibition. Specifically, a
3 model was supported in which high levels of physiological arousal elicited decays in response
4 inhibition in those high in trait emotion-based impulsivity (Pearlstein et al., 2019). As such,
5 ambulatory measures of physiology (e.g., skin conductance, ambulatory electrocardiograms)
6 may be useful in disentangling whether changes in arousal are necessary to see within-person
7 urgency processes unfold.

8 *Measure momentary impulsivity through specific and objective behavioral indicators.*

9 The current study examined subjective reports of impulsivity in the moment, requiring
10 participants to have enough self-awareness in the moment to accurately report whether their
11 behavior is impulsive (e.g., “*I said things without thinking.*”). Future studies would benefit from
12 replicating these momentary within-person models of urgency using either specific (preferably
13 objective) behaviors relevant to the individual as the outcome. For example, emotion-based
14 impulsivity has been linked specifically to alcohol and substance use, binge eating, aggressive
15 behavior, and gambling (see Berg et al., 2015 for review). This would be especially important in
16 clinical samples in which these risky behaviors have a potential higher cost, and where these are
17 known to be problematic for the individual. That is, perhaps generalized impulsivity is not
18 actually what drives individual differences in dispositional urgency, but rather the notion that the
19 individual is doing something rashly that is specifically ill-advised for them. Notably, these
20 behaviors have a lower base rate than a subjective sense of impulsivity and may require longer
21 EMA protocols to capture enough variance in the behavior to detect trigger-symptom
22 contingencies. An additional approach may be to use idiographic indicators, defined by each

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individual, but then can be studied in the aggregate by modeling the link between affect and “their behavior” (e.g., Lindhiem et al., 2016; Wright & Woods, 2020).

Examine temporal and contextual dependency between affect and impulsivity.

The present study assumed that the link between affect and impulsivity happens *at roughly the same time* rather than over time. We believe this to be the most reasonable first step absent any more specific suggestions of timing from the theoretical literature (Hopwood et al., in press). However, temporal dependency may matter, such that ill-advised action or *inaction* may only be linked to affect after longer periods of time or beyond a cumulative threshold. It could be that this dynamic process needs to be modeled with differential lags to assess the temporal dependency between affect and impulsivity. For example, Differential Time Varying Effect Models (DTVEM; Jacobsen, Chow, & Newman, 2019) could be used to examine the ideal lag time between 1) an increase in affect, 2) a cognitive reaction to that affect/arousal, and 3) an ill-advised action or inaction.

Convergently, it may be that the dynamic urgency process is contextualized, such that it only manifests given appropriate affordances. For example, mounting negative affect at work may have little immediate impact because the individual is not in an environment that affords impulsive behavior. But once the shift is over, they may rashly engage in any number of ill-advised behaviors (e.g., speeding in the car, drinking heavily) because the external constraint of the place of work has been removed. The issue of contextual specificity of affordances is not incommensurate with delays in temporal lags, in so far as it might be a plausible explanation for delayed associations. However, it is meaningfully different from a possible threshold process, and future work should be designed to test each hypothesis. Ideally, both theoretical and

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empirical work on the putative timing of these effects would advance and mutually inform each other (Hopwood et al., in press).

Investigate momentary emotion-based impulsivity in clinical populations.

It is possible that, according to the RRE framework, we would only see associations between affect and impulsive *inaction* in those high in internalizing psychopathology. Likewise, the association between affect and ill-advised actions may only be amplified in those characterized by externalizing psychopathology. Although emotion-based impulsivity was proposed as a construct relevant to the full spectrum of personality, it may also be the case that reflexive responding to negative and positive affect with action or inaction is only observed in clinical samples. There is some support for this given the stronger effect sizes that emerged in CC and based on Sharpe and colleagues (2020) findings using daily diaries in a clinical sample. Furthermore, a recent meta-analysis found that trait measures of negative urgency were associated with impaired response inhibition with moderate/large effects in clinical samples but very small effects in student and community samples (Johnson et al., 2020). As such, more nuanced examinations of the mechanisms of emotion-based impulsivity as they relate to internalizing and externalizing psychopathology in clinical populations are warranted.

Conclusions

In sum, across four diverse samples we observed significant individual differences in *NU* and *PU* pathways consistent with Feil and colleagues (2020) who found that, *in general*, momentary negative affect predicted greater impulsivity, and considerable individual differences existed in these effects ranging from a slightly negative relationship to a moderately positive one. Although it is clear that individual differences exist in the link between affect and impulsivity, this within-person pathway is largely unrelated to dispositional measures of impulsivity and

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- 1 personality. Instead, dispositional measures are robust predictors of individual differences in
- 2 averages of the constituent relevant behavior assessed in daily life (e.g., impulsivity, affect), but
- 3 not their links together, as the construct has been construed. Future work is needed to continue
- 4 disentangling these processes and develop validated and consistent measures of both within and
- 5 between-person negative and positive urgency processes.

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MOMENTARY URGENCY CASCADE

Table 1. Description of Level 2 measures across samples.

Sample	Dispositional Impulsivity	Internalizing Pathology	Externalizing Pathology
SA	UPPS-P Positive Urgency and Negative Urgency; total UPPS-P Urgency	MASQ Anhedonic Depression; NEO-FFI Neuroticism	HPS
SB	PID-5-SF Impulsivity	PID-5-SF Detachment and Negative Affect	PID-5-SF Antagonism and Disinhibition; mean daily alcohol use
C	PAI-BOR Self Harm; PID-5-SF Impulsivity	PID-5-SF Detachment and Negative Affect; BAI; BDI	PID-5-SF Antagonism and Disinhibition; mean daily alcohol use
CC	CAT-PD-SF Affective Lability, Non-Perseverance, Non-Planfulness, and Risk Taking	CAT-PD-SF Detachment and Negative Affectivity; CES-D	CAT-PD-SF Antagonism and Disinhibition; PROMIS-AU

Note. BAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory; CAT-PD-SF = Computerized Adaptive Test of Personality Disorder - Static Form; HPS = Hypomanic Personality Scale; MASQ = Mood and Anxiety Symptom Questionnaire; NEO-FFI = NEO Five-Factor Inventory; PAI-BOR = Personality Assessment Inventory - Borderline Features; PID-5-SF = Personality Inventory for DSM-5 – Short Form; PROMIS-AU = Patient-Reported Outcomes Measurement Information System Alcohol Use - Short Form 7a; UPPS-P = UPPS-P Impulsive Behavior Scale.

MOMENTARY URGENCY CASCADE

Table 2. Within-subjects associations of affect and impulsivity in daily life.

	Sample SA			Sample SB			Sample C			Sample CC		
	Estimate	2.5% CI	97.5% CI	Estimate	2.5% CI	97.5% CI	Estimate	2.5% CI	97.5% CI	Estimate	2.5% CI	97.5% CI
<i>PU</i>	.03	.01	.05	.05	.03	.08	.02	.00	.04	-.01	-.03	.01
<i>NU</i>	.06	.04	.08	.10	.07	.13	.10	.07	.12	.32	.30	.34

Note. *PU* = Positive Urgency; *NU* = Negative Urgency. Results are reported from models including UPPS-P Positive Urgency and Negative Urgency (SA); PID-5-SF Impulsivity (SB); PID-5-SF Impulsivity and PAI-BOR Self-Harm (C); or CAT-PD-SF Affective Lability, Non-Perseverance, Non-Planfulness, and Risk Taking (CC). All pathways estimated as random effects. Bayesian estimation is used to provide standardized values. Bolded values are significant at a 95% credibility interval.

MOMENTARY URGENCY CASCADE

Table 3. Fixed and random effects for the unstandardized models of affect and impulsivity in daily life.

	Sample SA		Sample SB		Sample C		Sample CC	
	Fixed Effect	<i>SD</i> of Random Effects	Fixed Effect	<i>SD</i> of Random Effects	Fixed Effect	<i>SD</i> of Random Effects	Fixed Effect	<i>SD</i> of Random Effects
<i>PU</i>	.03	.09	.03	.05	.01	.07	-.02	.28
<i>NU</i>	.07	.10	.07	.11	.07	.10	.53	.38

Note. *PU* = Positive Urgency; *NU* = Negative Urgency. Results are reported from models including UPPS-P Positive Urgency and Negative Urgency (SA); PID-5-SF Impulsivity (SB); PID-5-SF Impulsivity and PAI-BOR Self-Harm (C); or CAT-PD-SF Affective Liability, Non-Perseverance, Non-Planfulness, and Risk Taking (CC). Bolded values are significant at a 95% credibility interval.

MOMENTARY URGENCY CASCADE

Table 4. Summary of findings across each sample.

	<i>SA</i>			<i>SB</i>			<i>C</i>			<i>CC</i>		
	<i>Dis. Imp</i>	<i>Ext</i>	<i>Int</i>	<i>Dis. Imp</i>	<i>Ext</i>	<i>Int</i>	<i>Dis. Imp</i>	<i>Ext</i>	<i>Int</i>	<i>Dis. Imp</i>	<i>Ext</i>	<i>Int</i>
<i>PU</i>	ns	ns	ns	ns	+	+	ns	ns	ns	ns	ns	ns
<i>NU</i>	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
<i>IMP</i>	+	+	+	+	+	+	+	+	+	+	+	+
<i>NA</i>	+	+	+	+	+	+	+	+	+	+	+	+
<i>PA</i>	-	+	-	ns	-/+	-	ns	+	-	-	-	-

Note. *PU* = Positive Urgency; *NU* = Negative Urgency, *IMP* = Impulsivity, *NA* = Negative Affect, *PA* = Positive Affect, *Dis. Imp* = Dispositional Impulsivity, *Ext* = Externalizing, *Int* = Internalizing. Results were consistent for all models with the exception of externalizing and *PA* in sample *SB*. *PA* was positively associated with PID-5-Antagonism and negatively associated with PID-5-Dishinibition.