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Impulsivity, aggression, and impulsive aggression in suicidality

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ABSTRACT

Background: Impulsivity and aggression are individual differences that receive considerable attention as psychological targets in suicide prevention. Their proposed roles in predicting suicidality, however, are conflicting and they may act together under the broader psychopathology of 'impulsive aggression'.
Aim: To investigate the nature of associations between impulsivity, aggression, and impulsive aggression, and suicidal ideation and behavior.
Method: Impulsivity, aggression, impulsive aggression, and suicidal ideation and behavior, were assessed in 624 participants (aged 16 years and over) via an online survey. Participants were categorized as those with (1) no history of suicidal ideation or suicide attempts, (2) a history of suicidal ideation but not of suicide attempts, and (3) a history of suicidal ideation and suicide attempts.
Results: Two pathways were associated with suicidality. First, all three constructs were associated with increased suicidality overall. Second, they were each associated with an increased likelihood to have a history of both suicidal ideation and action.
Limitations: We assessed psychological traits and further work is required to determine whether state-based measures yield consistent results.
Conclusion: Impulsivity, aggression, and impulsive aggression are each associated with increased suicidality overall and with the likelihood of having a history of both suicidal ideation and suicide attempts. The results will contribute to the development of suicide risk formulation and prevention by demonstrating how key psychological constructs contribute to the development of suicidality.

1. Introduction

Identification of individual differences associated with suicidality allows development of targeted interventions (McHugh et al., 2019). Impulsivity and aggression are proposed to elevate suicidality (e.g. Anestis et al., 2014; Barzilay & Apter, 2014; Brent & Mann, 2005, 2006), however, both have been operationalised in diverse ways leading to complex and contradictory findings (Anestis et al., 2014; Gvion & Apter, 2011). They may also be part of a larger '*impulsive aggression*' psychopathology (Brent & Mann, 2005, 2006). Clarity around the contribution of impulsivity, aggression, and impulsive aggression, to suicidality will inform suicide prevention.

Definitions of impulsivity include disinhibition, sensation-seeking, risk-taking, deficits in planning, and urgency (Anestis et al., 2014). It is included in leading psychological models of suicide (Barzilay & Apter, 2014). In Beck et al.'s (1990) Cognitive Model of Suicidal Behavior, impulsivity is a dispositional trait which increases vulnerability to suicide. Anestis et al. (2014) similarly propose impulsivity to be a distal risk factor which elevates risk through exposure to painful life experiences. In Baumeister's (1990) Escape Theory, suicidality increases when individuals can no longer resist impulsive urges to remove themselves from aversive self-awareness via increased behavioral disinhibition. Finally, in the Integrated Motivational Volitional Model (IMV; O'Connor, 2011; O'Connor & Kirtley, 2018), impulsivity plays a similar role to that of behavioral disinhibition proposed by Baumeister (1990), as a volitional moderator bridging the gap between suicidal ideation and action.

In a meta-analysis of associations between trait impulsivity and suicidality, Anestis et al. (2014) concluded that the association is weak. In their systematic review, Gvion and Apter (2011), however, concluded that the relationship between impulsivity and suicidality is consistent across psychiatric and non-clinical populations. The variety of definitions of suicidality and impulsivity across the literature likely contribute

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to such discrepancies (Gvion & Apter, 2011; Klonsky & May, 2010; Lockwood et al., 2017). Anestis et al. (2014), for example, focussed on trait impulsivity assessed through self-report or behavioral measures and included only studies which looked at the presence or absence, or frequency, of suicidal behavior. Gvion and Apter (2011) used broader definitions and argued that the literature is contradictory due to diverse operationalizations (see also Klonsky & May, 2010). In a systematic review of associations between impulsivity and self-harm in adolescents Lockwood et al. (2017) reported different relationships depending upon the operationalization of self-harm and impulsivity (e.g. mood-based measures of impulsivity were positively correlated with non-suicidal self-harm, whereas cognitive dimensions distinguished current from past self-harm, and ideation from action). Finally, a meta-analysis of relationships between cognitive and behavioral impulsivity and suicidality, found cognitive impulsivity to be the stronger predictor (Liu et al., 2017).

There is also evidence that impulsivity interacts with aggression. Gvion and Apter (2011) demonstrated them to be related to each other and to suicide, although the patterns of these relationships were complex. A recent systematic review concluded that both impulsivity and aggression were risk factors for serious suicide attempts (Gvion & Levi-Belz, 2018). Again, however, there are multiple definitions with some defining aggression as behavior intended to harm another person motivated to avoid being harmed, and others as reactive (response to perceived threat that is impulsive and emotionally charged) or proactive (premeditated and controlled) (Gvion & Apter, 2011). Meta-analytic evidence supports positive associations between aggression and suicidality, albeit dependent upon the measures of aggression and suicidality, and population. Orri et al. (2018), for example, reported positive associations between irritability and suicidal ideation and action in community, but not psychiatric, samples.

Some have argued that aggression and impulsivity should be treated as a single phenotype in relation to suicidality (e.g. Mann et al., 1999; Mann & Currier, 2010; Seroczynski et al., 1999). Brent and Mann (2005, 2006), for example, argued that impulsivity, hostility, and aggression are all part of an overarching *disinhibitory psychopathology* construct operationalised as *impulsive aggression (IA)*, defined as "the tendency to respond to provocation or frustration with hostility or aggression" (pp. 2720). Wenzel and Beck (2008) update of Beck et al. (1990) Cognitive Model includes aggression in an equivalent role to impulsivity and argue both may be components of a 'disinhibitory psychopathology' (e.g. Gorenstein & Newman, 1980; Mann et al., 1999). In Brent and Mann's (2005) Clinical-Biological Model of Suicidal Behavior, IA is viewed as a familial trait mediating between psychopathology and suicidal behavior (Mann & Currier, 2010). In Plutchik et al. (1989) Two Stage Model of Outward and Inward Directed Aggression, IA is triggered by stress, and the likelihood of expression against the self is increased when coupled with depression.

Impulsivity, aggression, and IA, then, appear in multiple psychological models of suicide and are proposed to predict suicidality via a number of pathways. A useful way of structuring these competing hypotheses is to include them as testable pathways in an overarching theoretical framework. As impulsivity and aggression are viewed variously as dispositional traits (Beck et al., 1990; Brent & Mann, 2006), state responses to adversity and stress (Plutchik et al., 1989), or as some combination of the two (Baumeister, 1990; O'Connor, 2011), a stress-diathesis model is most appropriate. O'Connor, 2011, O'Connor & Kirtley, 2018) IMV model incorporates three stages, spanning the emergence of suicidal ideation and action. As shown in Fig. 1 below, this model allows testable pathways corresponding to each of the proposed roles of impulsivity, aggression, and IA. Pathway A corresponds to Beck et al.'s (1990) proposal that impulsivity and aggression, and to Brent and Mann (2006) that IA, are dispositional traits which increase vulnerability to suicide. Pathway B corresponds to Plutchik et al.'s (1989) proposal that stress increases aggressive impulses which, when in combination with depression, are more likely to be directed towards the self. Finally, Pathway C corresponds to O'Connor, 2011, O'Connor & Kirtley, 2018) and Baumeister's (1990) proposition that impulsivity moderates the relationship between suicidal ideation and suicidal behavior.

Predictions stemming from Pathway A are that trait impulsivity and aggression (Beck et al., 1990) and IA (Brent & Mann, 2005) are positively related with suicidal ideation and suicidal behavior (and significantly higher among participants with a history of suicidality than without). Predictions stemming from Pathway B are that IA mediates the relationship between stress and suicidal behavior, in interaction with depression (Plutchik et al., 1989). Specifically, IA is most strongly positively related to suicidal behavior in those who report depression. The prediction stemming from Pathway C is that impulsivity is higher in those who have attempted suicide than those who have experienced suicidal ideation but have not attempted suicide (O'Connor, 2011; O'Connor & Kirtley, 2018). This is the first study to compare roles of

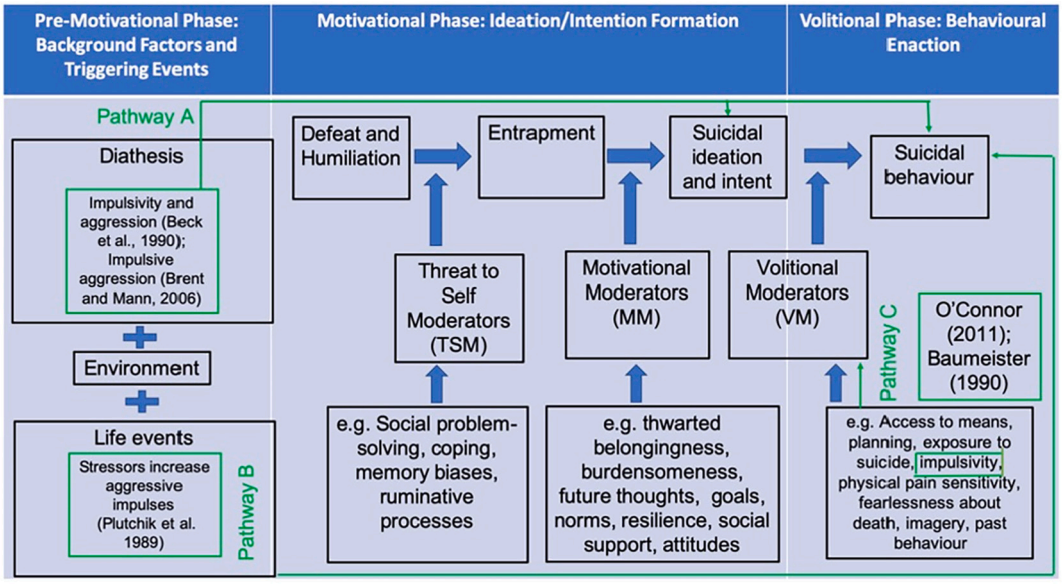

Fig. 1. The adapted Integrated Motivational Volitional Model of Suicidal Behavior (O'Connor & Kirtley, 2018) with proposed pathways between impulsivity and aggression and suicidal behavior in green. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

impulsivity and aggression in the context of specific psychological models of suicide, and to explore the combination of impulsivity and aggression as an 'impulsive aggression' factor in this context. By so doing, we aim to clarify roles of impulsivity and aggression in the development of suicidality.

2. Materials and methods

2.1. Participants

Six hundred and twenty-four participants completed an online survey advertised on social media (female $n = 452$ (72.4 %); age = 16–81 years, mean = 41.87 (13.47)). Five hundred and six (81.1 %) were from Scotland (the remainder were from the rest of the UK). Power analysis (using G Power), identified a minimum of 33 participants per group for statistical power to detect a weak effect. The study was approved by the University of Glasgow Research Ethics Committee.

2.2. Measures

2.2.1. Demographics

Participants reported age, gender, and country of residence.

2.2.2. Stress

Stress was assessed using Cohen's (1994) Perceived Stress Scale. This 10-item scale (Cronbach's $\alpha = 0.78$; Cohen et al., 1988) assesses stress in the last month (e.g. "how often have you felt that you were unable to control the important things in your life?"). Scores range from 0 to 40 with higher scores indicating higher stress.

2.3. Impulsivity

The Barrett Impulsiveness Scale (BIS-11; Patton et al., 1995) uses 30 items to assess impulsivity (e.g. "I do things without thinking") across three domains (attentional, motor, and non-planning impulsivity; Cronbach's $\alpha = 0.8$ (Reise et al., 2013)). Scores range from 30 to 120 with higher scores indicating higher impulsivity.

The UPPS-P-S Impulsive Behavior Scale (UPPS; Whiteside & Lynam, 2001; Lynam et al., 2011) is a 20-item measure of general impulsivity across positive and negative urgency, lack of premeditation, lack of perseverance, and sensation seeking (Cronbach's $\alpha = 0.87$). Scores range from 20 to 80, with higher levels showing higher impulsivity.

2.4. Aggression

The Buss-Perry Aggression Scale (BPAS; Buss & Perry, 1992) is a 29-item (e.g. "Some of my friends think I am a hothead") scale which assesses general aggression and physical, verbal, anger, and hostility (Cronbach's $\alpha = 0.78$; Harris, 1997; Samani, 2008). Scores range from 29 to 145, with higher scores indicating higher aggression.

2.5. Impulsive aggression

Brent and Mann (2005, 2006) describe IA as a hybrid of impulsivity, aggression, and hostility. Plutchik et al. (1989) describe an 'aggressive impulse' conceptually distinct from aggression, which can be directed towards self or others. As there are no published measures of IA, we explored the ways in which impulsivity and aggression group together using exploratory factor analysis.

2.6. Depression

The PHQ-9 (Spitzer et al., 1999) is a 9-item (e.g. "little interest or pleasure in doing things") measure of symptoms of depression in the last fortnight (Cronbach's $\alpha = 0.89$; Kroenke et al., 2001). Scores range from 0 to 29 with higher scores indicating greater severity.

2.7. Suicidality

Suicidal ideation and behavior were assessed with the following items: (1) "Have you ever thought of taking your life, even though you would not actually do it?" and (2) "Have you ever made an attempt to take your life, by taking an overdose of tablets or in some other way?" (taken from the Adult Psychiatric Morbidity Survey (self-completion version), 2014). Response options were "no", "yes", and "would rather not say". Responses were used to allocate participants to 3 groups: (1) no history of suicidal ideation or suicide attempts, (2) history of suicidal ideation but not of action, and (3) history of suicidal action.

To assess validity of our measure of suicidal history, we compared groups on a validated measure of suicidality (the Suicide Probability Scale, Cronbach's $\alpha = 0.92$; Cull & Gill, 1988). This eight item scale asks participants to rate the frequency of suicidal cognitions such as "I have thought of how to do myself in". Scores range from 0 to 32, with higher scores indicating greater severity.

2.8. Analysis

Inspection of the data revealed no duplicate entries (identical entries from the same IP address) or potentially inaccurate entries (i.e. where a participant gave the same response, or small number of responses, across all items).

Exploratory factor analysis determined the structure of intercorrelations between items on impulsivity (BIS-11, UPPS) and aggression (BPAS) measures, to extract an 'IA' factor. We used Varimax rotation under the assumption that our factors should not be significantly correlated.

Univariate three-way anova was used to test for differences in impulsivity, aggression, and IA, between groups who did and did not report experiencing suicidal ideation and attempts (Pathway A). Significant differences were followed up with between groups *t*-tests. Moderated mediation analysis determined whether IA (alone and in interaction with depression) mediates between the experience of stressors and suicidal ideation (binary coded as history of suicidal ideation or not) or attempts (binary coded as history of suicide attempts or not) (Pathway B). Univariate binary logistic regression was used to determine whether impulsivity, aggression, and IA, predict whether participants who had experienced suicidal ideation had also attempted suicide or not (Pathway C). All significant predictors were entered simultaneously into multiple regression to determine their independent contributions. In all cases, total scores for scales were first entered into analyses. Where these were significant, analyses of sub-scales were conducted. Analyses were conducted using IBM SPSS v28. Where data for an item included in an analysis was missing (or required for calculation of a scale or subscale), that participant was excluded from that analysis.

3. Results

All pairwise comparisons were significant with the exception of age between suicidal ideation and no suicide attempts compared with suicidal ideation and suicide attempts; BIS-11 total score between no suicidal ideation and no suicide attempts compared with suicidal ideation and no suicide attempts; and physical aggression between suicidal ideation and no suicide attempts compared with suicidal ideation and suicide attempts. For correlation matrix, see Supplementary Material 1.

3.1. Factor analysis of impulsivity and aggression

Item scores for BIS-11, UPPS, and BPAS were entered into an exploratory factor analysis with Varimax rotation. There were no items with communalities <0.5, Bartlett's Test of Sphericity was significant ($x^2(3081) = 19{,}489.63$ ($p < 0.001$), and KMO sampling adequacy was 0.91, indicating the appropriateness of the data for factor analysis. The

factor solution yielded 18 factors which accounted for 63.02 % of the variance. As, however, there were no factors on which items measuring both impulsivity and aggression loaded significantly, we re-ran the analysis using subscale scores. Here, there were no items with communalities <0.5, Bartlett's Test of Sphericity was significant ($x^2(55) = 2745.34$ ($p < 0.001$), and KMO = 0.83. Three factors were extracted, accounting for 65.12 % of the variance (Table 2). Of these, we treated the factor with the greatest eigenvalue (4.72), accounting for 39.31 % of the variance, and which included significant factor loadings for measures of impulsivity and aggression as our measure of 'IA'.

Table 2
Loadings for 'impulsive aggression' factor.

Variable	Factor 1 (*Impulsive aggression*) Eigenvalue = 4.72 % variance = 39.31	Factor 2 Eigenvalue = 1.7 % variance = 14.13	Factor 3 Eigenvalue = 1.31 % variance = 10.89
BIS-11 attentional impulsivity	0.712	0.259	0.188
BIS-11 motor impulsivity	0.697	0.264	−0.216
UPPS negative urgency	0.793	0.111	0.050
UPPS positive urgency	0.590	0.413	0.248
UPPS sensation seeking	0.635	0.362	−0.171
UPPS (lack of) premeditation	0.187	0.227	−0.742
UPPS (lack of) perseverance	0.839	0.132	−0.021
Physical aggression	0.570	−0.199	0.041
Verbal aggression	0.104	0.838	−0.190
Anger	0.072	0.887	0.008
Hostility	0.252	0.335	0.695

3.1.1. Pathway A: impulsivity, aggression, and IA will be positively correlated with suicidal ideation and suicide attempts

There were significant differences between groups (suicidal ideation and suicide attempts > suicidal ideation and no suicide attempts > no ideation or attempts) for BIS-11 and subscales, UPPS total and negative and positive urgency and lack of premeditation subscales, BPAS and subscales, and the IA factor (Table 1). Post-hoc analyses revealed significant differences between all groups on each of these variables (all $p < 0.01$).

3.1.2. Pathway B: IA, and its interaction with depression, will mediate the relationship between stress and suicidality

In moderated mediation analysis to determine whether IA in interaction with depression mediated the relationship between stress and suicidality (using Hayes' (2017) PROCESS macro for SPSS v3.5), there was no significant moderated mediation of relationships between stress and suicidal ideation (beta = 0.12, $p < 0.001$) or suicidal action (beta = 0.1, p < 0.001), by the interaction of IA and depression (all $p > 0.05$). Fig. 2.

3.1.3. Pathway C: impulsivity and aggression will moderate transition from suicidal ideation to action

For participants who reported suicidal ideation with or without suicide attempts ($n = 536$), univariate binary logistic regression models revealed that BIS-11 (beta = 0.05, OR = 1.05, $p < 0.001$), UPPS (beta = 0.06, OR = 1.07, $p = 0.009$), BPAS-aggression (beta = 0.02, OR = 1.02, p < 0.001), and IA (beta = 0.53, OR = 1.87, p < 0.001) predicted whether participants had experienced suicide attempts (Table 1).

In univariate binary logistic regression models to determine whether sub-scales of each measure predicted whether participants had a history of suicide attempts, BIS-11 attentional impulsivity (beta = 0.13, OR = 1.13, $p < 0.001$), BIS-11 motor impulsivity (beta = 0.1, OR = 1.1, $p < 0.001$), BIS-11 non-planning impulsivity (beta = 0.08, OR = 1.08, p <

Table 1
Descriptive statistics for total sample, and for groups of participants who reported no history of suicidal ideation or suicide attempts, a history of suicidal ideation and no suicide attempts, and a history of suicidal ideation and suicide attempts.

	Mean (+-SD)	No suicidal ideation or suicide attempts (mean + -SE)	Suicidal ideation and no suicide attempts (mean + − SE)	Suicidal ideation and suicide attempt(s) (mean + − SE)
	$n = 624$	$n = 88$	$n = 299$	$n = 237$
Age	41.87 (13.47)	45.74 (14.57)	41.59 (13.46)	40.76 (12.84)*
Gender	Female: n = 452 (72.4 %)	Female: $n = 57$ (64.8 %)	Female: $n = 207$ (69.2 %)	Female: $n = 188$ (79.3 %)**
Suicide Probability Scale	18.44 (6.78)	8.59 (0.6)	13.83 (0.33)	19.17 (0.37)**
PHQ-9	16.52 (7.71)	4.74 (0.76)	12.04 (0.41)	17.22 (0.46)**
Perceived Stress Scale	22.44 (4.5)	19.39 (0.44)	21.3 (0.24)	22.74 (0.27)**
BIS-11 total impulsivity	72.87 (12.68)	60 (1.25)	66.54 (0.68)	73.47 (0.78)**
BIS-11 attentional impulsivity	20.32 (4.67)	15.15 (0.46)	18.14 (0.23)	20.58 (0.28)**
BIS-11 motor impulsivity	25.17 (5.24)	22.11 (0.51)	22.95 (0.28)	25.23 (0.31)**
BIS-11 non planning impulsivity	27.38 (5.85)	22.73 (0.59)	25.44 (0.32)	27.66 (0.38)**
UPPS total impulsivity	48.47 (10.17)	39.81 (0.97)	43.7 (0.53)	48.76 (0.59)**
UPPS negative urgency	11.86 (3.24)	8.44 (0.33)	10.46 (0.18)	12.08 (0.2)**
UPPS positive urgency	9.46 (3.46)	6.74 (0.33)	7.97 (0.18)	9.56 (0.3)**
UPPS sensation seeking	9.76 (3.4)	9.41 (0.34)	9.23 (0.18)	9.66 (0.21)
UPPS (lack of) premeditation	9.16 (3.02)	7.28 (0.27)	8.09 (0.15)	9.27 (0.17)**
UPPS (lack of) perseverance	8.23 (2.39)	7.93 (0.25)	7.96 (0.14)	8.25 (0.15)
Total aggression	78.89 (16.42)	68.67 (1.68)	78.04 (0.91)	83.74 (1.02)**
Physical aggression	24.61 (4.79)	23.03 (0.51)	24.64 (0.27)	25.37 (0.31)**
Verbal aggression	13.24 (4.43)	11.56 (0.47)	13.07 (0.25)	14.07 (0.28)**
Anger	22.05 (4.14)[c]	19.4 (0.43)	21.95 (0.23)	23.16 (0.26)**
Hostility	18.91 (7.2)	14.67 (0.74)	18.38 (0.4)	21.15 (0.45)**
IA factor	0 (1)	−0.56 (0.85)	−0.14 (0.85)	0.39 (1.01)**

* Univariate 3-way ANOVA (chi-square for gender) $p < 0.05$
** $p < 0.01$.

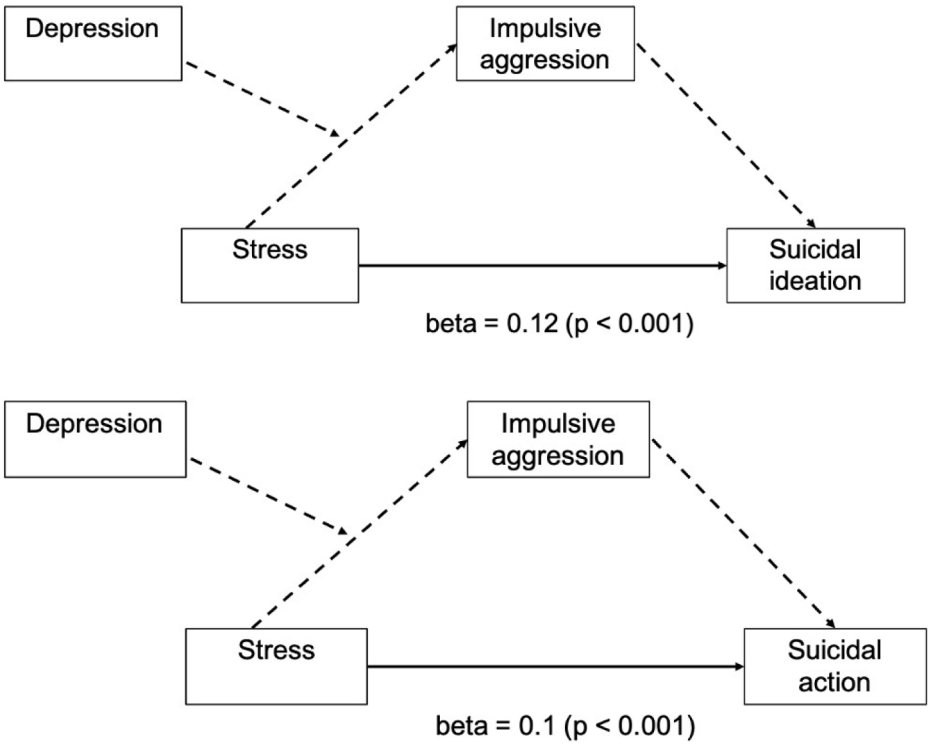

Fig. 2. Path diagram showing no evidence of significant mediation, or moderated mediation, of relationships between stress and history of (a) suicide ideation or (b) action by IA and depression.

0.001), UPPS negative urgency (beta = 0.17, OR = 1.19, $p < 0.001$), UPPS positive urgency (beta = 0.16, OR = 1.18, $p < 0.001$), UPPS (lack of) premeditation (beta = 0.18, OR = 1.2, p < 0.001), BPAS physical aggression (beta = 0.04, OR = 1.04, $p = 0.05$), BPAS verbal aggression (beta = 0.05, OR = 1.05, $p = 0.008$), BPAS anger (beta = 0.08, OR = 1.08, p < 0.001), and BPAS hostility (beta = 0.06, OR = 1.06, p < 0.001), significantly predicted a history of suicide attempts. UPPS sensation seeking and (lack of) perseverance, did not significantly predict a history of suicide attempts ($p > 0.08$).

In multiple binary logistic regression including total impulsivity and aggression scores (the IA factor was excluded due to low tolerance to multicollinearity), BIS-11 (beta = 0.03, OR = 1.03, $p = 0.007$) and UPPS (beta = 0.03, OR = 1.03, $p = 0.033$) maintained significance, and BPAS lost significance (beta = 0.01, OR = 1.01, $p = 0.3$).

4. Discussion

We report support for two pathways by which impulsivity, aggression, and IA may increase suicidality. First, several measures of impulsivity and aggression, and IA, were positively correlated with suicidality, supporting Pathway A (Beck et al., 1990; Brent & Mann, 2006). Trait impulsivity and aggression may, then, act as temperamental dimensions which increase suicidality. Second, impulsivity, aggression, and IA, differentiated between those with suicidal ideation only and those with a history of suicidal action, supporting Pathway C (O'Connor, 2011; O'Connor & Kirtley, 2018). Impulsivity, aggression, and IA, acted as volitional moderators from suicidal ideation to action in accordance with the IMV Model (O'Connor, 2011; O'Connor & Kirtley, 2018). We did not find support for Pathway B, that IA in combination with depression mediates relationships between stress and suicidality (Plutchik et al., 1989). We note, however, that our measure of stress was based on current perceptions while measures of suicidality were historical. While this may have influenced our likelihood to detect a significant pathway, our results are not consistent with this pattern.

Scores on both measures of impulsivity (BIS-11 and UPPS) varied between groups with presence and absence of suicidal ideation and action. This was also the case for all BIS-11 subscales (attentional, motor, and non-planning impulsivity) and for the UPPS subscales of negative and positive urgency, and lack of premeditation. The UPPS subscales of sensation seeking and lack of perseverance did not differ on the basis of history of suicidality. This is in line with previous findings which have shown negative urgency and lack of premeditation to be the UPPS subscales most strongly related to suicidality, distinguishing, for example, between those with suicidal ideation with and without a history suicide attempts (Beach et al., 2022; Klonsky & May, 2010). Negative urgency is the tendency to give in to impulses when experiencing negative emotions, so it is not difficult to see how this could increase risk of moving from suicidal ideation to action. Lack of premeditation (deficits in the ability to think through the consequences of one's actions), also makes intuitive sense in the context of a volitional moderator. Our findings support these and others, which demonstrate that impulsivity – at least in relation to suicidality – should not be tried as a single construct. In particular, results point to negative urgency and lack of premeditation as targets for suicide risk assessment and intervention.

We are cautious in extrapolating from our results to operationalizations of suicidality beyond those reported here. Lockwood et al. (2017), for example, reported different relationships depending upon the operationalization of self-harm and impulsivity. Furthermore, it is important to consider the potential for differences in associations between suicidality and self-report, compared to neurocognitive, measures. Recent meta-analyses have demonstrated larger associations between neurocognitive measures and suicidality (McHugh et al., 2019), and behavioral and cognitive impulsivity (Liu et al., 2017), than have been reported in meta-analyses that have focused on self-report measures of impulsivity. Liu et al. (2017) also found the associations to be stronger when the suicide attempt was more proximal to the measure of impulsivity. In a systematic review and meta-analysis, however, we have recently reported behavioral impulsivity to be more strongly predictive of suicidality than cognitive measures (Moore et al., 2022). Future

research should compare roles of state and trait multi-dimensional impulsivity on suicidality and the movement from ideation to action in longitudinal designs.

Our results are consistent with a model in which impulsivity, aggression, and 'IA', contribute to suicidality. In all cases, the contribution of impulsivity, aggression, and IA were equivalent. As with impulsivity, however, aggression is defined and operationalised in multiple ways and here we included four dimensions (physical, verbal, anger, and hostility) all of which contributed to suicidality. While our results are consistent with models in which physical aggression and impulsivity are treated as a single phenotype in relation to suicide (e.g. Mann et al., 1999; Mann & Currier, 2010; Seroczynski et al., 1999), and we argue that aggression should be targeted in suicide intervention, further work is required to delineate the structure and function of an IA phenotype. Our exploratory factor analysis demonstrated that physical aggression correlated with measures of impulsivity, whereas verbal aggression, and hostility and anger, grouped on separate factors. 'IA' may refer specifically to physical aggression. Are there qualitative differences in the impulsivity of physical and other forms of aggression which make physical aggression a bigger risk factor for suicidality? Is physical aggression overall, in combination with impulsivity, a risk factor for suicidality or is it a specific component of physical aggression that reflects likelihood of directing physical aggression towards oneself that should be a variable of focus?

We assessed psychological traits and further work is required to determine whether state-based measures yield consistent results. Longitudinal work would elucidate how our psychological variables predict development of suicidality over time. Our sample was limited to those with access to the internet, and the interest required to complete a survey, so may have been biased towards those with an interest in understanding suicide, perhaps due to lived experience. We did not include formal methods of ensuring honesty or sustained attention in responses from our participants, which should be included in future online research. Here we used single item measures of experience of suicidal ideation and action. When we grouped our participants on the basis of their history of suicidality we found them to differ significantly in severity in suicidal cognitions (the SPS, Cull & Gill, 1988) as expected. While this lends some validity to our use of the single item measures, future work would benefit from more fine grained measures of suicidality, including type, duration, and severity of suicidal ideation, and number, recency, and medical severity of suicide attempts.

We have reported roles of impulsivity, aggression, and IA, in increasing suicidality and the likelihood of experiencing suicidal action in addition to ideation. Impulsivity and aggression are promising psychological targets for suicide prevention.

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Data availability

Data will be made available on request.

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