Potential mechanisms underlying suicidality in autistic people with attention deficit/hyperactivity disorder (ADHD): testing hypotheses from the interpersonal theory of suicide

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Abstract

Background

Autistic people with co-occurring ADHD appear to be at heightened risk of suicide. To understand why, we explored two explanatory mechanisms from the interpersonal theory of suicide: first, that co-occurring ADHD might be associated with greater risk through greater thwarted belongingness and perceived burdensomeness; and secondly, that hyperactive/impulsive features might incur additional risk through their association with painful and provocative events, which are suggested to create 'capability' for suicide.

Methods

Autistic adults (n = 314) completed an online survey including measures of thwarted belongingness, perceived burdensomeness, painful and provocative events, acquired capability for suicide, and ADHD features. Creating an overall index of likely ADHD, we examined associations between likely ADHD, suicide ideation and lifetime suicide attempts via the parallel mediators of thwarted belongingness, perceived burdensomeness, anxiety and depression. In several models, we then examined hyperactive, impulsive and inattentive features as predictors of exposure to painful and provocative events and subsequent capability for suicide, and examined whether these two variables, sequentially or individually, mediated an association with lifetime suicide attempts.

Results

Likely ADHD was associated with past-year suicide ideation via greater depression and perceived burdensomeness, which also mediated its association with more suicide attempts.

Hyperactive and impulsive features were associated with exposure to painful and provocative events and through this acquired suicide capability. Both features were associated with more numerous suicide attempts via these two mediators sequentially, and via exposure to painful and provocative events alone.

Conclusions

These data suggest that suicidality in autistic people with ADHD may be partially related to perceived burdensomeness and to acquired suicide capability following exposure to painful and provocative events. However, as we observed a pathway to suicidality associated with painful and provocative events alone, it is likely that there are also other explanatory mechanisms for the influence of traumatic events on suicide risk.

Background

Suicide is a leading cause of premature mortality in autistic people without intellectual disability, with suicide attempts and deaths considerably higher than those seen in the general population.[1-5] One group who appear at particular risk within this demographic are autistic people with co-occurring attention deficit/hyperactivity disorder (ADHD), which has a lifetime prevalence of 40.2% in autistic samples.[6] ADHD is considered by many to be a neurological "cousin" of autism,[7] a developmental condition with shared genetic heritability[8,9] and an overlapping neurological profile.[10] Despite some shared features that may challenge differential diagnosis,[11] ADHD possesses its own distinctive behavioural and neurological features which distinguish it from autism, and the appearance of ADHD and autistic features within an individual shows that the two can co-occur.[10,12]

One study estimated the risk of suicide attempts in these individuals as threefold higher than the fourfold increase already seen within the autistic community[13]; in the same cohort, suicide deaths were increased fivefold on top of the eightfold increase seen in individuals with autism alone. With similar findings corroborated in ADHD samples,[14] this heightened risk in autistic people with ADHD is importantly independent of psychiatric conditions like anxiety, depression and substance abuse,[13] which are also more common in this cohort[15,16] and a major correlate and risk factor for suicidality, in and of themselves, in both autistic and ADHD populations.[2,17,18] Similarly, a number of studies report an association between ADHD and suicidality[14,19-21] which is separate from these confounds and seemingly reflects something about living in the world as an individual with ADHD.[22] These concerning findings highlight the need to examine the role of co-occurring ADHD in autistic suicidality and to identify the mechanisms through which these individuals might be at greater risk.

Recent efforts to comprehend suicidality in autistic people have drawn on theoretical frameworks in an attempt to integrate and explain seemingly disparate risk factors. To date, the dominant paradigm in suicidology is the Interpersonal Theory of Suicide (ITS),[23-25] which holds that suicide ideation and suicide attempts are distinct phenomena dependent on specific proximal risk factors. The theory suggests that the desire to die by suicide arises from the confluence of 'thwarted belongingness' (a state of loneliness and the absence of reciprocal caring relationships) and 'perceived burdensomeness' (feelings of self-hate and worthlessness, beliefs that one is a liability to others). The ITS holds that suicide attempts and deaths occur in people in whom suicide ideation converges with the *capability* to enact lethal self-injury. Such capability can be 'acquired' through exposure to physically painful and emotionally provocative or triggering experiences. While events of this nature include exposure to traumatic events (e.g. violent victimisation, accidents, combat experience), engagement in non-suicidal self-injury (NSSI) or intravenous drug use, they also include a range of behaviours associated with thrill-seeking or extreme sports (e.g. skydiving, rock climbing, getting a tattoo, riding a motorbike): essentially, experiences in which individuals are exposed to pain and fear of pain and death, and can become habituated to the same.[26,27]

The explanatory power of the ITS lies partly in its recognition of overarching psychological constructs which incorporate individual correlates of suicidality (e.g. unemployment, family conflict), with life events and experiences. Many varied factors associated with suicidality in autistic people – for instance, loneliness and unmet support needs,[17,28,29] camouflaging,[17] low self-worth,[30] NSSI[17,31] – may, if the theory is applicable in this group, be understood in terms of a small number of shared psychological constructs. Recent investigations support the relevance of thwarted belongingness, perceived burdensomeness and acquired capability to suicidality in autistic people,[32,33] although they suggest that factors traditionally associated with suicidal ideation in the ITS might also

contribute to suicide attempts in autistic people. Perceived burdensomeness appeared to be a particularly potent predictor of both outcomes, and mediated the higher rates of suicide ideation seen in autistic people who were single.[33] In the same vein, in the general population, perceived burdensomeness and thwarted belongingness mediated the association between camouflaging autistic traits and suicidality.[34]

In considering suicide risk associated with ADHD through the lens of the ITS, it may be significant that non-autistic people with ADHD struggle with loneliness, low self-worth, feelings of inferiority and difference from others, and may engage in camouflaging as they "strive to be normal".[35-39] They are more likely to experience academic underachievement and/or exclusion, unemployment, difficulty sustaining employment, and to find themselves in financial arrears or dependent on family.[40] Financial distress, which is suggested by the ITS as a likely antecedent of perceived burdensomeness,[24] has actually been linked to psychological distress and suicide in this population,[19] While little research has explored ITS constructs as predictors of suicidality in ADHD, recent studies in the general population has indeed suggested a mediating role for perceived burdensomeness and thwarted belongingness in the association between ADHD traits and suicide ideation.[41] With both states (particularly perceived burdensomeness) associated with suicidality in autistic people,[32,33] it is possible that the higher risk of suicide ideation in autistic people with ADHD might also be mediated by greater likelihood of experiencing these states. As children and adolescents, these individuals tend to score more poorly than young people with either condition alone on standardised measures of adaptive and executive function, experience more mental health conditions, and struggle more with the social and academic pressures of school.[16,42-45] There are few studies examining the welfare of autistic adults with co-occurring ADHD, but those that exist suggest that with greater degrees of ADHD features, autistic people rate their quality of life as poorer (including in relation to physical and mental health) and may be more

isolated, with lower likelihood of employment and independence.[46,47]

While we might hypothesise that high states of thwarted belongingness and perceived burdensomeness, if present, would be associated with a strong desire for death, two additional mechanisms may be relevant in explaining the high rates of suicide attempts and deaths in autistic people with ADHD. First, there is some suggestion that mental rehearsal of suicide plans, a behaviour associated with suicide ideation *and* subsequent attempts, is a unique facet of the acquired capability construct which both reinforces suicide ideation *and* contributes to the erosion of fear of death.[48] In this way, prolonged periods of intense suicide ideation with mental rehearsal of suicide plans, which are suggested by heightened rates of suicide ideation in neurodivergent people,[4,49-51] may habituate individuals to the thought of suicide and actually enable them to act on suicidal thoughts. Secondly, an additional pathway to suicidality in ADHD is indicated by one of its core feature domains,[1] that of hyperactive/impulsive features. While trait impulsivity is not a reliable predictor of suicide attempts,[52] impulsivity is considered an indirect and distal risk factor because it increases the likelihood that an individual will be drawn and/or exposed to the painful and provocative events which increase suicide capability.[53,54] Unfortunately, while a number of studies report associations between ADHD and suicidality,[19,21,55] NSSI,[56] and violent and traumatic events,[57-59] few examined these associations in relation to specific features. Several studies implicate hyperactive/impulsive features in self-injurious behaviour,[60,61] but neither examined the specificity of this association to hyperactive/impulsive features or looked at subsequent effects on acquired capability and later suicidality. Although one study did support a link between ADHD and suicidality in relation to victimisation trauma,[62] these authors did not examine whether acquired capability mediated an association between exposure to this type

[1] DSM-5 conceptualises ADHD as comprising two domains, namely inattentive and hyperactive-impulsive features. While previous versions allowed diagnosis of attention deficit disorder without hyperactivity (DSM-III), and then hyperactive and inattentive "subtypes" (DSM-IV), the present single diagnostic entity recognises that both types of feature present in varying degrees across the lifespan (Epstein & Loren, 2013).

of provocative event and suicide attempts, or consider differential effects of ADHD features.

In light of the apparent greater risk of suicidality suggested in autistic people with ADHD,[13,14] the present study aimed to examine associations between co-occurring ADHD, suicide ideation and suicide attempts in light of two hypothesised pathways based on the ITS and previous autism literature. Our first analyses focused on thwarted belongingness and perceived burdensomeness, which we hypothesised might occur at higher levels in autistic people with ADHD due to the deleterious academic, occupational, social and emotional correlates of co-occurring autism and ADHD.[46,63,64] In the general public, the association between these constructs and ADHD features mediated their association with suicide ideation,[41] consistent with the assertions of the ITS. We hypothesised a similar mediating role of these constructs between co-occurring ADHD and suicide ideation in our autistic sample, but given that thwarted belongingness and perceived burdensomeness may be relevant to suicide attempts in autistic people,[32] we also examined their role in the association between co-occurring ADHD and suicide attempts. Our second analyses focused on acquired capability, which is understood to accrue from exposure to painful and provocative events.[26] We hypothesised that hyperactive/impulsive features, in particular, would be associated with higher incidence of painful and provocative events and henceforth greater acquired capability for suicide, and that these two variables would mediate an association between this specific feature domain and suicide attempts.

Methods

Participants

These analyses were performed using data from the same autistic sample (n = 314)

described in Moseley et al. (2022).[33] These volunteers responded to online advertisements on social media and to adverts distributed to the Autistica Research Network and the Cambridge Research Database. The majority (95.8%) lived in the UK, with 1.3% living in the USA and the remainder within South America and the European Union. Fifty-four of the sample (11 of those who reported their sex as male, 43 who reported their sex as female) had been formally diagnosed as having ADHD (unfortunately, we did not enquire when these diagnoses were made). Further demographic information about the sample is displayed in Table 1, along with their scores to major study variables.

Table 1

Sample demographic information and scores in major study variables

Sample characteristics (n = 314)			
Average age	41.9 years (SD: 13.4, range: 18-72)		
Average age at autism diagnosis	34.6 years (SD: 14.8, range: 2-67)		
Sex	Male: 26.8%	Female: 72.9%	Other: 3%
Gender identity[2]	Cisgender male: 25.2% Non-binary (including agender, genderqueer and other identities): 14.6%	Cisgender female: 57.3% Transgender (male, female and non-binary transgender identities): 2.9%	
Ethnicity	Caucasian/White: 79.9%	Black: 1.6%	Mixed race: 5.4%

[2] Unfortunately, the wording of our survey (based on our awareness at the time of design) was flawed. As we included a single selectable item for transgender identities (not allowing participants to pick male, female or other options within this category, although some chose to enter free text), we cannot ascertain the number of trans people with different identities within this survey. 'Sex' and 'gender', as labelled here, were presented in the survey as follows: "When you were born, what sex were you assigned to?" (options: male, female, other); "Oftentimes, people's gender identity matches the sex they were assigned at birth, but this is not always the case. Can we ask how you would describe your gender identity? You can choose more than one option, or write something in." (options: male, female, genderqueer, agender, transgender, cisgender, a gender not listed here [free text entry]).

	Other ethnicities: 4.3% No response: 8.8%		
Educational attainment	GCSEs, high-school diploma or equivalent: 94.9% Bachelors degree: 70.1% Postgraduate qualifications: 35.7%		
Average scores in major study variables (SD), *range in italics*			
ADHD Index t-scores (CAARS-S:S)	Inattention/Memory t-scores (CAARS-S:S)	Hyperactivity/Restlessness t-scores (CAARS-S:S)	Impulsivity/Emotional Lability t-scores (CAARS-S:S)
66.8 (12.9), *34-90* α = .84	65.1 (13.7), *35-90* α = .84	55 (11.6), *33-82* α = .80	60.3 (13.2), *37-90* α = .78
Thwarted Belongingness (INQ-15)	Perceived Burdensomeness (INQ-15)	Acquired Capability (ACWRSS)	Painful and Provocative Events (PPES)
38 (9.2), *10-63* α = .87	17.1 (9.6), *6-42* α = .93	29.9 (13.2), *0-56*	46.4 (10.7), *26-78*
Depression (PHQ-9)		Anxiety (GAD-7)	
13 (7.2), *0-27* α = .90		11 (5.9), *0-21* α = .91	

Note. Demographic information and average sample scores on scales used in this analysis. ADHD variables are derived from the Connors Adult ADHD Rating Scale Self-report Short version (CAARS-S:S); thwarted belongingness and perceived burdensomeness from the Interpersonal Needs Questionnaire-15 (INQ-15); acquired capability from the Acquired Capability With Rehearsal for Suicide Scale (ACWRSS); painful and provocative events from the Painful and Provocative Events Scale (PPES); and depression and anxiety from the Patient Health Questionnaire (PHQ-9) and Generalised Anxiety Disorder 7 (GAD-7) respectively. Internal consistency is provided for those scales assessing reflective constructs (whose items indicate one or more latent variables).

Materials and procedure

The Science and Technology Faculty Ethics Panel at Bournemouth University reviewed and approved this study; measures taken for the safety and comfort of participants are listed in full in a previous publication.[33] Participants completed an online survey (hosted on Qualtrics) which included measures of co-occurring ADHD, ITS constructs, suicide ideation and attempts, along with depressive and anxious symptoms. Internal consistency was high for each measure in this sample (see Table 1).

Independent variables: Co-occurring ADHD and feature domains

As it has only recently become possible for individuals to be diagnosed with both autism and ADHD and women are particularly under-recognised,[12,65] we deemed it highly likely that more participants might exhibit ADHD features than just those who had received official ADHD diagnoses. The Connors Adult ADHD Rating Scale Self-report Short version (CAARS-S:S[66]) includes 26 items which correspond to subscales Inattention/Memory problems, Hyperactivity/Restlessness, Impulsivity/Emotional Lability, and Problems with Self-Concept. We transformed these raw scores for each subscale into t-scores for comparison with standardised, age-appropriate norms for males and females, and used the t-scores for Inattention/Memory, Hyperactivity/Restlessness, and Impulsivity/Emotional Lability as continuous measures in our analysis.

An additional subscale of the CAARS-S:S, the ADHD Index, constitutes 12 items which are most strongly indicative of likely ADHD. In the general population, t-scores of 70 in the ADHD Index are highly indicative of likely ADHD. Standardised scores do not, to our knowledge, exist for autistic adults, but in our sample, 142 participants (45.2%) scored above 70 on the ADHD Index (108 females and 34 males, a subset which included the 54 participants with official ADHD diagnoses). Using this, we created a binary index indicative of likely ADHD (participants coded 1 if their ADHD Index t-score was 70 or above).

Mediators: ITS constructs

The Interpersonal Needs Questionnaire-15 (INQ-15). The INQ-15[67] includes nine statements related to thwarted belongingness and six to perceived burdensomeness. Participants responded to items on a scale from 1 to 7, with higher scores indicating greater thwarted belongingness and perceived burdensomeness.

The Acquired Capability with Rehearsal for Suicide Scale (ACWRSS). The ACWRSS[48] is a brief, 7-item measure wherein higher scores reflect greater acquired capability. While the scale comprises items assessing fear of death, pain tolerance and mental rehearsal, only the total score was used here.

Painful and Provocative Events Scale (PPES). The 26-item version of the PPES[26] includes a list of experiences (e.g. "Have you gone skydiving?", "Did you get a tattoo?"). Participants responded to each item with "Never" (scored 1), "Once" (2), "2-3 times" (3), "4-20 times" (4), or "More than 20 times" (5).

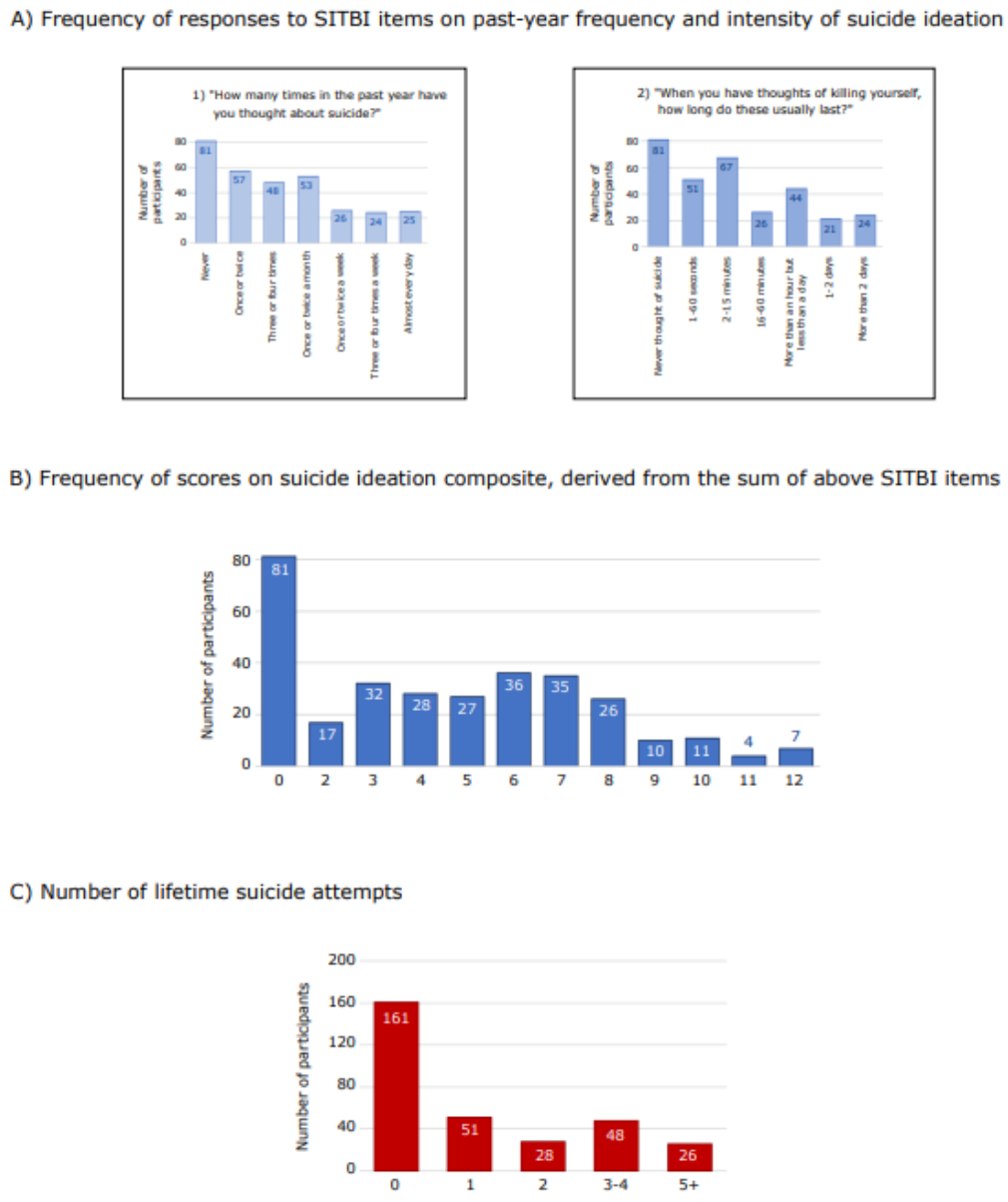
Dependent variables: Suicide ideation and attempts

We created a continuous composite item reflecting the frequency and intensity of suicide ideation over the past 12 months, based on the sum of scores to two correlated items ($r = .55$, $p < .001$) in the Self-Injurious Thoughts and Behaviours Interview short form (SITBI[68]). More detail can be seen where originally reported in Moseley et al. (2022).[33] The composite score ranged between 0 (no suicide ideation within the past year), or an integer between 2-12: low scores reflected rare or brief incidents of suicide ideation, while higher scores indicated the presence of suicide ideation which was frequent and/or intense. For an ordinal index of lifetime suicide attempts, we used the SITBI item, "How many times in your lifetime have you made an actual attempt to kill yourself, in which you had at least some intent to die?". Participants could respond with "Never" (scored 0), "Once" (1), "Twice" (2), "Three or four times" (3), or "Five or more times" (4). Frequency of participant responses to

the two SITBI items, the suicide ideation composite, and number of lifetime suicide attempts, can be seen in Figure 1.

Figure 1

Past-year suicide ideation and lifetime suicide attempts in the sample



Note. Figure reproduced with permission from Moseley et al. (2022, *Molecular Autism*). Part A displays responses to two items from the SITBI, the sum of which comprises our past-year suicide

ideation composite score (Part B). Part C shows number of lifetime suicide attempts reported in our sample.

Covariates and additional mediators: Depressive and anxious symptoms

As additional variables relevant to suicidality, we included depression and anxiety as covariates and extra mediators in our analyses. These were measured with the Patient Health Questionnaire (PHQ-9[69]) and the Generalised Anxiety Disorder-7 (GAD-7[70]) respectively.

Analysis

Firstly, we examined the data for each variable and outcome measure for outliers, normality, autocorrelations, and homoscedascity and normal distribution of residuals. We then performed mediation analyses using PROCESS for SPSS (version 3),[71] a macro based on ordinary least squares regression with bootstrapping (5000 samples). In each instance, we set confidence intervals at 95%, and controlled for age and sex as covariates.

Data was standardised for all analyses with PROCESS, though confidence intervals are generated in unstandardised form; as such, we present both standardised and unstandardised coefficients for each model. Our first set of analyses focused on thwarted belongingness and perceived burdensomeness. We used our binary measure of likely ADHD in two mediation analyses (adjusting alpha levels, $p = .025$): in these, we examined indirect effects of this binary predictor on past-year suicide ideation and then lifetime suicide attempts. Thwarted belongingness, perceived burdensomeness, depression and anxiety were included as parallel mediators in this model (Model 4 in PROCESS). Indirect effects and their confidence intervals are presented in unstandardised and in partially standardised form (full standardisation is not possible or indeed recommended for dichotomous predictors).[71]

Our second set of analyses, focusing on pathways to acquired capability via painful and provocative events, used the sequential mediation model (Model 6). Controlling for all the variables in the previous analyses (anxiety, depression, thwarted belongingness and perceived burdensomeness) in addition to age and sex, we examined distinct pathways between ADHD feature domains and lifetime suicide attempts via exposure to painful and provocative events (first mediator) and then acquired capability total score (second mediator). We hypothesised that this pathway would be specific for Hyperactivity/Restlessness and Impulsivity/Emotional Lability (henceforth Hyperactivity and Impulsivity) features, but to confirm this specificity, the analysis was also performed for the Inattention/Memory domain (henceforth Inattention). Alpha levels for these three analyses were corrected to p = .017. Indirect effects and their confidence intervals are presented in unstandardised and standardised form, along with the upsilon statistic as a reflection of effect size.[72]

Results

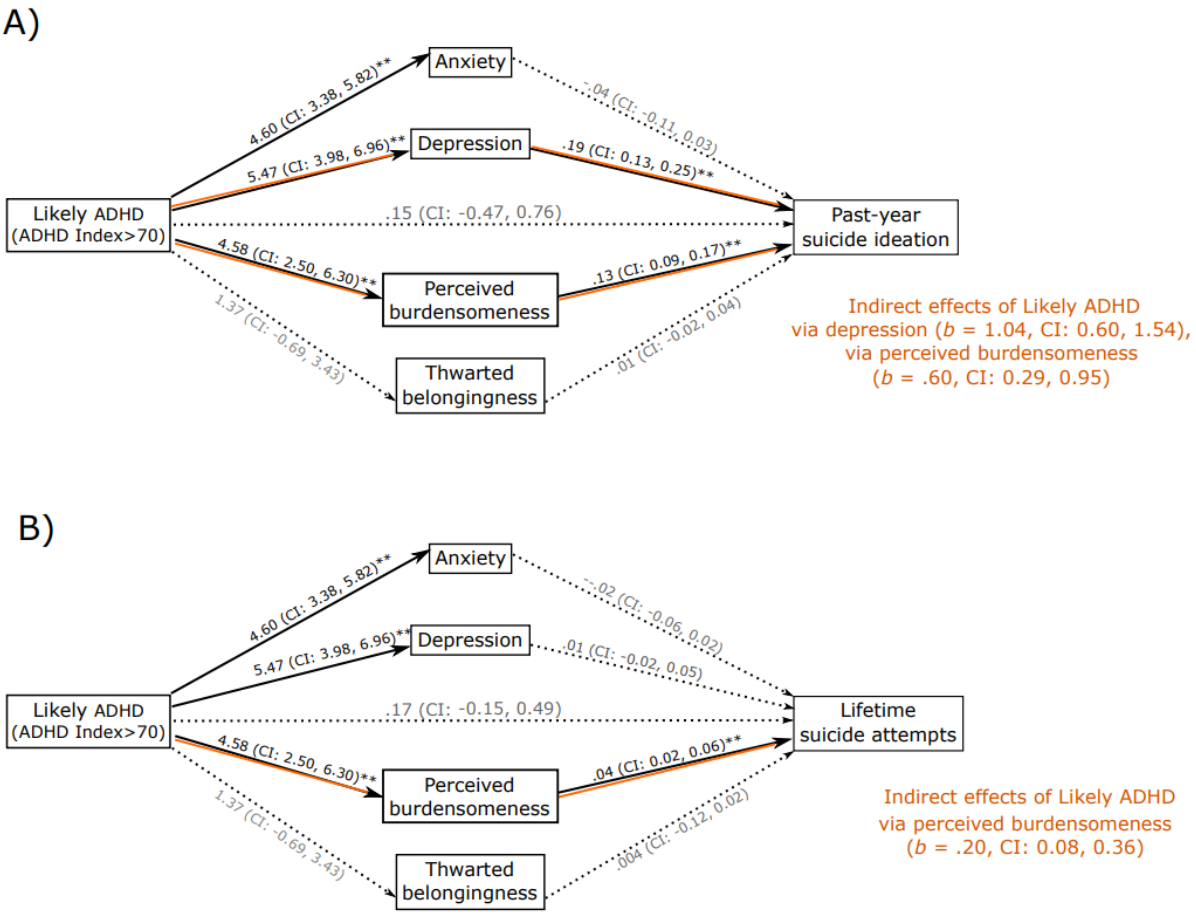
Co-occurring ADHD, thwarted belongingness and perceived burdensomeness

Our binary index of likely ADHD was associated with greater anxiety (b = 4.60 [β = .78], p < .001, CI: 3.38, 5.82), depression (b = 5.47 [β = .76], p < .001, CI: 3.98, 6.96) and perceived burdensomeness (b = 4.58 [β = .48], p < .001, CI: 2.50, 6.30), though *not* thwarted belongingness (b = 1.37 [β = .15], p = .1920, CI: -0.69, 3.43). Perceived burdensomeness (b = .13 [β = .37], p < .001, CI: 0.09, 0.17), depression (b = .19 [β = .41], p < .001, CI: 0.13, 0.25), and sex (with being female associated with greater likelihood of suicide ideation: b = -.82 [β = -.11], p = .0128, CI: -1.47, -0.18) all contributed to the model for past-year suicide ideation (R^2 = 0.46, F (7, 306) = 37.71, p < .001), though anxiety (b = -.04 [β = -.06], p = .3011, CI: -

0.11, 0.03) and thwarted belongingness (b = .01 [β = .03], p = .5302, CI: -0.02, 0.04) did not. Likely ADHD did not directly predict greater suicide ideation (b = .15 [β = .04], p = .6399, CI: -0.47, 0.76), but a significant total effect (b = 1.62 [β = .48], p < .001, CI: 0.89, 2.35) reflected that mediation was occurring. In this way, likely ADHD was associated with suicide ideation via greater depression (unstandardised effect b = 1.04 [bootSE = .24], bootstrapped CI: 0.60, 1.54; when partially standardised, b = 0.31 [bootSE = 0.07], bootstrapped CI: 0.18, 0.45) and stronger feelings of burdensomeness (unstandardised effect b = .60 [bootSE = .17], bootstrapped CI: 0.29, 0.95; when partially standardised, b = 0.18 [bootSE = 0.05], bootstrapped CI: 0.09, 0.28).Relationships between variables (unstandardised) are depicted in Figure 2, part A).

Figure 2

Associations between co-occurring ADHD, thwarted belongingness, burdensomeness and suicidality



Note. Part A depicts associations between likely ADHD (predictor), anxiety, depression, perceived burdensomeness and thwarted belongingness (mediators), and past-year suicide ideation (outcome); Part B depicts the same variables but lifetime suicide attempts as the outcome variable. Unstandardised coefficients for significant associations are marked in bold lines with single asterisks (*) depicting significance below the corrected alpha level (p = .025); bold lines with double asterisks (**) reflect associations significant at p < .001, and dotted lines reflect relationships that were non-significant. Indirect effects (coefficients and confidence intervals) are unstandardised.

Only perceived burdensomeness (b = .04 [β = .31], p < .001, CI: 0.02, 0.06) and female sex (b = -.50 [β = -.16], p = .0041, CI: -0.84, -0.16) were directly predictive of lifetime suicide attempts (R^2 = 0.15, F (7, 296) = 7.44, p < .001), when this outcome was modelled as the dependent variable. While not predicting lifetime suicide attempts directly (b = .17 [β = .12],

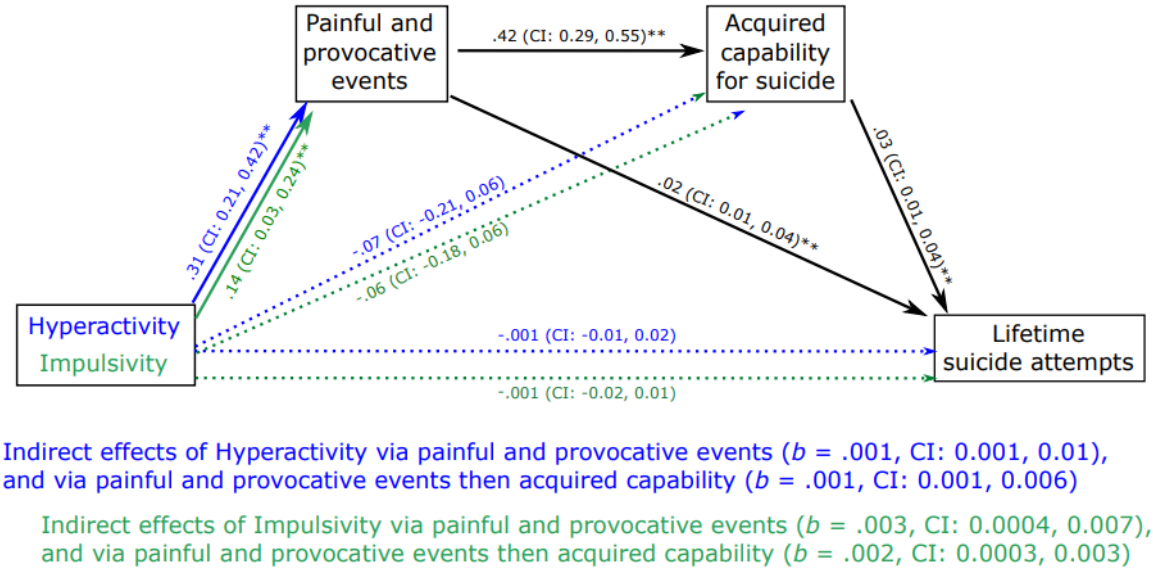
p =.2988, CI: -0.15, 0.49), a significant total effect of likely ADHD (b = .36 [β = .26], p = .0206, CI: 0.06, 0.67) reflected an indirect relationship where likely ADHD was associated with more numerous suicide attempts via its association with greater feelings of burdensomeness (unstandardised effect b = .20 [bootSE = .07], bootstrapped CI: 0.08, 0.36; when partially standardised, b = .15 [bootSE = 0.05], bootstrapped CI: 0.06, 0.26) (Figure 2, part B).

ADHD feature domains, painful and provocative events and acquired capability

With three analyses, we then examined effects of Hyperactivity, Impulsivity and Inattention as predictors of painful and provocative events, acquired capability and lifetime suicide attempts sequentially (Figure 3 depicts unstandardised coefficients reflecting relationships between variables). Hyperactivity was significantly associated with painful and provocative events as the first mediator (b = .31 [β = .34], p < .001, CI: 0.21, 0.42; R^2 = 0.23, F (7, 304) = 12.71, p < .001). It was not directly associated with acquired capability (b = -.07 [β = -.07], p = .2596, CI: -0.21, 0.06), which was predicted by PPES scores (b = .42 [β = .34], p < .001, CI: 0.29, 0.55; R^2 = 0.29, F (8, 303) = 15.20, p < .001).

Figure 3

Associations between ADHD feature domains and lifetime suicide attempts



Note. Figure 3 depicts two separate mediation analyses, one with Hyperactivity (blue) as the predictor, the other with Impulsivity (green) as the predictor. Lines in black reflect relationships between painful and provocative events, acquired capability and lifetime suicide attempts with coefficients from the Hyperactivity analysis. Double asterisks represent unstandardised coefficients significant at p < .001; single asterisks represent unstandardised coefficients significant below the corrected alpha level (p = .017). Indirect effects (coefficients and confidence intervals) are unstandardised.

Both PPES scores (b = .02 [β = .16], p = .0087, CI: 0.01, 0.04) and acquired capability (b = .03 [β = .26], p < .001, CI: 0.01, 0.04) contributed to the model for lifetime suicide attempts (R^2 = 0.24, F (9, 302) = 10.62, p < .001). Hyperactivity did not directly predict lifetime suicide attempts (b = .001 [β = .001], p = .8777, CI: -0.01, 0.02) but was associated with this outcome via two indirect pathways. Firstly, Hyperactivity was associated with increased exposure to painful and provocative events, which in itself predicted more

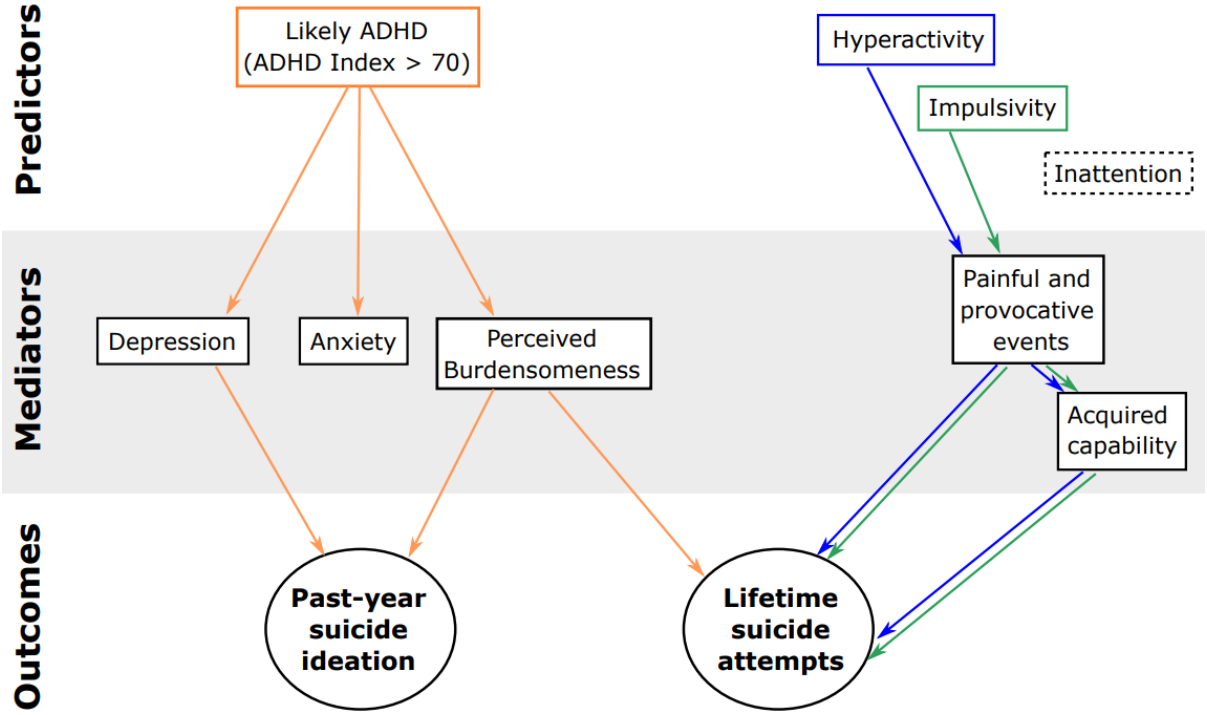
numerous suicide attempts (unstandardised b = .001 [bootSE = .003], bootstrapped CI: 0.001, 0.01; standardised β = .05 [bootSE = 0.03], bootstrapped CI: 0.01, 0.11; υ = .003). Secondly, in a sequential mediation effect, Hyperactivity was associated with increased exposure to provocative events, with greater acquired capability, and through these with more numerous suicide attempts (unstandardised b = .001 (bootSE = .001], bootstrapped CI: 0.001, 0.006; standardised β = .03 [bootSE = 0.01], bootstrapped CI: 0.01, 0.05; υ = .001).

Impulsivity functioned entirely similarly to Hyperactivity, being associated with painful and provocative events directly and being indirectly associated with lifetime suicide attempts via the same two indirect pathways (see Supplementary Materials for statistical notations and for covariate effects which were not the focus of this analysis). Inattention was not associated with painful and provocative events (b = .05 [β = .07], p = .2287) or acquired capability (b = -.06 [β = -0.07], p = .2107), and was not directly or indirectly associated with lifetime suicide attempts.

Our analyses focusing on relationships between suicidality, co-occurring ADHD and ADHD feature domains are summarised in Figure 4.

Figure 4

Summarised analyses of relationships between ADHD and suicidality



Note. Relationships between variables are summarised in Figure 4. Likely ADHD was positively associated with suicide ideation via perceived burdensomeness and depression; perceived burdensomeness also connected ADHD co-occurrence to lifetime suicide attempts. Finally, Hyperactivity and Impulsivity were associated with lifetime suicide attempts via increased exposure to painful and provocative events, and through this exposure and increased capability for suicide.

Discussion

Suicide is devastating for the individual and their families and community. There is a critical need for psychological theory to identify a parsimonious set of explanatory principles with

clear implications for prevention and intervention.[73] In line with previous efforts to test the relevance of ITS constructs to autistic suicidality,[32,33] the present study considered theory-derived hypotheses in relation to the heightened risk observed in autistic people with ADHD.[13,14] We primarily hypothesised a mediating role for thwarted belongingness and perceived burdensomeness in associations between likely co-occurring ADHD, suicide ideation and suicide attempts. Secondly, we considered an effect of hyperactive/impulsive features on painful and provocative events, acquired capability, and through these, lifetime suicide attempts.

Our first hypothesis was partially supported in so far as our binary index of likely ADHD was associated with greater anxiety, depression, and perceived burdensomeness; it was indirectly associated with greater likelihood of suicide ideation via its effects on depression and perceived burdensomeness, and indirectly associated with more numerous lifetime suicide attempts via perceived burdensomeness. The relationship between likely ADHD, anxiety, depression and perceived burdensomeness corroborates extant literature purporting poorer mental health, social and occupational outcomes in autistic people with ADHD.[16,46]

In relation to suicidality, studies in non-autistic people with ADHD suggested that the deleterious outcomes associated with ADHD might give rise to negative affect and through this, suicide ideation.[74] A single study in the general population examined this association in relation to the ITS, showing that the association between ADHD traits and suicide ideation was indeed mediated by higher scores in thwarted belongingness and perceived burdensomeness.[41] While the present study supports a mediating role for perceived burdensomeness, the apparent irrelevance of thwarted belongingness stands in contrast to these previous findings and those of Pelton et al.,[32] who previously found associations between this constructs and both suicide ideation and attempts. Notedly, as those authors did

not control for depression, the effect of thwarted belongingness they observed could have been confounded by depression. They do note, however, that autistic and non-autistic people differ in the way they interpret a couple of items from the INQ, such that the test may not work entirely similarly in these two groups; furthermore, apparently pathological scores in thwarted belongingness may be sadly less remarkable in autistic people,[75] given their typically smaller social networks. This may explain why thwarted belongingness was not especially associated with suicidality in the sample reflected herein and in Moseley et al. (2022),[33] and highlights the importance of developing adapted tools for testing hypotheses around suicidality in neurodivergent groups.

Our second hypothesis concerned with likely ADHD pertained to the association between impulsivity and painful and provocative events,[53,54] which are suggested to play an important role in the development of acquired suicide capability. This expectation was borne out, as both hyperactive and impulsive features were associated with acquired capability only through painful and provocative experiences; part of their indirect association with lifetime suicide attempts was realised via this sequential pathway. Though previous research is scarce in relation to the mechanisms that might underpin an association between ADHD feature domains and suicidality, these findings corroborate the relationship between hyperactive/impulsive features and a range of behaviours and outcomes that might serve to desensitise individuals to pain and fear of death, including NSSI,[57-59] abusing substances and other risky behaviours,[76] getting accidentally injured or involved in accidents.[77,78]

While we did not predict significant associations between inattentive features and our mediators, it is important to note that these features are, in fact, also associated with risky behaviour, accident and injury, and suicide itself in people with ADHD.[20,78,79] It is likely that this association is underpinned by different mechanisms, such as difficulties with cognitive control as opposed to sensation-seeking. In that that the PPES includes many events that are

"actively approached rather than passively experienced" and that these items are associated with sensation-seeking,[80] it is possible that hyperactive/impulsive features of ADHD were more likely to correlate with this instrument, despite rates of real-life accidents and injuries associated with inattentive features. It is possible that the different means through which autistic and non-autistic people with ADHD experience painful and provocative events also bear relevance to the impact of the same on acquired capability for suicide, but this query requires further, more extensive investigation.

Interestingly, although hyperactivity and impulsivity were associated with lifetime suicide attempts via painful and provocative events and acquired capability sequentially, they also exerted an indirect effect on lifetime suicide attempts via exposure to painful and provocative events alone. An intriguing parallel with this finding comes from Pelton and colleagues,[32] who observed an indirect effect of lifetime trauma on lifetime suicidality via acquired capability *and* a direct effect of lifetime trauma on suicidality. The consistency of this association across measurement tools – Pelton and colleagues used the Vulnerability Experience Quotient,[81] which is validated in autistic people – highlights the significance of this association, the mechanisms of which are still unknown.

In this analysis, depression and anxiety were controlled for as covariates, but exposure to painful and provocative events might plausibly be associated with lifetime suicide attempts via their impact on psychiatric health. Recent studies have examined the apparent elevation of PTSD or complex PTSD in autistic people, finding that post-trauma symptoms are associated with a wider range of events than those traditionally associated with PTSD.[82-84] Indeed, autistic and non-autistic authors are increasingly recognising the damage incurred by aspects of 'simply' living in the world as a neurodivergent person, including the chronic stress associated with victimisation, social marginalisation, and sensory discomfort and/or pain.[85,86] Trauma, and rumination, have indeed been purported as the mediators of relationships

between autistic traits and mood disorder in the general population[87]; the same research group reported an association between lifetime suicidality, depression and rumination.[88] The autistic community have highlighted research around the impact of stressful and traumatic life events as a priority,[89] and this is corroborated by the association between painful and provocative events and lifetime suicide attempts in our data, over and above effects via acquired capability.

As this finding cannot be clearly understood in light of the ITS, it is important to recognise that this is but one theoretical approach to suicidality, and future studies may benefit from consideration of a wider constellation of dynamic and stable factors.[90,91] One alternative, for instance, places greater emphasis on the balance between factors that "push" individuals towards suicide, chiefly pain (psychological and otherwise) and hopelessness, and factors that "pull" or anchor individuals to life, chiefly connections to friends and family, communities, and other valued things, roles or purposes.[92] This and other approaches provide testable hypotheses that, compared, could shed light on mechanisms underpinning suicidality in autistic people; more broadly, though, this kind of consideration of factors which make life unbearable and their relationship and relative weighting against the factors that make life worth living for autistic people may be of great clinical value. It is however important, as noted by Mitchell and colleagues,[93] to recognise the tendency of such models to focus principally on *intrapersonal* factors, which could divert attention from the very real damage incurred on the individual by systemic disadvantages and societal prejudices towards neurodivergent people. In that sense, interventions with such goals of supporting connectedness and reducing feelings of thwarted belongingness and perceived burdensomeness in the individual, may be ineffectual without commitment to meaningful change at a societal level.

Limitations and future directions

The primary limitation on conclusions drawn from this data rests on their cross-sectional nature, which disallows directional relationships to be inferred between our variables of interest. Mediation models are by nature suggestive of causality and the hypotheses derived from the ITS likewise assume directional relationships between variables, but cross-sectional designs do not allow us to affirm causal relationships between any of the variables as modelled herein.[94] This is particularly notable in light of the fact that non-fatal suicide attempts, themselves, are recognised as a potent means of accruing capability for future attempts.[24,95] As such, although associations between hyperactive/impulsive features, painful and provocative events and acquired capability appear compatible with ITS hypotheses, we cannot ascertain when suicide attempts occurred during the lifetime, and how these affected scores in these variables. Likewise, we cannot ascertain that thwarted belongingness and perceived burdensomeness preceded suicide ideation; sadly, experiences of suicide ideation and non-fatal attempts themselves affect social relationships, with some individuals experiencing alienation and shame,[96,97] that could, themselves, contribute to these apparently suicidogenic states. While cross-sectional studies can assist with preliminary hypothesis testing and highlighting areas of potential relevance, longitudinal designs are imperative to understand the development of these cognitive-affective states and their relationship to suicidality, and the development of suicide capability in response to real-life events.

The present findings come from the same sample described in Moseley et al. (2022),[33] and the same limitations of our sample are true. In that the sample was mainly British and largely Caucasian, the findings cannot be presumed to generalise to autistic people from other cultures and racial/ethnic groups. Similarly, as the sample primarily comprised cisgender autistic women with only a small proportion of autistic men (a smaller proportion of whom

scored above cut-off on the CAARS-S:S), effects of sex in the current study may be spurious and further research is needed to generalise findings to cisgender men more broadly. Transgender men, transgender women and people with non-binary and broader identities were likewise under-represented, and notably our survey (based on our limited awareness at the time of design), did not adequately differentiate between different transgender identities, such that the numbers presented do not adequately reflect different transgender identities - this is especially important to attend to in future studies, given that suicide risk may be even higher in neurodivergent trans and non-binary communities.[98] Other potentially marginalised aspects of identity, such as sexual orientation, are also important to measure and examine in future research. Other groups un- or under-represented here include autistic people with severe intellectual disability, as the study was accessible only to those able to respond to an online advertisement and complete an hour-long (approximately) online survey; for the same reason, those with lower literacy and computer literacy skills, were less likely to participate. Self-reported diagnoses were not validated by the researchers. Furthermore, although our advertisement did not mention ADHD specifically, the study may have been especially salient to individuals with experience of mental ill-health and suicidality, such that there may be a self-selection bias at play.

Limitations of our measures include our use of normative assessment tools for ITS constructs. Unfortunately, autism-adapted versions of these measures do not exist, so we cannot be sure that the present measures used in autistic populations actually capture the constructs intended by the original authors.[75] Even in the general population, there is a broader conceptual confusion around the nature and optimal assessment of certain constructs, like acquired capability.[99,100] Although we employed total ACWRSS scores as indicative of suicide capability in our sample, it is highly possible that the scope of this construct differs in neurodivergent people. The deeper meaning of constructs such as perceived burdensomeness,

thwarted belongingness and acquired capability as perceived and experienced by autistic adults, and whether autistic people themselves perceive these concepts as relevant and important to suicidality, is an important target for future research.

Our investigation operationalised "likely ADHD" by way of CAARS-S:S scores, but this tool was likewise not designed for use in autistic people, or to differentiate between the cognitive and emotional profiles associated with ADHD and autism. Other studies suggest that autistic people (without ADHD) tend to score more highly than neurotypical people on the CAARS family of tests, though their scores are still significantly lower than those of non-autistic individuals with ADHD.[101,102] Nevertheless, the suggested ADHD Index cut-off was based on general population norms and has not been ratified for use in autistic people. While it is highly likely that some participants had undiagnosed ADHD, we cannot ascertain whether participants above ADHD Index cut-offs would actually have met diagnostic criteria for ADHD. Future investigations should validate this co-occurrence with formal diagnostic tools, but if using screening tools, might consider those whose items map directly onto DSM criteria,[103] such that "likely ADHD" could be classified on the basis of meeting a sufficient number of diagnostic criteria. In addition, future research would benefit from including a comparison group of non-autistic people with ADHD to examine shared mechanisms for suicidality alongside additive effects of co-occurring ADHD and autism. Future research would also benefit from greater scrutiny of variables common to both people with ADHD and autistic people – such as broader psychopathology and substance abuse,[2,17,18] socioeconomic and educational disadvantage,[104,105] – all of which have relevance to everyday difficulties faced by autistic and non-autistic people with ADHD,[106-109] to suicidality and interpersonal and intrapersonal constructs fundamental to the ITS.[110-112] As we lacked control groups and more extensive consideration of such extraneous variables, we cannot confirm that the associations we observed are indeed particular to co-occurring ADHD within the autistic

population, or delineate whether these effects are associated with intrapersonal features or other consequences of living as an autistic person with ADHD.

Finally, while our analysis focused mainly on mechanisms associated with hyperactive-impulsive feature domains, future investigations should explore the explanatory pathways between inattentive features and suicidality in autistic and non-autistic people with ADHD. There is a potential intersection of interest here in relation to sex and late diagnosis, both variables of significance to suicidality (see, for e.g., recent literature [1,13,113]). In non-autistic people with ADHD, cisgender women and girls are more likely to present with primarily inattentive features,[114] a profile which, aside from sex, is associated with longer duration of ADHD going unrecognised,[115] often to the detriment of the individual.[35,116,117] There is some suggestion that autistic people are more likely to show a combination of hyperactive/impulsive and inattentive features,[118,119] though it is entirely possible that inattentive features are likewise under-recognised in autistic girls, women and people assigned female at birth (AFAB). In relation to suicidality, we know that the girls, women and AFAB people who receive a diagnosis of autism or ADHD are more likely to exhibit psychiatric conditions and visibly severe difficulties.[120-122] As we controlled for sex and used CAARS-S:S scores as indicative of co-occurring ADHD, the present study cannot speak to this issue, but as other studies have reported that suicide attempts are higher in autistic women with ADHD than any other group,[13] the intersectionality of age at diagnosis, feature profile and sex and gender may be important for future study.

Conclusion

Our findings suggest that constructs from the ITS may bear partial relevance to heightened suicidality in autistic people with co-occurring ADHD. Most particularly, we

found that perceived burdensomeness mediated the association between suicide ideation, suicide attempts, and our binary indication of co-occurring ADHD. Furthermore, that a relationship between hyperactive/impulsive features and lifetime suicide attempts was mediated by greater exposure to painful and provocative events and acquired capability sequentially. In that ITS constructs appear relevant to suicide in autistic people, future investigations should validate how these constructs are experienced and how they can be accurately assessed within longitudinal designs. However, the nature of a relationship between hyperactive/impulsive features via painful and provocative events alone also supports the importance of investigating other theoretical approaches, and pathways between traumatic events and suicidality.

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Authorship Confirmation Statement

Quantitative data were collected and analysed by Dr Moseley, the primary author of the manuscript, with support for recruitment from Ms. Smith, Dr Allison and Professor Baron-

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