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A prospective examination of sleep chronotype and future suicide intent among adults in the United Kingdom: A test of the integrated motivational volitional model of suicide

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ABSTRACT

Objectives/background: Prior research identified a connection between evening chronotype and suicidality, but the mechanism underlying that connection is not well understood. The Integrated Motivational Volitional (IMV) Model of Suicide may provide a theoretical explanation for this link. The current project includes a three-time point longitudinal survey to examine whether 1) suicide intent likelihood varies across time, 2) chronotype affects suicide intent likelihood prospectively, and 3) defeat and entrapment explain the association between chronotype and suicide intent likelihood.

Patients/methods: Participants (n = 187 UK adults) completed a baseline survey (demographics, chronotype (morning-eveningness; MEQ), defeat and entrapment, and perceived intent to make a future suicide attempt), and follow-up surveys (MEQ and suicide intent likelihood) 3 and 6 months later.

Results: Results indicated that suicidal intent at 6-month follow-up was lower than baseline or 3-month follow-up. It was also found that strong evening chronotype at baseline is associated with increased suicidal intent 6 months later, and that defeat mediates this relationship.

Conclusion: Our theoretically informed findings shed light on the psychological mechanisms linking chronotype (i.e., eveningness) and future suicide intent by highlighting the role of defeat and entrapment. We propose that feelings of defeat might be derived from evening types' experiences of social jetlag (resulting from conflict between biologically driven sleep schedules and externally dictated social schedules), which consequently drives entrapment and greater future suicide intent. Within this context, defeat and entrapment may be good transdiagnostic and modifiable target variables for future intervention development.

1. Introduction

Suicidal and self-harming behaviours (SSHBs) represent a major global public health concern with over 700,000 people dying from suicide every year [1]. In addition, it is estimated that for every person who dies by suicide, there are an additional 20–40 individuals who will engage in SSHBs [2,3]. Assessments of suicidality often rely on identification of more distal, or unmodifiable, risk factors such as personal and family attempt history, psychopathology, childhood adversity, and sociodemographic status. Yet there remain unacceptable levels of specificity and sensitivity when trying to predict who are at an increased risk of SSHB [4]. As a result, there has been an increasing focus on investigating more specific and modifiable markers of risk [5] which can inform and augment intervention and prevention efforts.

Within the field of suicidology, this has led to an emphasis on theoretical frameworks which will allow us to understand the processes resulting in a person experiencing suicidal thoughts and subsequently translating these into behaviours (i.e., ideation-to-action frameworks [6]). Importantly, these frameworks allow an examination of how proximal and dynamic risk factors might be linked to suicidality. However, although there is an established evidence base showing a strong association between clinically salient sleep problems and suicide (e.g., Ref. [7,8]), we still do not fully understand the mechanisms which might explain why this relationship exists.

Studies have repeatedly shown a significant positive association between various sleep problems (e.g., nightmares, insomnia, sleep

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chronotype) and SSHBs across multiple populations (e.g., Ref. [9,10]), but few studies have explored these relationships longitudinally (e.g. Ref. [11]). In addition, studies which have attempted to explore the relationship between sleep problems and SSHBs in the context of theory, have primarily done so cross-sectionally (e.g., Ref. [12–14]). Considering that suicide risk is dynamic (e.g. Ref. [15]) it is important to ensure that any attempt to understand the mechanisms explaining SSHBs also consider the relationships over time. Much literature has focused specifically on those sleep parameters which might be impacted by sleep hygiene interventions (e.g., insomnia); however, these interventions rarely account for the relatively well-fixed physiology behind chronotypes. There is therefore a need to further explore the important link between sleep chronotypes and SSHBs in the context of theories, such as the Integrated Motivational Volitional (IMV) Model of Suicidal Behaviour [16,17], which might suggest other avenues for interventions.

Chronotype refers to an individual's circadian preference and reflects the physiological arrangement of the circadian system [18]. It is most variable in adolescence and later life but is believed to be relatively stable during adulthood [19]. Researchers generally study chronotype in terms of self-assessed "morningness-eveningness" preferences [20]. Individuals who have a clear preference to function and engage in activities in the evening are described as having an evening chronotype. This trait is associated with circadian phase delay and is linked to a number of adverse outcomes including lower mood (e.g. Ref. [21]), increased substance use [22], increased all-cause mortality (e.g. Ref. [23]), and SSHB [24–26].

Given the consistently highlighted link between eveningness and negative outcomes, there may be value in examining how psychological factors impact the mechanisms underlying the relationship. Littlewood, Kyle, Pratt, Peters & Gooding [27] conducted a systematic review of the role of psychological variables in the relationship between sleep difficulties and SSHB and concluded that it is important to consider these variables within the context of theory, as such work may offer important insights which can serve to support intervention development going forward.

The IMV is a tripartite ideation-to-action framework which recognises that in order for us to better understand suicide, we must move beyond focussing on psychiatric categories. Core to the model is the experiences of defeat and entrapment. Specifically, defeat refers to a perceived sense of failed struggle in relation to the loss or disruption of some valued status, whilst entrapment is characterised by an individual's perception of their circumstances as being inescapable. There is an emerging evidence base which has indicated the value of distinguishing between internal (i.e., feeling trapped in one's own thoughts and beliefs) and external (i.e., feeling trapped in one's external circumstances and relationships) experiences of entrapment within the context of the IMV (e.g., Ref. [28,29]). This distinction might be particularly pertinent when trying to understand the link between sleep problems and suicide on the basis that an adequate quality and quantity of sleep is crucial for emotion regulation [30,31].

So far, the studies, which have examined the psychological mechanisms highlighted within the IMV in the context of sleep, have identified some clear pathways to SSHBs; however, to date none of these have specifically focussed on sleep chronotype. Littlewood et al. [13] explored defeat, entrapment, and hopelessness in the context of the relationship between nightmares and suicidal behaviours in a sample who had experienced trauma and symptoms of posttraumatic stress disorder (PTSD). They found that nightmares were both directly and indirectly associated with suicidal behaviours, through perceptions of defeat, entrapment, and hopelessness. Similarly, Hochard, Heym and Townsend [32] found that entrapment interacted with both nightmares and insomnia to predict SSHB in a sample of adults. In a study of the link between insomnia/nightmares and suicidal ideation in adolescents, Russell et al. [14] found that perceptions of both defeat and entrapment were elevated in young people who reported clinically salient insomnia and/or nightmares, relative to those who did not. In addition, it was found that the relationship between insomnia and suicidal ideation was fully mediated by perceptions of defeat and entrapment, whereas nightmares were indirectly associated with suicidal ideation through perceptions of defeat and entrapment.

1.1. The present study

Given the role of defeat and entrapment in the context of the insomnia/nightmare and suicidality relationship, examining the potential multistep pathways linking sleep chronotype and suicidal intent via perceptions of defeat and entrapment is warranted. This is particularly the case on the basis that research is still unclear on how modifiable chronotype is, and therefore, interventions directed at cognitive factors such as defeat and entrapment, may allow for further intervention development in the future. With that in mind, the research questions (RQs) of the current study were.

RQ1: Does suicide intent likelihood vary across time?
RQ2: Does baseline chronotype affect suicide intent likelihood prospectively?
RQ3: Do entrapment and defeat explain the association between chronotype and suicide intent likelihood prospectively?

2. Method

2.1. Participants

Table 1 contains information about sample demographic, morning-eveningness, and suicide characteristics. The sample was of young-to-middle adult average age, and predominantly white. Although mostly comprised of cisgender women and heterosexual persons, the sample was quite diverse with respect to gender identity and sexual orientation. Employment status was mixed between primarily students, as well as full-time and part-time workers. Education level was relatively diverse with the highest subgroup attaining a bachelor's degree. Average defeat and entrapment scores were consistent with prior UK community-based adult data in the literature (e.g. Ref. [33]). Average suicide attempt likelihood scores across time-points fell in a range between no chance at all and rather unlikely [34]. All morning-eveningness scores fell in the intermediate (i.e., not morning or evening leaning) range [35].

2.2. Procedures

A university Ethics Review Board in the United Kingdom provided approval for this study. As part of the ethics process all participant facing documents (i.e., study information sheet, consent form, recruitment materials, surveys, and debriefing sheets) were reviewed by the ethics review board prior to approval. Inclusion criteria included (a) being 16 years or older, and (b) living in the UK. These criteria were informed by UK law governing the age of consent to participate in research is 16 years of age []; therefore, parental consent was not required for persons 16–18 years of age who took part in the study. No restrictions were placed on participation based on suicide or mental health histories. Study recruitment took place virtually through social media platforms (e.g., Facebook, Twitter) and the university research participation platform. Regardless of recruitment source, interested persons clicking on the research link or QR code were led to a study information sheet summarizing study goals, procedures, risks, and other pertinent details. The study information summary also contained contacts for mental health resources (e.g., Samaritans). Affirmation of consent was provided by clicking yes to provide consent before commencing the study. As a result, the consent process was not witnessed by anyone as all engagement with the research process was controlled by the participant and could be completed at a time and place of their choice,. Community-based participants received no compensation for the study; university students received course research credit. After completion of the

Table 1
Sample demographic information (N = 187).

Variable	*n* (%)	*M* (*SD*)
Gender identity		
Cisgender man	41 (21.9)	–
Cisgender woman	119 (63.6)	–
Transgender man	5 (2.7)	–
Non-binary	6 (3.2)	–
Queer	1 (.5)	–
Do not know	1 (.5)	–
Multiple identities endorsed	14 (7.5)	–
Sexual orientation		
Heterosexual	127 (67.9)	–
Gay	5 (2.7)	–
Lesbian	1 (.5)	–
Bisexual	28 (15.0)	–
Queer	8 (4.3)	–
Questioning	6 (3.2)	–
Other (non-specified)	10 (5.3)	–
Not sure	1 (.5)	–
Decline to state	1 (.5)	–
Race/ethnicity		
White	181 (96.8)	–
Asian	1 (.5)	–
Arabic	1 (.5)	–
Multi-racial	3 (1.6)	–
Other (not specified)	1 (.5)	–
Employment status		
Full-time employment	78 (41.7)	–
Part-time employment	29 (15.5)	–
Self-employed	8 (4.3)	–
Student	56 (29.9)	–
Retired	7 (3.7)	–
Unemployed	9 (4.8)	–
Highest education		
Primary education	2 (1.1)	–
Secondary education	20 (10.7)	–
Post-secondary education (e.g., college, A-levels)	33 (17.6)	–
Vocational qualification (e.g., certificate)	23 (12.3)	–
Undergraduate/bachelor's degree	69 (36.9)	–
Master's degree	33 (17.6)	–
Doctoral degree	7 (3.7)	–
Age	–	33.45 (13.01)
Defeat	–	26.73 (15.09)
External entrapment	–	13.04 (10.41)
Internal entrapment	–	8.84 (7.69)
Baseline suicide attempt likelihood	–	1.67 (1.56)
3-month suicide attempt likelihood	–	1.66 (1.50)
6-month suicide attempt likelihood	–	1.51 (1.53)
Baseline morning-eveningness	–	46.38 (10.54)
3-month morning-eveningness	–	46.82 (10.12)
6-month morning-eveningness	–	47.45 (10.57)

Notes: N = 187; n = Subsample size; M = Mean; SD=Standard deviation.

baseline survey, participants indicated whether they were interested in participating in follow-up survey at 3- and 6-month follow-up. In response to a debriefing form summarizing the study goals, those persons provided email addresses in response to an open-ended prompt in order to keep email addresses separate from survey responses. The debriefing form also contained contact information for mental health resources.

Follow-up surveys focused solely on suicide and sleep related measures. Follow-up contacts were emailed directly to participants with a maximum of two follow-ups. Participant data were linked via a randomly assigned study ID number. The baseline survey administration, which was part of a larger study (Cramer et al., in press), required a maximum of 30 min to complete, with subsequent time-points requiring no more than 10 min per follow-up survey. The debriefing form at each time-point also included research team contact information and mental health support resources. In total, recruitment took place over the course of one academic year. Email addresses were deleted upon completion of data collection in order to maintain data privacy and anonymity.

2.3. Measures

2.3.1. Demographics

Demographics were collected at baseline only. A participant self-report information sheet collected the following demographic data: age, gender identity, sexual orientation, race, employment, and education status. Response options allowed participants to select more than one identity for gender, sexual orientation, and race.

2.3.2. Chronotype

Chronotype, or morning-eveningness, was measured at all three study time-points. The Morningness-Eveningness Questionnaire (MEQ [35]) contains a series of 19 questions capturing information about a person's sleep-wake cycle patterns. Each question provides a set of four or five response choices, with each response choice having a respective point value. Responses are summed for a total score, with subsequent morning-eveningness range ratings being calculated based on cut-scores (e.g., score of 31–41 = moderate eveningness). The MEQ total score displays consistently acceptable internal consistency (α range = .80 to .82; [36,37]). Internal consistency values in the present study were .86 at baselines, .87 at 3-month follow-up, and .87 at 6-month follow-up.

2.3.3. Defeat

Defeat was assessed at baseline only. The Defeat Scale (D-Scale; Gilbert & Allan, 1998) contains 10 items capture general feelings of overwhelm or humiliation. Respondents use a five-point scale: 0 ("Not at all like me") to 4 ("Extremely like me"). After three items are reverse-scored, a summed total score is tabulated. Internal consistency values for the D-Scale are regularly high (αrange = .93 to .96) ([33]; Gilbert & Allan, 1998). Internal consistency in the present baseline sample was .96.

2.3.4. Entrapment

Entrapment was measured at baseline only. The Entrapment Scale (E-Scale; Gilbert & Allan, 1998) comprises 16 items assessing feelings of a lack of escape. Prior E-Scale psychometrics in the population of the present study supported a two-factor model of entrapment [33]. As such, we used the E-Scale to derive two subscales: internal entrapment (6 items) and external entrapment (10 items). Respondents use a five-point scale: 0 ("Not at all like me") to 4 ("Extremely like me"). E-Scale internal consistency values for internal (α = .95) and external (α = .93) entrapment in this population are acceptable [33]. Internal consistency values for the present sample were .93 for internal entrapment and .95 for external entrapment.

2.3.5. Suicide attempt likelihood

Suicide attempt likelihood was measured at all three time-points. Likelihood of making a future suicide attempt was assessed with a single item from the Suicidal Behaviour Questionnaire-Revised (SBQ-R [34]). The SBQ-R is a widely used 4-item screener of lifetime suicidal behaviour. Each of the four questions assesses a different aspect of past, recent or future behaviour on different response options. For instance, item 4 captures likelihood of making a future suicide attempt (i.e., "How likely is it you will attempt suicide someday?") along a 7-point (0 = never, 6 = very likely) scale. Although a summed total lifetime suicidal behaviours score consistently demonstrates good internal consistency (αrange = .82 to .88; [33,34]), we employed the single item to assess future suicide attempt likelihood. Such an approach is common in the literature (e.g., Ref. [38,39]), showing appropriate validity and utility in suicide research.

2.4. Data analysis

2.4.1. SPSS V.25 was used to conduct analyses addressing RQ1 – 3

For RQ1, a one-way repeated measures Analysis of Variance (ANOVA) was conducted to assess change in participant endorsement of

suicidal intent across baseline, 3-month follow-up, and 6-month follow-up. Effect size was calculated and interpreted using η_p^2 [40]. Consistent with best practices in statistical literature (e.g. Ref. [41]), where a significant omnibus test emerges, post hoc analyses were conducted. We used Fisher's Least Significant Difference (LSD) when the model only included three timepoints [42]. For RQ2, simple linear regression was used to assess the prospective impact of participant chronotype at baseline on suicidal intent at 6-month follow-up. Effect size was calculated and interpreted using R^2 [40]. For RQ3, a multiple parallel mediation using the Hayes [43] bootstrapping method (PROCESS function, model 4, 5000 bootstrapped samples) was used to test the relationship between participant chronotype at baseline and suicidal intent at 6-month follow-up in the presence of baseline measures of external entrapment, internal entrapment, and defeat (E− and D Scales). Percentile bootstrap confidence intervals (PBCI) were calculated due to their robustness against inflation of type I error rates [44]. A significant indirect effect was deemed present when the 95 % confidence interval did not include absolute 0 [43]. Standardized coefficients were used to quantify the effect size of each path [45] and R^2 was used to interpret the unique variability in suicidal intent at 6-month follow-up accounted for by significant mediators.

3. Results

3.1. RQ1: does suicidal intent vary across time?

Omnibus test results indicated that suicidal intent varied significantly across time points with a small effect size, $F(2, 372) = 3.058$, $p = .048$; $\eta_p^2 = .016$. As the omnibus test was significant, post hoc analysis was performed. Post hoc analysis using Fisher's Least Significant Difference (LSD) showed that while there was not a significant difference between suicidal intent at baseline ($M = 1.674$, $SD = 1.564$) and three-month follow-up ($M = 1.663$, $SD = 1.499$), six-month follow-up endorsement ($M = 1.513$, $SD = 1.532$) was significantly lower than both baseline and the three-month marks ($p = .034$ and $p = .025$, respectively).

3.2. RQ2: does baseline chronotype affect suicidal intent prospectively?

Results indicated that baseline chronotype was associated in a prospective fashion with suicidal intent at 6-month follow-up with a small to medium effect size, $F(1, 182) = 12.876$, $p < .001$; $R^2 = .061$. Directionality suggests that as chronotype becomes more evening, endorsement of suicidal intent increases.

3.3. RQ3: do entrapment and defeat explain the association between chronotype and suicidal intent prospectively?

Results indicated that the total effect of chronotype on suicidal intent was significant, the direct effect was not, and indirect effects are present (Fig. 1).

The A paths revealed a significant effect of chronotype on the mediators, such that as participant chronotype becomes more evening, their endorsement of external entrapment, internal entrapment, and defeat increases (see Table 2). The B paths revealed a significant effect of defeat on the suicidal intent, such that as endorsement of defeat increases, suicidal intent increases; external and internal entrapment were not significant predictors of suicidal intent (see Table 2). The C path revealed a significant total effect of chronotype on the suicidal intent, such that as participant chronotype becomes more evening, their endorsement of suicidal intent increases (see Table 3). The direct effect in path C' was not significant, indicating that the total effect of chronotype on suicidal intent disappears in the presence of external entrapment, internal entrapment, and defeat, which suggests these factors as full mediators for path C as an indirect effect (see Table 3). However, as indicated by 95 % CIs, the only significant indirect effect from chronotype to suicidal intent was through defeat[1] (see Table 4).

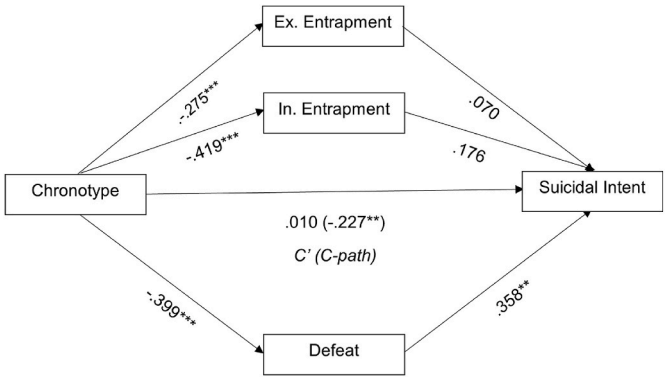

Fig. 1. Multiple Parallel Mediation Full Path Relationships Using Standardized Coefficients

Note. *p*-values indicated as: * = <.05, ** = <.01, *** = <.001. Full mediation of the relationship between chronotype and suicidal intent is present at a small to medium effect size. The significant total effect, *C*, turns into a non-significant direct effect, *C'*, in the presence of the mediators (see Table 3). The mediation is carried by defeat only (see Table 4).

Table 2
A and B path relationships using standardized coefficients.

Paths	*beta*	*t*(N)	*p*
Chronotype to Ex. Entrapment	−.275	−3.889 (187)	<.001
Chronotype to In. Entrapment	−.419	−6.285 (187)	<.001
Chronotype to Defeat	−.399	−5.931 (187)	<.001
Ex. Entrapment to Suicidal Intent	.070	.637 (187)	= .525
In. Entrapment to Suicidal Intent	.176	1.245 (187)	= .215
Defeat to Suicidal Intent	.358	2.90 (187)	= .003

Table 3
Total and direct effects using standardized coefficients.

Effect	*beta*	*t*(N)	*p*	LLCI	ULCI
Total (C)	−.227	−3.164 (187)	= .002	−.054	−.012
Direct (C')	.010	.141	= .888	−.018	.021

Note. Results indicate full mediation; total effect is significant, while direct effect is not. LLCI = Lower Limit Confidence Interval; ULCI = Upper Limit Confidence Interval.

4. Discussion

Previous research has highlighted a link between various sleep pa-

Table 4
Indirect effects using standardized coefficients.

Mediator	*beta*	*SE*	LLCI	ULCI
Ex. Entrapment	−.019	.046	−.327	.052
In. Entrapment	−.074	.062	−.201	.044
Defeat	−.143	.062	−.272	−.027

Note. Results indicate mediation through defeat only; confidence interval crosses zero for external and internal entrapment, while it does not for defeat. LLCI = Lower Limit Confidence Interval; ULCI = Upper Limit Confidence Interval.

[1] The unique variability in suicidal intent accounted for by each mediator pathway was approximately: Defeat = 3.6 %, External Entrapment = .7 %, and Internal Entrapment = 1.0 %.

rameters and suicidality but has mostly done so cross sectionally, and little of this work has been theoretically derived. We therefore examined the prospective association between sleep chronotype and suicidal intent in a community sample of UK adults and explored the role of theory in this context. In relation to our first RQ (RQ1), we found that suicidal intent varied across the time points with a significant difference from baseline and the first follow-up point until the final follow-up. This is in line with past research which has confirmed that suicidal ideation, intent, and behaviours are not homogenous and will vary in their duration, frequency, and severity both within as well as between individuals (e.g., Ref. [46,47]). For instance, suicidal ideation may remit within 6-month periods (e.g. Ref. [48]); moreover, baseline suicidal intent in particular may only be predictive of later intent at, or stable over, short time frames (e.g., within 2–3 h [46]). The slight decline in suicidal intent observed in the present study occurred without intervention, and fits with this existing body of literature.

When examining whether baseline chronotype predicted suicidal intent over time (RQ2), we found that with an increase in eveningness, there is a corresponding increase in suicidal intent over time. This finding is of interest for a number of reasons. Firstly, this is an established relationship within the clinical literature (see e.g. Ref. [49], for a review); however, our findings highlight that focussing on person specific sleep preferences within non-clinical samples may be equally important. When considering these findings in the context of what that might mean for the potential for this suicidal intent to be translated into behaviours, it is worth noting evidence which suggests that eveningness is associated with higher levels of impulsiveness [26,50]. In the context of suicide theory, the IMV model recognises that impulsivity is a key volitional moderator impacting the suicidal ideation to behaviour relationship, and, thus, it is possible that an eveningness chronotype has the potential to impact the transition to thoughts and subsequent behaviours at different points.

Second, there may be clinical and research implications to be considered based on eveningness being associated with worse suicidal intent. For instance, a leading short-term suicide risk management technique concerns forming collaborative crisis response plans in order to reduce imminent risk and enhance supportive protective factors (e.g., Ref. [51,52]). Moreover, leading suicide-specific therapies often address underlying problems or contributing factors (e.g., sleep disturbance). Where eveningness is a significant part of the clinical picture, intervention strategies redressing eveningness and its associated problems (e.g., sleep disturbance) may need to be integrated into crisis response plans or long-term therapy. Emerging sleep and eveningness treatment literature suggests such intervention strategies may include psychoeducation on sleep health, specific sleep medicine visits, motivational interviewing, chronotherapy, or cognitive-behavioral therapy for insomnia (e.g., Ref. [53,54]). Further clinical intervention research is needed to test sleep-focused interventions for suicide prevention, however [55].

The he study also investigated the extent to which the IMV model of suicide was able to provide any insights in the reasons why the relationship between sleep chronotype and suicidal intent might exist (RQ3). Our research adds to the existing literature which recognises that certain types of cognitions and perceptions mediate the relationship between sleep chronotype and adverse outcomes (e.g., Ref. [12,56,57]). We examined this process specifically within the context of the IMV by focussing on the self-reported experiences of defeat and entrapment. Previous research that has examined the relationship between various sleep parameters and suicidality have highlighted the utility of doing so within the context of the IMV [13,14,32].

Our research supports and extends these findings when applied specifically to chronotype. In particular, our findings demonstrate that defeat, a key motivational variable within the IMV model of suicide, mediates the relationship between baseline eveningness and suicidal intent 6 months later. Previous cross-sectional research has highlighted an association between eveningness and perceptions of defeat in a non-clinical sample [58]. However, this is the first investigation to examine this association prospectively and to explore this motivational cognition as a potential mediator underpinning the link between chronotype and suicidal intent.

It has been suggested that, rather than eveningness having an intrinsic detrimental effect on wellbeing, poorer mental outcomes experienced by those with an evening chronotype may be (at least partly) explained by the consequences of social jetlag – the misalignment between an individual's preferred sleep-wake patterns (i.e., their internal biological time) and socially-driven behavioural schedules (i.e., the external social clock) [12,59]. The experience of circadian misalignment or disruption of the internal biological clock and the externally dictated social clock is more pronounced in those endorsing an evening chronotype (Merikanto et al., 2012 [60]). Moreover, evidence suggests that persons with an evening chronotype routinely report poorer sleep quality and shorter sleep duration (hence chronic sleep restriction) (e.g. Ref. [61]). As such, social jetlag focussed research may provide a valuable future lens through which to investigate the chronotype-defeat pathway. To examine the hypothesis that social jetlag and its consequences (e.g., discordant biological versus social clock, sleep disturbance) mediates the link between eveningness and perceptions of defeat, future research should include a measure that captures sleep-related information on both free and constrained days to determine the misalignment between externally dictated requirements and preferred sleep–wake schedules (e.g., the Munich Chronotype Questionnaire [62]). This would also provide the opportunity to explore potential dose-dependent relationships in terms of social jetlag.

4.1. Strengths and limitations

The study provides a foundation for future research to apply a theoretical lens to our understanding of the sleep–suicidality relationship. Our findings offer novel insights into how sleep chronotype might be related to the development of suicidal intent and demonstrate that the experiences of defeat and entrapment are not specific to the experiences of nightmare and insomnia, and therefore adds weight to the growing evidence that defeat and entrapment are potential transdiagnostic constructs [33,63].

The results of the current study should be interpreted in light of some methodological limitations. Honest or accurate survey responding is a common limitation of online survey research [64]. While data quality procedures were employed during data cleaning (e.g., data cleaning based on response time, repeat IP address elimination; Cramer et al., in press), accuracy of some information is still a limitation of all online research. Findings should be interpreted with caution and replicated through future research as a result. Chronotype is a unique characteristic of an individual, and as a result, further research should employ different methodologies, to further expand our understanding of this construct in the context of suicidality. For example, circadian rhythm could be measured through actigraphy [65]. Also, cortisol could be measured through either saliva or hair (e.g. Ref. [66]) in future studies on chronotype, sleep disturbance, and suicide. Samples. In addition, we only measured defeat and entrapment at baseline. However, as these constructs appear to be subject to fluctuations over time [67], there might be a need to ensure that future research done to inform clinical practice repeats measurement of these as well as the core outcome measures. One method which may provide value in any investigation of the time course of constructs is ecological momentary assessments (EMA), which allow researchers to collect data at multiple times across a day, and within a person's natural environment [68–70]. If done in conjunction with objective measures of sleep chronotype, such work has the potential to overcome the known limitations of retrospective assessment of questionnaire-based studies. Finally, we recognise that we did not include any questions relating to medications use. Given that medications can impact sleep stages by either exacerbating the sleep problem or improving it therapeutically [71], it is important to ensure

that information about chronic medication use is recorded in future research.

5. Conclusion

Our study highlighted that sleep chronotype is linked to suicidal intent experiences over time. Importantly our study indicates that the relationship between sleep chronotype and suicidal intent is mediated by experiences of defeat. The findings of our study suggest that prompt identification of evening chronotype and subsequent feelings of defeat may pave the way for the prevention of future suicidality. Findings may be understood in terms of social jetlag due to a strong biologically driven preference for later bedtimes and rise-times. Importantly, our study highlights the value of a theoretical approach to understanding the link between sleep and suicidal intent and offers transdiagnostic mechanisms for future intervention and prevention efforts.

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CRediT authorship contribution statement

Susan Rasmussen: Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Conceptualization. **Joseph F. Chandler:** Writing – original draft, Formal analysis. **Kirsten Russell:** Writing – original draft. **Robert J. Cramer:** Writing – original draft, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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