Dynamics of despair: examining suicidal ideation using real-time methodologies

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CHAPTER 07:

Discussion

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In the previous chapters, we have explored the short-term temporal dynamics of suicidal ideation and the value of real-time assessment methods in the study of both suicidal ideation and its related risk and protective factors in daily life. Finally, in the previous chapter, we explored how this real-time data may be used to make predictions of individuals' suicide risk in the future. Here, we discuss how these findings fit within our greater understanding of suicidal ideation, consider the strengths and weaknesses of the methodologies used, and discuss directions for future research. Finally, we explore the promise of real-time monitoring approaches for clinical practice.

Ecological Momentary Assessment (EMA) in Suicide Research

The use of ecological momentary assessment (EMA) in mental health research in general, and suicide research specifically, has grown exponentially in recent years. A 2016 review of 669 e-mental health research articles (including EMA) concluded that 57% of the identified literature had been published in the previous five years (Firth et al., 2016). A more recent review of 35 articles on EMA in suicide research concluded that 74% of the studies had been published within the prior three years (Sedano-Capdevila et al., 2021). It therefore appears that pleas to increasingly focus on short-term timeframes when examining suicidal thoughts and behaviors (Bryan and Rudd, 2016; Franklin et al., 2017) have been heard and put into action – aided by the omnipresence of mobile phones and other commercial wearables in our modern society.

Considering the marked expansion of EMA in psychological research, concerns may arise that the feasibility and safety of such measures in at-risk populations has not been comprehensively assessed prior to such broad application. It should be noted, though, that a number of reviews have previously concluded that EMA is feasible and safe; EMA has been tested in a number of clinical populations, including those with anxiety (Walz et al., 2014) and depressive disorders (Colombo et al., 2019). Since then, these findings have been extended to patients with suicidal thoughts and behaviors (see **Chapter 2**, as well as Gee et al., 2020; Sedano-Capdevila et al., 2021 for reviews). Our examination of the acceptability, feasibility and safety of EMA in **Chapter 3** also largely supports these early conclusions, although two major points are discussed here that should be taken into consideration when designing EMA studies in suicide research.

Feasible – with Certain Limitations In **Chapter 2**, we reviewed EMA studies in suicide research and concluded that EMA appears feasible, even in this potentially challenging patient group. This is reassuring, considering that patients with more severe

mental health symptomatology may generally be less inclined to participate in scientific research (Sheridan et al., 2020), and be more likely drop out of longitudinal cohort studies (Lamers et al., 2012). Instead, we found evidence of high compliance to study assessments (i.e., EMA response rates), both in the prior literature (*Med* = 70%; **Chapter 2**) as well as in the present cohort (*Med* = 84%; Chapter 3). Likewise, attrition was low (*Med* = 6% in prior studies; **Chapter 2**, and 1% in our cohort during the EMA period; **Chapter 3**), giving further support for the feasibility of EMA among patients with suicidal symptoms.

It is evident, however, that recruitment remains a challenge for mental health research in general (Tranberg et al., 2023), and EMA studies in particular (Nuij et al., 2022). While patients with more severe symptomatology may feel less able to further exert themselves by taking part in scientific research (Sheridan et al., 2020), it is also known that the increased burden of EMA designs specifically may discourage potential participants (Bos, 2021). While our sample size (*N* = 82) was larger than the average of previous studies (*Med* = 50; **Chapter 2**), larger cohorts have also been assessed (e.g., *n* = 237 in Rogers, 2021). Once part of the study, however, it appears that the burden of repeated assessments does not impact data quality and quantity, at least within typical EMA designs (with an average duration of *Med* = 14 days; **Chapter 2**). However, missingness may become more apparent when researchers aim to extend electronic symptom monitoring to span many months, or even a year, as in the present study (**Chapter 6**). The reduction in response rates from our daily EMA (*Med* = 84%) to our weekly questionnaires (*Med* = 74%) was substantial, but response was still sufficient for analysis. Indeed, prior feasibility studies on digital assessments of suicidal ideation have only focused on short-term EMA, rather than symptom monitoring over longer timeframes. We are the first to employ such repeated (weekly) electronic assessments of suicidal ideation over an extended (12-month) period. Consequently, current conclusions from the field rightfully, and carefully, state that "it is feasible to apply *short-duration* [electronic symptom monitoring]" (van Genugten et al., 2020, p. 1). The feasibility of extended symptom assessments, therefore, warrants further examination. Preliminary findings from our study are encouraging and indicate that such symptom monitoring does not, at the very least, appear *un*feasible. Such extended monitoring may be needed when events of interest concern suicidal behavior (due to the low base rate of suicide attempts and mortality) (Glenn & Nock, 2014). For such studies, it seems clear that researchers should aim for larger initial sample sizes in order to account for the more substantial attrition that follows from intensive longitudinal assessments over longer timeframes.

Considering Participant Safety When Examining Risk Studies have consistently shown that EMA of suicidal ideation does not lead to systematic negative symptom reactivity (see **Chapter 2** for a review of the literature, and **Chapter 3** for our examination of EMA iatrogenic effects in our sample). However, our findings indicate that a minority of participants may experience such effects. Namely, 18% of our participants reported retrospectively that the EMA had sometimes triggered their suicidal ideation (when not experiencing ideation prior to the EMA prompt), and 10% that the EMA had sometimes worsened their ideation (when already experiencing ideation).[1] It should be noted that these reports were not accompanied by observable increases in the participants' EMA-ratings. These inconsistencies indicate that this topic requires continued attention. It also remains to be examined to what *extent* these negative consequences are experienced by participants, and certain limitations should be considered when interpreting these findings. Most importantly, we did not specify in our questionnaire whether any triggering or worsening effects were experienced only *occasionally,* or *systematically* in response to every prompt, and how *distressing* these perceived increases were for the participants. Many testing procedures within medical and psychological research (such as blood tests, Lavery & Ingram, 2005) or paradigms including distressing imagery (Jorm et al., 2007)) may cause a certain level of discomfort to participants, but these effects are typically short-lived. Indeed, the literature indicates that participating in mental health research (Jorm et al., 2007), including research on suicide-related phenomena (Schatten et al., 2022; Smith et al., 2010), is more likely to result in positive rather than negative outcomes. This was also apparent in our sample, with 22% of participants reporting *improved* mood in response to the EMA measures, and the group as a whole exhibiting a reduction in overall suicidal ideation severity from pre- to post-EMA (although the latter finding may simply reflect regression to the mean).

Another question regarding participant safety that readers may have while considering the data reported in **Chapter 6**, as well as the description of ***Case Study 3***, is: *could something have been done to intervene and prevent an attempt?* The implementation of safety procedures and how such procedures may look like is a focal point in the discourse regarding suicide research, and especially that of the ever-growing field of EMA. Even though we can relatively confidently conclude that, based on the existing evidence, repeat suicidal ideation assessments do not lead to systematic, substantial or sustained increases in symptoms (**Chapter 2** & **Chapter 3**), the fact remains

[1] 5 participants reported both a triggering and a worsening effect, 5 reported a triggering effect only, and 1 participant reported a worsening effect only.

that such assessments do provide unique opportunities for intervention. However, such safeguards are rarely implemented in EMA designs, unless studying underage populations (**Chapter 2**). In the present study, we employed a number of safety measures. First, we performed a comprehensive assessment of the participants' risk status at baseline in order to determine whether the participant was stable enough to participate, or in need of immediate referral for emergency services or specialized mental health care. Second, we required all participants with severe symptomatology to be currently under the care of a specialist (psychologist and/or psychiatrist), and we notified the general practitioner, and/or treating specialist of each participant of their involvement in the study. Third, we created personalized suicide safety plans for each participant, detailing their preferred coping strategies and resources to be consulted in case of suicidal crises. These safety plans also included a reminder to the participants that if they felt like their participation in the study was affecting their mental health in a negative way, they could discontinue at any time. Finally, we explicitly informed the participants that their responses within the app would not be viewed by study personnel prior to the completion of the data collection period(s) (first after the end of the 21-day EMA, and then after the 1-year monitoring period) and in case they experienced issues with the study proceedings (incl. iatrogenic effects) they should directly contact the study personnel, or if they experienced a suicidal crisis, they should consult their suicide safety plan (which also included resources such as the 113 suicide prevention line, and the emergency line (112)). Yet, we did not employ built-in algorithms within the app that would have triggered an alert to the study personnel in response to the participants' reports of high levels of suicidal ideation. However, a question also remains about how effective such safeguards might be. For example, an EMA study of 434 adolescent and adult psychiatric patients with a recent history of suicidal ideation and/or behavior employed real-time interventions in response to participant's EMA suicidal ideation ratings (based on scores >= 8 out of 10) (Bentley et al., 2024). This included presenting participants with their safety plan, as well as a message being sent out to the study's risk monitoring team that subsequently contacted the participant within 24 hours. For patients whose responses triggered this intervention, there was evidence of discontinuity in ratings such as that participants were more likely to rate their ideation below the threshold in future entries. Further, 22% of suicidal ideation ratings that triggered the response were changed to a lower rating (most commonly, a 7 i.e., just below the threshold) before submitting the survey after participants received a pop-up notification about the intervention steps. Hence, it appears that the possibility of intervention may not necessarily lead to a better identification of crises, but rather the omission of the reporting of such crises when they

occur, and can cause strategic responding that may impact data quality due to artificial ceiling effects. Developing real-time intervention protocols that do not lead to such effects remains a goal, but also a challenge, for future research. Despite these limitations, when used in primary mental health care, monitoring of scores in real-time can be beneficial.

Correlates and Predictors of Real-Time Suicidal Ideation

In **Chapter 2**, we discuss how EMA has utility not only for the real-time assessment of suicidal ideation, but also for the examination of the correlates and predictors of suicidal thoughts. Based on our review of the literature, we found that a range of such potential risk and protective factors have already been examined in EMA designs, with the most commonly assessed predictors including contextual factors, affective states, as well as constructs from *the Interpersonal Psychological Theory of Suicide (IPTS)* (Van Orden et al., 2010) (i.e., hopelessness, thwarted belongingness (or loneliness), and burdensomeness). However, studies so far have predominantly considered only a small number of variables within a certain model, and been unsuccessful in establishing robust short-term temporal predictors of suicidal ideation that may function as warning signs (i.e., factors that signal imminent changes in ideation levels). Such lack of significant temporal findings may reflect a true lack of relations between the observed variables, but may also result from insufficient modeling techniques.

Symptom Networks of Suicidal Ideation In **Chapter 4**, we examined associations between a range of cognitive-affective predictors in relation to real-time suicidal ideation using *network modeling*. The network perspective is increasingly applied to better understand co-occurring symptoms (Borsboom, 2017; Fried et al., 2017), such as those that may lead to the emergence and maintenance of suicidal ideation (de Beurs, 2017). Within this perspective, network modeling allows us to consider these factors not only as correlates or predictors, but also *consequences,* of suicidal ideation (Borsboom et al., 2021; de Beurs, 2017). Complex and bi-directional associations may then be examined, to see how symptoms influence each other over time.

We found that suicidal ideation was concurrently associated with hopelessness, loneliness and burdensomeness, as well as increased sadness and shame, and reduced happiness, calmness and optimism. These experiences also feature in the case studies presented in **Chapter 1**, such as when Vivian (***Case Study 1***) and Mary (***Case Study 2***) struggle to stay calm and optimistic as their daily struggles accumulate, and they feel

increasingly hopelessness about future outcomes. Rodrigo (***Case Study 3***) also feels hopeless and alone following the end of an abusive relationship. Likewise, Mary describes how she is "*well aware of* [her] *loneliness"* as she struggles to reach out to friends and is consumed by sadness and grief about the prospect of losing her husband.

We further found that shame, specifically, was concurrent associations with active ideation, and prospectively predicted increases in acquired capability at the subsequent time point. Shame is acknowledged to play a significant role in suicidal outcomes, especially among patients with post-traumatic stress disorder (PTSD) (Goffnett et al., 2020). Shame may elicit more negative arousal than other negative cognitive-affective states, such as sadness or hopelessness (Piretti et al., 2023). Therefore, shame may represent a more undesirable state that individuals feel greater need to escape from, explaining its role in active ideation and capability for suicide specifically. However, shame is rarely treated as an important trans-diagnostic risk factor in clinical practice. Our findings indicate that not only is shame a significant correlate of suicidal ideation, but that it may specifically signal increases in preparedness for suicide, and therefore, increase the risk of future suicidal behavior. Although a number of interventions exist that target shame (Goffnett et al., 2020; Norder et al., 2023), they are not frequently employed in suicide prevention. However, shame-reduction components may easily be incorporated into many interventions that are already commonly used in mental health care, such as cognitive behavioral therapy (CBT) or mindfulness-based interventions (Goffnett et al., 2020).

Further, we found that although the experience of passive suicidal ideation was predictive of increased hopelessness over time, experiences of active ideation were instead followed by *improvements* in mood. Such findings indicate that suicidal ideation may sometimes have a relief function and that it may be used by individuals as a form of maladaptive coping (Coppersmith, et al., 2018). Suicidal plans may also increase an individual's sense of control over their lives, especially in the face of uncontrollable stressors and lack of other avenues for escape. Such motives were also apparent in the case studies presented in **Chapter 1**, where Vivian (***Case Study 1***) describes her suicidal ideation as a form of coping and escapism, and when Mary (***Case Study 2***) grows *more* hopeless after letting go of her suicide plan. These observations are also in line with the *Integrated Motivational-Volitional Model (IMV)* of suicidal behavior (O'Connor & Kirtley, 2018), which highlights the perception of entrapment as a driving force in the emergence of suicidal ideation.

Sleeplessness and Hopelessness Another factor that we found to prospectively predict suicidal ideation is sleep. Sleep disturbances as risk factors for suicidal thoughts and behaviors have long received limited attention in comparison to many other longitudinal risk factors (such as depressive symptoms or sociodemographic characteristics (Borges et al., 2008)). However, this is starting to change, with two recent meta-analyses examining sleep as a longitudinal predictor of suicidal outcomes (Harris et al., 2020; Liu et al., 2020). In **Chapter 5**, we subsequently examined sleep characteristics as short-term (next-day) predictors of suicidal ideation, and found evidence indicating that interrupted sleep during the night (i.e., *middle insomnia*), as assessed with both subjective and objective measures, specifically appeared to lead to worse mental-health outcomes (i.e., hopelessness and suicidal ideation) the subsequent day. Namely, subjective reports of poor sleep quality, short sleep duration and increased nighttime awakenings were all associated with increased symptoms the next day. Therefore, our findings indicate that rather than accumulating over time, the detrimental consequences of poor sleep may be immediately observable in participants' psychological functioning the following day. Sleep disturbances are also explicitly mentioned by Vivian in ***Case Study 1***, where her ideation intensifies in late evening hours when she is unable to sleep and her mind becomes "stuck" on negative thoughts.

On the other hand, our findings also indicate that sleep may represent a fruitful target for suicide interventions. However, like shame-reduction techniques, such interventions are not commonly used in the treatment of patients with suicidal ideation. Sleep interventions are more frequently offered to other patient groups, such as those with PTSD (Miller et al., 2020) or depressive disorders (Gee et al., 2019), due to their high co-occurrence with clinically significant sleep complaints. Existing evidence also indicates that such interventions may not only improve sleep, but also general mental health functioning (Scott et al., 2021). We also recently performed a systematic review and meta-analysis of the effectiveness of sleep interventions in reducing suicidal thoughts and behaviors (McLellan et al., in preparation). Our findings indicated that sleep interventions, overall, had a small but significant effect size in reducing suicidal outcomes. Circadian rhythm treatments, specifically, had a moderate effect size, and CBT for insomnia a small effect size, while pharmacotherapy (i.e., hypnotic-sedative medication) was not associated with reductions in suicidal symptoms. The effectiveness of sleep interventions for reducing suicidal thoughts and behaviors has not previously been systematically evaluated, and our findings support the application of sleep therapies for individuals at-risk for suicide. While sleep complaints may often get overlooked in clinical practice (both general medicine as well as mental health care) (Ogeil et al., 2020), such disregard may

contribute to their chronicity and associated negative consequences, including depression, hopelessness and suicidal ideation (Roth, 2007). However, many effective sleep therapies exist, and these interventions may also be provided in a group setting (or more recently, online), widening their potential reach for at-risk groups (van der Zweerde et al., 2016). Further, circadian rhythm therapies, which had a larger effect size in our meta-analysis than CBT and pharmacotherapy, are even less often employed in health care than sleep therapies (Kramer et al., 2022). However, it is well established that circadian disruptions are implicated in many psychiatric disorders including depression, although longitudinal studies on suicide outcomes are lacking (Kivelä et al., 2018).

Variability of Suicidal Ideation

The focal point of many early EMA studies on suicidal ideation has been the variability of ideation within days (see e.g., Hallensleben et al., 2018; Kleiman et al., 2017). As presented in **Chapter 6**, we also examined different dimensions of real-time suicidal ideation dynamics, including its frequency, intensity and variability over time. Our subsequent findings were in line with prior studies, including the early observation that *"variability in suicidal ideation appears the norm, rather than the exception"* (Witte et al., 2006, p. 1038). However, while much of the discourse on real-time suicidal ideation dynamics has focused on its variability, we also observed substantial between-person differences in the average intensity, as well as frequency, of ideation. Therefore, early findings on the instability of suicidal ideation in the short-term may have led to an excessive emphasis on variability statistics. Our findings indicate that important determinants of suicidal ideation also include other characteristics (such as its intensity and frequency). Indeed, it should now be apparent that variability should not (and probably *can*not) be considered in isolation of these factors.

The variability of suicidal ideation, however, has important implications for clinical practice. Crucially, even though patients may appear stabilized after intervention (e.g., when preparing patients for discharge), such stability may not be maintained once the patient exits a highly controlled clinical setting. Further, the highly variable nature of suicidal ideation indicates that even though patients may indicate the absence of suicidal desire at discharge, they may return to high-intensity ideation moments only a few hours or days later. Indeed, it is often reported that those planning suicidal acts frequently deny such plans only shortly before taking their lives (Berman, 2018). These findings are sometimes interpreted to reflect dishonesty on the part of the individual. Our findings indicate that these patients may be honest – at least *in the moment* – but that reports of

low-risk status may have limited temporal continuity. Mental health professionals who assess suicide risk are well aware that repeat assessments of suicidal ideation over a number of hours and/or days are warranted. This is especially relevant when evaluating those leaving in-patient treatment, as the week immediately following hospitalization represents an especially high-risk timeframe for a repeat suicide attempt (Chung et al., 2019). Risk of suicide attempt is also elevated following discharge for those psychiatric patients whose reason for hospitalization was *not* a suicidal crisis (Chung et al., 2017; Haglund et al., 2019). Indeed, this timeframe may be associated with a number of triggers, such as return to stressful environments, or feelings of helplessness when lacking follow-up care. Such worries, and their impact on suicidal ideation, is also apparent in ***Case Study 1***: towards the end of the assessment period, we can see Vivian growing increasingly worried about her return home after attending an extended residential treatment program. These concerns subsequently appear to reduce her resilience, with Vivian's suicidal ideation levels exhibiting substantially higher peaks in response to the same stressors that in the previous weeks had led to only minor increases.

Prediction of Suicide Attempts

In **Chapter 6**, we examined the prospect of *digital phenotyping* of suicidal ideation, that is, identifying subtypes of suicidal ideation based on electronically collected data on suicidal ideation dynamics (Ballard et al., 2021). Curiously, while this approach was also implemented in one of the first EMA studies in the field (Kleiman et al., 2018) it has not been employed since – until the present study. Our findings also showed partial support for the phenotype classification presented by Kleiman et al. (2018), indicating that meaningful subtypes may be identified among patients with suicidal ideation based on the temporal dynamics of their ideation (incl. frequency, intensity, variability). More specifically, our findings indicate that profiles characterized by higher variability – but also higher frequency and intensity of ideation – may be associated with worse clinical profiles at baseline, and pose a higher risk for suicidal behavior in the future. However, the exact number and clinical relevance of such subtypes warrants further research and replication in larger and more representative samples, before these findings can be generalized to the highly heterogeneous population of individuals with suicidal ideation.

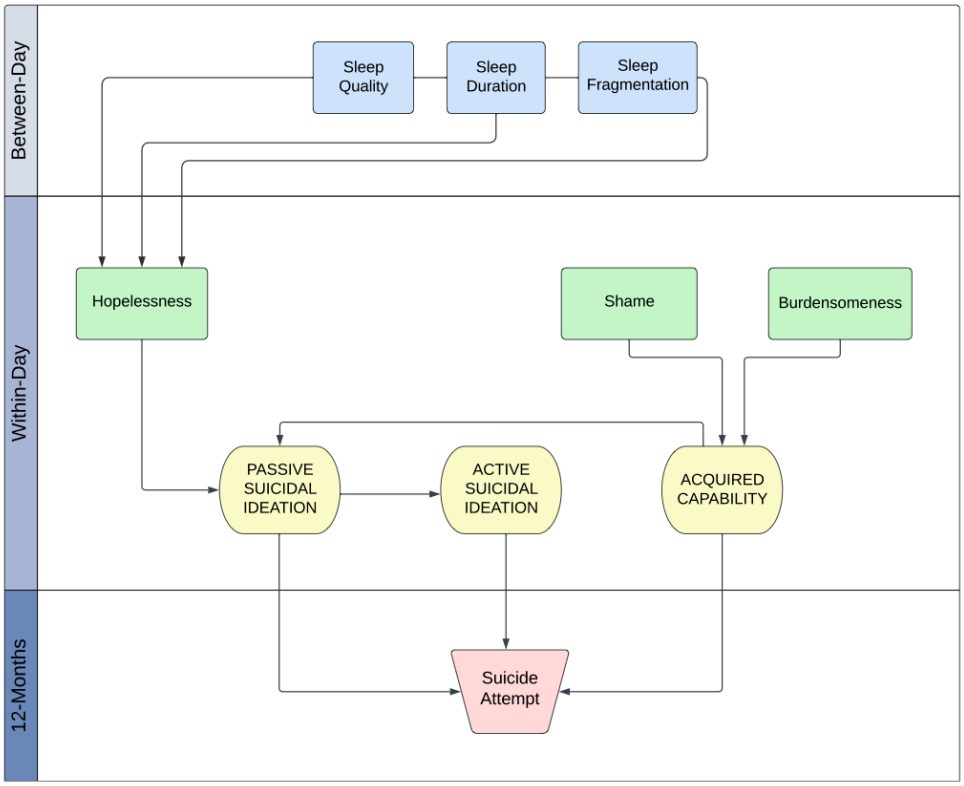
It has frequently been proposed that EMA data on acute suicide risk factors (i.e., warning signs) have increased utility in predicting suicide risk, especially in the short-term. However, only two studies (Wang et al., 2021 and **Chapter 6**) so far have actually put

this hypothesis to test, and used EMA-data to prospectively predict suicidal behavior. Both studies found that EMA-derived data on suicidal ideation dynamics significantly predicted the risk of suicide attempt in the future (1-month later: Wang et al., 2021, to 12-months later: **Chapter 6**). However, neither study considered other EMA-derived predictors than suicidal ideation itself. Hence it remains to be determined whether other short-term predictors (such as hopelessness, loneliness, coping, or substance use) may be used to predict acute risk.

Further, the utility of phenotyping approaches in predicting suicidal behavior warrants further research. Importantly, our phenotype categorization was not a stronger predictor of future suicide attempt than prior attempt history. However, no predictors exist that are considered to be as robust in predicting future suicidal behavior than past suicide attempt history (Bostwick et al., 2016; Cornaggia et al., 2013), while we found both past suicide attempt history as well as our phenotype categorization to exhibit comparable (large) effect sizes. Our findings also indicate that, in tandem with past suicide attempt history, phenotyping may be especially useful in identifying those individuals with a past attempt history that may no longer be at high risk. As all individuals who made a repeat attempt during our follow-up period had a past suicide attempt history, attempt history alone had poor specificity in differentiating those participants at *low* risk. Based on our results, those past suicide attempters with current moderate frequency, but low intensity and low variability ideation, may not presently represent a risk group. Therefore, phenotyping might be combined with information about past suicide attempt history to produce even stronger prediction models, although this remains to be tested in future studies. Figure 1 presents a graphical depiction of the significant study findings relating to prospective predictors of suicidal ideation and behavior.

Future examinations of prospective suicidal behavior will necessitate assessments over lengthy follow-up periods (e.g., 12-months as in the present study), and subsequently considerations of how to maintain compliance over extended study periods. Our experience (**Chapter 3**) indicates that both direct contact with participants (either in-person or online), as well as the promise of personalized feedback on the data provided, may be effective in maintaining compliance both short- and long-term. Indeed, in the final feedback survey that the participants filled in following the 1-year monitoring period (data not reported here) many indicated that they would have wished for a feedback report also following this period. Participants often choose to specifically participate in research that they perceive to be personally relevant to them (Sheridan et al., 2020); as such, incentives offered to participants should ideally also have personal meaning.

Figure 1. A Graphical Overview of Significant Study Findings Relating to Prospective Predictors of Suicidal Ideation and Behavior



Note: The direct association between acquired capability and suicide attempt in the figure reflects the observed association between past suicide attempt history and prospective re-attempt

Limitations

Many of the limitations relevant for the present findings and study design have already been discussed within this chapter, but four overarching points are summarized here. First, although our sample size was within the (upper) range of similar past (EMA) studies (*Med* = 50; **Chapter 2**), it is still meager in comparison to the broader literature on longitudinal cohort studies on suicidal ideation (Large et al., 2016). Our sample size further diminished in size considerably with the extension of our measurements over a full year. Hence, it bears repeating that our findings need replication, especially in larger samples. Future studies should also aim to better understand participants lost to follow-up, such as how many may have become non-responders due to suicide. Examining differences in suicidal ideation dynamics between those with a prospective suicide

attempt, and those with suicide mortality, may provide further insights into the clinical relevance of such indices. Risk factors for suicide and suicide attempts are known to overlap, but also differ, and predictors of suicide remain less well-established (Cornaggia et al., 2013).

A limitation not yet addressed in detail is the representativeness of our sample. Overall, our sample was predominantly female, young, and highly educated (**Chapter 3**). It is known that women are more likely to experience suicidal ideation and to attempt suicide than men (Canetto & Sakinofsky, 1998) – but also to participate in scientific research (Glass et al., 2015; Saphner et al., 2021). Meanwhile, men are more likely to die by suicide (Canetto & Sakinofsky, 1998), but remain more underrepresented in mental health research (Watkins, 2012), perhaps because they are also less likely to seek professional help (Chatmon, 2020). In intervention studies specifically, women outnumber men 3:1 (Knox et al., 2023). Further, those with a lower education level are also more likely to die by suicide (Nock et al., 2008), but less likely to participate in empirical research (Saphner et al., 2021). These factors together may limit the generalizability of our findings, especially with regard to better understanding and predicting suicidal behavior within these populations.

When considering the clinical applicability of our findings, it should be acknowledged that group-level findings may not always be relevant to the individual case. For example, there has recently been discourse about the extent to which associations identified in group-level network models are applicable to the individual (Bos & Wanders, 2016; Bos, 2021). While such limitations are partially addressed by examining within-person rather than between-person effects within the networks (i.e., examining intraindividual change rather than between-person differences, as also done in the present study, **Chapter 4**), the fact remains that such models are based on data pooled across individuals. As such, only some connections identified in group-level models, but not others, may be observable in a specific individual. However, due to the repeated nature of EMA measures, in clinical practice where the focus is on an individual patient, data collected from such a patient may also be used to create and examine individual (i.e., *idiographic*) networks. Such networks may provide unique insights into the patient's case, although caution should be used when applying and interpreting these models, as standardized methodologies are lacking, and interpretation of the *meaning* of such models is limited by subjective interpretation (von Klipstein et al., 2020). For example, in one recent study, 12 research teams analyzed a dataset from the same individual using network modeling, and produced vastly different models and clinical recommendations thereafter (Bastiaansen et al., 2020). Overall, it should be recognized that statistical

models reflect limited simplifications of real-world experience, whether that be on the group- or individual-level.

Finally, as discussed in **Chapter 1**, suicidal ideation and behavior are highly heterogeneous phenomena that are influenced by socio-cultural, developmental, and psycho-behavioral factors. More research is needed on how more distal risk factors, such as the experience of childhood trauma, may affect current suicidal ideation dynamics. For example, experiences of childhood abuse and neglect are known to associate with later difficulties in emotion regulation (Dvir et al., 2014), and that those with early trauma have more labile mood, as recently also demonstrated in an EMA study (Kuzminskaite et al., 2024). It is therefore conceivable that such risk factors may also affect current suicidal ideation dynamics, such as its variability. For example, in **Chapter 6** we found cases with PTSD to more frequently present with a phenotype characterized by increased variability. Regrettably, however, we did not assess history of childhood trauma within the present study, or inquire about the type and/or timing of other traumatic events. Future research should work to further examine the synergistic associations between distal and proximal risk factors, in order to observe how such acute risk factors may differently impact those with distinct vulnerability factors.

Future Directions

Research Perspectives Our suggestions for future research follow directly from our limitations. Larger sample sizes are needed for prediction models that are able to grasp the full range of the correlates and predictors involved in the emergence of suicidal ideation (Nock et al., 2008). We urge future research to also consider newer statistical techniques, such as machine learning and neural networks (Durstewitz et al., 2019), that may be used to both build and test suicide prediction models. Such models are also better able to account for the dependencies and temporal relations between a number of predictors simultaneously, while not being limited by assumptions of linearity. As frequently reported, short-term trajectories of suicidal ideation often lack clear linear patterns (Kleiman et al., 2017), and may not be suitable for linear statistics in the first place. Further, as discussed elsewhere (Bos & Wanders, 2016; Bos, 2021; von Klipstein et al., 2020), testing of idiographic prediction models are necessary in order to observe to what extend group-level findings can, or cannot, be applied to individual cases – especially as the prospect of employing EMA in clinical practice becomes more concrete.

Although the use of EMA in suicide research has grown exponentially in the past five years, the field of real-time data collection of suicidal outcomes is still in its infancy. Consequently, although there is a lot of discussion about the short-term dynamics of

suicidal ideation and these patterns are becoming better understood, we largely lack knowledge about the dynamics of suicide risk and protective factors themselves. Therefore, as discussed previously, a lack of a significant association between a predictor and an outcome in EMA designs does not necessarily indicate that the association does not exist at all and should not be further studied; it may merely indicate that a certain association does not exist within the hyper-specific timeframe within which the data were sampled. For example, if momentary anger does not predict suicidal ideation four hours later (as was the timeframe in the present study), does that mean that it is not associated with ideation more imminently 5, 10 or 30 minutes later? As such, the field may necessitate a step back, where more information first needs to be gathered about the temporal dynamics of these predictors themselves, before they can optimally be studied in relation to real-time suicidal ideation. For this purpose, neural networks may also be used to model different temporal dependencies between suicidal ideation and its predictors, such as examining whether the predictors as examined 1, 2 or 3 etc. time points prior best predict current levels of suicidal ideation. Inconsistencies in study designs (incl. sampling windows) may also explain differences in findings or lack of replication between studies. More standardization within EMA protocols is needed, especially if researchers aim to extend EMA methods to clinical practice (see ***Clinical Application*** below). Qualitative data from participants, such as text entries provided within EMA, may also help clarify on these processes, and guide EMA study designs. For example, a recent interview study also used qualitative methods to elucidate on the timeframe of the stages of suicidal ideation, planning and final decision preceding a suicide attempt (Heesen et al., 2024).

Clinical Application Since its early emergence, it has been suggested that EMA represents not only a relevant research methodology, but also a potential clinical tool (Davidson et al., 2017). For example, it has been proposed that EMA's ability to provide more detailed data on symptom dynamics could be helpful for treatment, as it may provide direct targets for intervention (Bos, 2021). For example, clinicians may work with patients to eliminate exposure to person- and context-specific suicidal ideation triggers identified through EMA. One of the goals of CBT, for example, is to help clients identify and avoid high-risk conditions associated with problematic behaviors, and encourage them to spend more time in low-risk environments (Fenn & Byrne, 2013). Further, EMA may help identify cognitive and affective states most closely associated with the client's ideation (such as hopelessness or shame) that may benefit from being targeting more in-depth in treatment

Although EMA has not yet been utilized in clinical practice in a wide-spread manner, such application appears to receive fairly broad support. A 2022 survey of 89 mental health practitioners and 62 researchers indicated that both groups considered EMA to be applicable and useful in clinical practice (Piot et al., 2022). More specifically, most responders considered EMA-based symptom monitoring to be useful for gaining insights about the context in which symptoms are more likely to emerge (55%). However, fewer responders considered EMA to be useful as a direct intervention tool (e.g., to alert patients about symptom increases, which was endorsed by only 11% of the responders). Practitioners, specifically, also indicated that EMA was easier to use, and its results easier to interpret, than assessment methods per treatment-as-usual (incl. semi-structured interviews, screening questionnaires, and paper-and-pen diaries). They further reported that EMA could conceivably be applied in all stages of treatment, from diagnostics to relapse prevention (Piot et al., 2022).

While the development of ecological momentary interventions (EMI) is also ongoing and has produced some positive early findings (see McDevitt-Murphy et al., 2018 for a review), it should also not be discounted that EMA-based symptom-monitoring *in itself may produce therapeutic effects*. That is, EMA may benefit patients even without the incorporation of additional intervention steps (such as alerts signaling symptom increases or prompts to employ certain coping strategies). Much of the research into reactivity to suicide assessments has focused on negative (i.e., iatrogenic) effects, but has not considered the potential that suicide assessments may also lead to symptom relief. However, such effects may also occur: as discussed in **Chapter 3**, we found 22% of our participants to report *improved* mood in response to the EMA measures. Without explicit intervention, evidence of behavioral change was also apparent in our sample, as described by one participant: *"I – was more aware of how bad things were and therefore tried to get into a healthier pattern"* (**Chapter 3**). Symptom self-monitoring may also be useful for patients with suicidal ideation, as it can demonstrate the ebb and flow of ideation, and the factors influencing it. Therefore, if well-tolerated by the client, the addition of electronic symptom self-monitoring in adjunct to treatment-as-usual may benefit existing treatment approaches, and potentially be therapeutic on its own right. However, for certain patients such excessive focus on symptoms may not be desirable (Bos, 2021), and the choice to employ EMA should be made on an individual basis. Within CBT, it is thought that self-monitoring may increase a sense of collaboration between a therapist and a client, and increase the client's sense of agency regarding their treatment (Cohen et al., 2013). In a recent qualitative interview study of 27 adults who had recently attempted suicide, most reported that they felt like their suicidal symptoms *"were not taken seriously enough"* by

health care workers, and wished they had had *"a safe space for discussing their feelings and thoughts related to their desire to die"* (Heesen et al., 2024,p. 8). The application of EMA-type digital recordings may signal to the patient that their complaints are properly acknowledged, and subsequently facilitate conversations between the patient and the clinician.

Final Conclusions

As discussed in **Chapter 1**, in ancient society, suicides were primarily seen as means-to-an-end to maintain societal status or to avoid humiliation and defeat (Hill, 2004). Therefore, suicides were considered to be a direct consequence of external events, and were not thought to necessitate further mental disturbance or distress on the part of the recently deceased. Indeed, suicide, as an act, was considered to be a rather unemotional event.

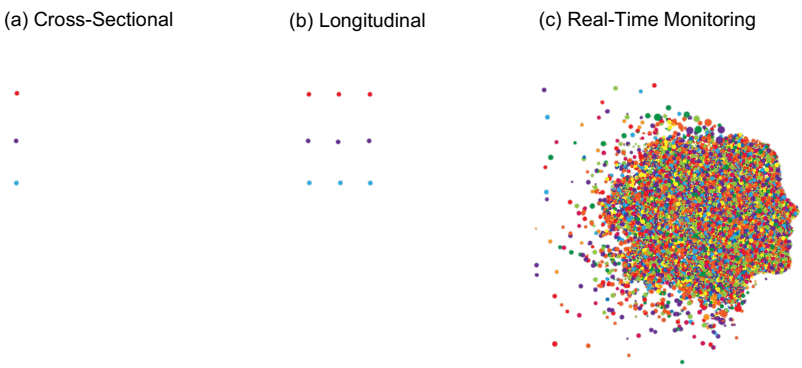
There exists, however, also a term in the Latin language that refers to the more psychological elements of suicidal ideation: *libido moriendi*, which describes the "lust for death" (Hill, 2004). Within this terminology is contained the idea that suicidal thoughts themselves can contain depth and despair beyond the Roman idea of suicide as an end result of a rational decision-making process. Indeed, in addition to shame and the desire to avoid humiliation, a wide array of thoughts and emotions can accompany suicidal thinking; these may include experiences of sadness, hopelessness and burdensomeness – but also feelings of calmness and relief. As described in **Chapter 4**, these emotions may further differ based on the stage of ideation one is at, be that the initial feelings of a dwindling desire to live, or later on, the emergence of more concrete thoughts about suicidal self-harm. However, rather fittingly within the Roman idea of suicide, we also found *shame*, specifically, to be a correlate for an active wish to die. As such, old and new theories of suicide may have commonalities.

The heterogeneity of suicidal ideation, both between and within individuals, is a theme that has transversed through each chapter of the dissertation, and is also apparent in the case studies presented in **Chapter 1** that illustrate how triggers and trajectories of suicidal ideation may differ based on the individual. In **Chapter 6**, we further aimed to quantify these differences in suicidal ideation by examining distinctive *between-person subgroups* of suicidal ideators, based on the *within-person dynamics* of their suicidal ideation. As such, heterogeneity need not be a challenge for research, but may also be used to establish order.

In the *Comprehensive Textbook of Suicidology,* Maris, Berman and Silverman (2000) address this heterogeneity by asking: *"Is suicide one thing or many things?"* and

subsequently answer: *"Given this choice, it seems clear that the answer is 'many'"* (p. 50). They further conclude that *"The complexity, variability,* [and] *multidimensionality of suicide has* [...] *pragmatic consequences"* (Maris et al., 2000, p. 50). The defining strength of real-time monitoring in suicide research may hence be considered to be its ability to simultaneously capture the many dimensions of suicidal symptoms – their context, correlates, antecedents and consequences, as well as their frequency, intensity, duration, and variability. Through repeated data-collection methods, we may not only observe individual data points, but see how these dots form together, to produce a clearer picture of the target under observation (Figure 2). Such symptom monitoring may also function as a mirror to patients, allowing them to better understand their symptoms and their unique underlying causes. The evaluation of such therapeutic approaches represents the next steps in the clinical application of methodologies capturing real-time suicidal ideation.

Figure 2. A Graphical Illustration of the Differences in Data Granularity between Cross-Sectional, Longitudinal, and Real-Time Data Collection Methods



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