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Personality of late- and early-onset elderly suicide attempters

Running title: Personality of late- and early-onset attempters

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Abstract

Objectives: While suicidal behavior often manifests in adolescence and early adulthood, some people first attempt suicide in late life, often with remarkable lethal intent and determination. Given these individuals' more adaptive functioning earlier in life, they may possess traits that hinder adjustment to aging, such as high conscientiousness, rather than impulsive-aggressive traits associated with suicidal behavior in younger adults. *Methods*: A cross-sectional case-control study was conducted in older adults aged ≥ 50 (mean: 65), divided into early- and late-onset attempters (age at first attempt ≤ or > 50, mean: 31 vs. 61), suicide ideators as well as non-suicidal depressed and healthy controls. Personality was assessed in terms of the Five-Factor Model (FFM, n = 200) and five DSM personality disorders analyzed on the trait level as continuous scores (PDs, n = 160). Given our starting hypothesis about late-onset attempters, the FFM dimension conscientiousness was further tested on the subcomponent level. *Results*: All clinical groups displayed more maladaptive profiles than healthy subjects. Compared to depressed controls, higher neuroticism and borderline traits characterized both suicide ideators and early-onset attempters, while only early-onset attempters further displayed lower extraversion and higher antisocial traits. Late-onset attempters were similar to depressed controls on most measures, but scored higher than them on orderliness, a conscientiousness subcomponent. *Conclusions*: While neuroticism, introversion, and cluster B traits are prominent in early-onset suicidal behavior, late-onset cases generally lack these features. In contrast, higher levels of orderliness in late-onset suicidal behavior are compatible with the age-selective maladjustment hypothesis.

Key words: suicidal behavior, old age, personality, personality disorders, Five-Factor Model

Key points:

- Personality of elderly attempters differed between those with early- and late-onset first attempts.

- Early-onset attempers possessed personality traits generally found in younger suicidal populations (high neuroticism, low extraversion, antisocial and borderline PD traits), supporting that constitutional suicide risk factors persist into late life in some individuals.

- Late-onset suicide attempters had higher levels of orderliness than non-suicidal depressed participants, suggesting that this generally adaptive trait may facilitate suicidal behavior in a subset of depressed elderly.

Introduction

To explain high suicide rates in old age,[1] researchers typically invoke stressors of aging such as illness, disability, loss and cognitive impairment.[2,3] By contrast, relatively little is known about the role of personality in late-life suicide. In younger people, personality traits are among the strongest predictors of suicidal behavior. This includes high neuroticism and low extraversion of the Five-Factor Model (FFM)[4] as well as impulsive-aggressive traits and affective instability found in borderline and other Cluster B personality disorders (PDs).[5] These traits' contribution to suicide risk, however, diminishes with age.[6] Furthermore, the literature on the role of personality in late-life suicidal behavior is inconsistent. In a recent review, we proposed the following explanations: (i) heterogeneous personality profiles of suicidal elderly and (ii) apparent heterogeneity due to differing study groups (e.g. comparing attempters to only non-clinical controls may confound personality differences arising from depression vs. suicidal behavior).[7]

Previous studies did not consider the possibility that heterogeneity in personality traits among suicidal elderly may arise from a varying life course of suicidal behavior, expressed primarily in age of onset. Whereas about two thirds of people who attempt suicide after age 55 do so for the first time,[8] others have a history of early-life attempts and likely resemble younger suicidal people with the qualification that their problems persist into old age. On the other hand, later-onset cases seem to possess a more adaptive personality profile,[9] potentially questioning any contribution of personality to late-life suicide. Yet, traits adaptive earlier in life, may hamper adjustment to the challenges of aging. For example, a qualitative psychological autopsy study described older suicide victims as well-adjusted and achievement-oriented earlier in life, but of a controlling and obstinate character.[10] Consistently, associations have been noted between late-

life suicide and higher conscientiousness,[6,11] late-life suicide and anankastic PD (the ICD-10 equivalent of obsessive-compulsive PD),[12] increased mortality in old age and perfectionism,[13] as well as between late-onset depression and need for control.[14]

Inconsistent findings may additionally arise from varying control groups across studies. Elderly suicide attempters/victims were more often found to have an altered personality profile when compared to healthy controls than to depressed controls, included in only a few studies.[7] Many findings obtained by comparing suicidal elderly to healthy elderly may therefore be better accounted for by depression than suicidal behavior. Additionally, no study of older adults compared personality profiles of those with suicidal behavior vs. only ideation. This comparison is crucial, as only a minority of those who contemplate suicide transition to behavior.[5]

The objective of our study was to improve our understanding of the personality background against which suicidal behavior emerges in late life by controlling for the potential confounders outlined above. We investigated both FFM and DSM personality traits in older suicide attempters, whom we classified as late- or early-onset based on whether they first attempted suicide after age 50 or earlier. The two attempter groups were compared to both healthy and depressed controls, as well as to suicide ideators. We hypothesized that, whereas maladaptive personality traits would be increased in all clinical groups compared to healthy subjects, Cluster B traits, high neuroticism, and low extraversion would be especially prominent in early-onset attempters and ideators as they are associated with suicidality in younger populations. By contrast, we hypothesized that late-onset attempters would have a more controlling personality,

captured by higher scores on the FFM dimension conscientiousness and/or specific subcomponents of this dimension, as well as more obsessive-compulsive PD traits.

Methods

Study design and sample characteristics

All procedures were in accordance with the ethical standards of the University of Pittsburgh's Institutional Review Board (Protocol IRB0407166). Our sample was composed of 200 older adults aged 50 or above (mean age: 65), enrolled in the Longitudinal Research Program for Late-Life Suicide,[15] for which they provided written informed consent after receiving a complete study description. Exclusion criteria for the program were the followings: any SCID/DSM-IV diagnosis of bipolar disorder, psychosis, dementia or mental retardation, a Mini-Mental State Examination (MMSE) score below 22, an ECT treatment in the past 6 months, or any neurological or major systemic illness. An unclear suicidal behavior history based on participants' reports and exogenous sources (medical records, treatment providers, friends/relatives) also prompted exclusion. Recruitment sources included both in- and outpatient psychiatric settings as well as primary care and community advertisements.

Following a cross-sectional, case-control design, participants were separated into five groups: early-onset suicide attempters (n = 24), late-onset suicide attempters (n = 41), suicide ideators (n = 45), depressed controls (n = 45) and healthy controls (n = 45).

To ensure suicidality at the time of consent, attempters needed to have at least one suicide attempt (defined as a self-injurious act with the intent to die) in the past month or, if the attempt

was remote, to have current strong ideation (defined as a desire and a plan to attempt suicide) in the past month. *Early-onset attempters* had made at least one attempt up to and including age 50. *Late-onset attempters* had first attempted suicide after age 50. The age cutoff for the early- and late-onset subdivision was decided by median split of age at first attempt in the subsample with SIDP-IV scores (for plots of age at first attempt vs. personality scores, see Figure S3 in the Supporting Information available online).

Suicide ideators had no lifetime history of attempt. They were required to have strong suicidal ideation within the month preceeding study enrollment.

Healthy and depressed controls were enrolled in the Longitudinal Research Program as comparison subjects and had no lifetime history of attempt, ideation or passive death wish. *Depressed controls* as well as all three suicidal groups had to be currently depressed defined by a minimum score of 14 on the 17-item Hamilton Rating Scale for Depression (HRSD), and/or a current depressive disorder diagnosis based on SCID/DSM-IV criteria. *Healthy controls* had no psychiatric illness, including substance abuse, as determined by the SCID/DSM-IV.

Assessments

NEO Five Factor Inventory (NEO-FFI) self-reports were used to assess the five personality dimensions of the FFM: neuroticism, extraversion, openness, conscientiousness and agreeableness.[16] The NEO-FFI contains 60 items, 12 per dimension, that are assessed on a five-point Likert scale going from 0 = strongly disagree to 4 = strongly agree. Each participant obtained one total score per factor that was subsequently Z-scored based on population reference

values[17] to improve generalizability of interpretations. Subcomponents were additionally derived for conscientiousness based on the scoring proposed by Saucier,[18] as the NEO-FFI does not allow the derivation of facets defined for the 240-item NEO-PI-R. There are three conscientiousness subcomponents, namely orderliness (being methodical, neat, organized and efficient), goal-striving (being goal-driven, hard working and motivated to excel) and dependability (being reliable, consistent and dependable).[19] Raw scores were used in this analysis, since no population norms exist for the subcomponents.

The *Structured Interview for DSM-IV Personality (SIDP-IV)* was available in a subsample of 160 participants for the following 6 personality disorders (PDs): schizotypal, antisocial, borderline, narcissistic, avoidant and obsessive-compulsive.[20] The forty other participants had completed the research program before this assessment was introduced, and were thus excluded from this part of the analysis. The SIDP-IV is administered in the form of a semi-structured interview where each question assessing a criterion of a given PD is rated from 0 to 3, going from absent to strongly present. To maximize statistical power and detect PDs at the trait level, we used total raw scores, assessing disorders as continuous dimensions instead of creating binary categories using the DSM's diagnostic thresholds. This method is further justified by the acknowledged arbitrariness of DSM thresholds for most PDs.[21] We excluded borderline item 5 investigating suicidal ideation and behavior to avoid inflating borderline PD scores in the three suicidal groups.

The 17-item Hamilton Rating Scale for Depression (HRSD)[22] was administered strictly within a month and in most cases within a week of the NEO-FFI and SIDP-IV measures respectively. The suicidal ideation item was excluded from total scores.

SCID/DSM-IV diagnoses were obtained at baseline for the lifetime history of substance use and anxiety disorders using the SCID-I (Structured Clinical Interview for DSM Disorders I).[23] They were coded as dummy variables.

Total physical illness burden was evaluated using the CIRS (Cumulative Illness Rating Scale) as a continuous measure.[24]

The suicidal groups were assessed for severity of suicidal ideation upon study enrollment using the *Beck Scale of Suicide Ideation (SSI).*[25] The attempter groups were further evaluated for the followings: *number of lifetime attempts*, *age at first* and *most recent attempt*, lethality score of the most severe attempt assessed by the *Beck Lethality Scale (BLS),*[26] as well as extent of planning before the most severe attempt, assessed by the *Beck Suicide Intent Scale (SIS)* and its *Planning* subscale.[27]

Quality checks

Missing personality data involved all schizotypal and avoidant items in 2.5% of participants, as these PD categories were added slightly later to our SIDP-IV assessment. In addition, out of the seven items composing the avoidant PD score, the 6th item ("Views self as socially inept, personally unappealing, or inferior to others") was missing in 31% of subjects, due to a

formatting error. The missing values were clearly explained by temporality (the item was omitted from the paper form initially used), and established to be missing completely at random by Little's test ($\chi^2_{14} = 21.64$, $p = 0.086$).[28] We used mean imputation to estimate them in participants who had completed the other avoidant items (*mice.impute.2l.zip* function for count data, package *countimp*).

Correlations for NEO-FFI personality dimensions and SIDP-IV PD traits can be found in the Supporting Information available online (Figures S1 and S2).

Data analysis

Our goal was to examine both severity and profile of personality pathology in early- vs. late-onset suicide attempters, ideators, depressed and healthy controls. We used two separate sets of regression models for normal range (NEO-FFI) and pathological (SIDP-IV) personality measures. All regression models co-varied for age, gender, and education. Analyses were conducted in R, version 3.3.2 (*lme4* and *lsmeans* R packages). Given that only very few subjects endorsed any level of schizotypal personality pathology (n = 16), this PD had to be excluded from all further analyses.

First, to identify general patterns of maladjustment and assess the relative importance of each trait compared to the others, we analyzed all FFM dimensions and, separately, all DSM PD traits in hierarchical models, treating them as indices of a global personality construct. Since FFM dimension scores approximated a normal distribution, they were entered as a dependent variable in a linear mixed-effects model (function *lmer)* testing a *study group*FFM dimension* effect.

DSM PD trait scores had a zero-inflated distribution and were included as dependent variable in a negative binomial mixed-effects model (function *glmer.nb*) testing *study group*PD type* as the main effect of interest. Both models included all above-mentioned demographic covariates, allowing them to interact with respectively FFM dimension or PD trait, as well as subject-level intercepts as random effects.

Given the significant *study group*dimension* and *study group*PD type* interactions, we followed up with individual regression models to investigate the group differences. Each FFM dimension's and PD trait's score was entered as the dependent variable and study group, age, gender and education as independent variables. Linear regression was used for the FFM dimensions (*lm*) and negative binomial regression for the DSM PD traits (*glm.nb*).

Given our hypothesis about late-onset attempters' controlling personality profile, we additionally looked at the three conscientiousness subcomponents in a linear mixed-effects model (*lmer*) predicting conscientiousness scores, with a *study group*subcomponent* interaction and demographic covariates (entered as interactions with subcomponent) as independent variables. Subject was added as a random effect.

We used Tukey's HSD within every model to control for type 1 error over group contrasts. We did not use additional type 1 error control across models for individual dimensions, because these dimensions are not independent and tap into a single overarching construct of dysfunctional personality.[29]

Results

[*Insert Table 1 here*]

Group characteristics

Sample characteristics are shown in Table 1. A similar pattern was seen in the subsample with SIDP-IV interviews (Table S1 in the Supporting Information available online). Physical illness burden was lower in healthy than in depressed controls and suicide ideators, but did not vary significantly between the other groups. The female:male ratio was higher in early-onset attempters compared to ideators and depressed controls. Both younger current age, and earlier age of depression and psychopathology onset characterized early-onset attempters and suicide ideators compared to non-suicidal comparison groups. Early-onset attempters were also younger than late-onset attempters at their first depressive episode (mean: 28 vs. 46 years) and, as expected, at their first suicide attempt (mean: 31 vs. 61 years). Early-onset attempters were additionally younger at their most recent attempt (mean: 46 vs. 62 years), since individuals with remote attempts were included as long as they currently met ideation criteria. Both attempter groups had more lifetime anxiety than depressed controls. Late-onset attempters were otherwise similar to non-suicidal groups for all measures. Current depression severity (HRSD score) was higher in early- than in late-onset attempters. However, late-onset attempters scored higher on suicide ideation than ideators and early-onset attempters, ideators having the lowest scores. Early-onset attempters had more attempts than late-onset attempters and, notably, their maximum attempt lethality score was lower.

[Insert Figure 1 here]

FFM dimensions

The hierarchical model revealed significant global differences between groups ($\chi^2_4 = 62.40$, $p < 0.001$). There was a decrease (indicative of less adaptive functioning) between healthy non-psychiatric controls and all clinical groups (all $p < 0.001$), and a subsequent U-shaped trend across clinical groups arranged in increasing order of late-life suicide risk: ideators/early-onset attempters had the lowest scores, whereas depressed controls and late-onset attempters scored relatively higher (Figure 1, Panel A). There was additionally a significant *study group*dimension* interaction ($\chi^2_{16} = 101.94$, $p < 0.001$) indicating distinct patterns of group differences across the five dimensions. In the post-hoc pairwise analyses of our separate models (Figure 1, Panel A and Table 2), higher neuroticism, lower extraversion and lower conscientiousness differentiated all four clinical groups from healthy non-psychiatric controls, while agreeableness was only lower in early-onset attempters and ideators compared to healthy controls. Openness did not vary significantly across groups. Neuroticism and extraversion displayed additional differences within the clinical participants: early-onset attempters scored higher on neuroticism than depressed controls, and lower on extraversion than both depressed controls and late-onset attempters. All differences remained when removing demographic covariates.

[Insert Table 2 here]

Conscientiousness subcomponents

In the hierarchical model testing group differences in conscientiousness subcomponents, there was a significant main effect of subcomponent (χ^2_2 = 709.77 $p < 0.001$), indicating that participants scored overall higher on orderliness than on goal-striving ($p < 0.001$), and scored higher on both of these measures than on dependability (resp. $p = 0.002$ and $p < 0.001$). There was a main effect of study group (χ^2_4 = 28.81 $p < 0.001$), which indicated lower conscientiousness scores in all four clinical groups than in healthy controls (similarly to our main linear model predicting conscientiousness). A significant *study group*subcomponent* (χ^2_8 = 34.93 $p < 0.001$) interaction was also present. In the post-hoc group comparisons by subcomponents, it became apparent that this effect was mainly driven by orderliness (Figure 1, Panel B and Table 3). Orderliness was higher in healthy controls than in the clinical groups and was also higher in late-onset attempters than in non-suicidal depressed controls and suicide ideators. Orderliness was the only construct differentiating late-onset attempters from depressed comparison subjects throughout the study.

[Insert Table 3 here]

DSM personality traits

In the global hierarchical model, study groups followed the same pattern as in the FFM analysis (χ^2_4 = 15.89 $p = 0.003$; in this case, the U-shaped trend between clinical groups was inverted since higher scores on the SIDP are more maladaptive). This pattern seemed to be driven by Cluster B traits, i.e. borderline, antisocial and narcissistic PDs (Figure 1, Panel C). All depressed groups scored predictably higher on PD traits than healthy comparison subjects (all $p < 0.001$).

Accounting for a significant *study group*PD type* interaction in the hierarchical model (χ^2_{16} = 30.65 $p = 0.015$), in the separate models, early-onset attempters and suicide ideators scored higher on borderline traits than depressed non-suicidal controls, while early-onset attempters scored higher on antisocial traits than both depressed controls and late-onset attempters (Figure 1, Panel C and Table 4). The same differences remained in models without demographic covariates, with the exception of higher antisocial traits in early- vs. late-onset attempters.

[Insert Table 4 here]

Discussion

Our case-control study of FFM and DSM personality traits in older adults found that a generally maladaptive personality profile was associated with suicide ideation and early-onset suicide attempts, but not with late-onset attempts. Only orderliness, a subcomponent of consciensiousness, was elevated in late-onset suicidal behavior. Two vignettes illustrating early- and late-onset cases, respectively, can be found in Table 5.

Compared to depressed non-suicidal participants, ideators and early-onset attempters were characterized by higher neuroticism and borderline traits, with early-onset attempters additionally displaying lower extraversion and greater antisocial traits. This suggests a high occurrence of labile/depressive affective states, impulsivity and interpersonal difficulties in these groups, features prominent in younger suicidal individuals.[5]

Higher lethality of attempts in the late-onset group indicated a higher risk of dying by suicide in those who first engage in suicidal behavior in late life. This group was more extraverted and less antisocial than early-onset attempters and did not display more maladaptive traits than depressed non-suicidal participants, suggesting that these dimensions of personality contribute little to late-onset suicidal behavior. This may prompt the question whether late-onset suicidal behavior is rational in that it does not arise in the context of chronic interpersonal and emotional dysfunction. Yet, all attempters in our study were depressed and most of them experienced psychopathology already in young adulthood (the mean age for any psychopathology in early- and late-onset cases was respectively 21.8 and 36.5 years), suggesting some level of chronic vulnerability.

Contrary to our hypothesis, obsessive-compulsive PD traits did not differentiate late-onset attempters from the other clinical groups. Since all of these groups scored higher on obsessive-compulsive PD than healthy controls, it may be the case that the difference originally found in anankastic (obsessive-compulsive) PD by Harwood and colleagues in their psychological autopsy study[12] was mainly due to their design, comparing suicide victims to natural death controls (many of whom may have been mentally healthy). However, we found that higher orderliness, a conscientiousness subcomponent generally considered adaptive, was higher in late-onset attempters than in both depressed non-suicidal individuals and suicide ideators. The fact that healthy controls still scored higher on this trait than all other groups, suggests that orderliness may mostly increase suicide risk in the context of depression. To the extent of our knowledge, this trait has not been directly investigated in late-life suicide. However, the two NEO-PI-R facets that most strongly correlated with orderliness in Saucier's original study,

namely order and self-discipline,[18] showed some level of association with suicidal behavior.[11,30] Several independent theorists throughout the 20th century described the profile predisposing to melancholic depression as an orderly personality with a rigid self-image, excessive adherence to social norms (hypernormia) and an intolerance of changes, ambiguity, or unpredictability.[31–33] While a few empirical studies have identified these characteristics in late-onset depression,[34] the relationship with late-life suicide has only been described qualitatively.[10,35,36] It seems nonetheless plausible that an orderly/methodical personality would facilitate planning of suicide attempts in depressed elderly populations.

The limitations of the present study were the lower number of septua- and octogenarian participants, hindering generalizability to the oldest elderly, as well as the higher percentage of missing data in one of the avoidant PD items. Even though all attempters had a current suicidal crisis at the time of baseline assessment, in some cases the attempt was remote. Attempted suicide was considered a proxy for suicide in our study. However, as individuals carrying out fatal vs. non-fatal suicidal behavior have been found to differ in some personality traits, our findings may not be fully generalizable to suicide victims.[11] Although eight out of ten measured traits had a monotonic relationship with age at first attempt (Supporting Information, Figure S3), our a priori cutoff differentiating early- and late-onset attempters, decided by median split, may have failed to capture the lifespan personality trends of conscientiousness and narcissistic traits, for which the relationship was biphasic. Our cross-sectional design did not enable testing personality stability over time nor personality traits at early-onset attempters' first attempt. However, personality may change with aging in common conditions such as early-stage Alzheimer's disease.[37–39] Further, measuring DSM PDs in late life remains inprecise, since

several criteria, such as "workaholism" for obsessive-compulsive PD, become unreliable in this age group. The assessment of personality using both a self- and a clinician-rated measure as well as the presence of multiple comparison groups serve as strengths to the study.

[Insert Table 5 here]

Conclusion

These findings advance our understanding of the dispositional diathesis to suicidal behavior in old age by highlighting heterogeneity related to its life course. Yet, the profile of late-onset cases remains relatively obscure. They may express maladaptive traits not captured by personality assessment tools developed for younger adults.[40] On the other hand, our finding of high orderliness in late-onset suicidal behavior could provide the first evidence for antagonistic pleiotropy whereby traits generally adaptive in early life convey suicide risk in old age.[41] Longitudinal studies are needed to characterize such abnormal maturational trajectories. Finally, clinicians should be aware of the high-risk but low-profile group of older patients who carry out first-time attempts without prior history of suicidal behavior or interpersonal dysfunction.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Table 1 – Sample characteristics

	Healthy controls n=45	Depressed controls n=45	Suicide ideators n=45	Early-onset attempters n=24	Late-onset attempters n=41	p value
Age (mean (sd))	68.4 (9.1)	66.3 (7.3)	63.2 (8.0)	59.7 (5.9)	64.8 (8.1)	<0.001
Gender (count (% of group)):						0.004
female	27 (60.0%)	20 (44.4%)	20 (44.4%)	19 (79.2%)	14 (34.1%)	
male	18 (40.0%)	25 (55.6%)	25 (55.6%)	5 (20.8%)	27 (65.9%)	
Education	15.7 (2.7)	15.1 (2.3)	14.6 (2.5)	14.0 (3.3)	14.5 (3.0)	0.093
Race (count (% of group)):						0.461
African-American	5 (11.1%)	7 (15.6%)	6 (13.3%)	5 (20.8%)	2 (4.9%)	
Asian	0 (0.0%)	1 (2.2%)	0 (0.0%)	0 (0.0%)	1 (2.4%)	
White	40 (88.9%)	37 (82.2%)	38 (84.4%)	19 (79.2%)	38 (92.7%)	
Multiple races	0 (0.0%)	0 (0.0%)	1 (2.2%)	0 (0.0%)	0 (0.0%)	
CIRS (mean (sd))	3.7 (2.1)	6.1 (2.5)	5.2 (2.2)	4.9 (2.4)	4.7 (2.4)	<0.001
HRSD (mean (sd))		11.6 (5.9)	12.2 (6.8)	15.7 (7.7)	10.5 (7.3)	0.029
Age of onset of depression (mean (sd))		48.4 (19.0)	38.4 (18.7)	27.9 (14.3)	46.4 (18.1)	<0.001
Age of onset of any psychopathology (mean (sd))		38.5 (23.4)	24.2 (19.0)	21.8 (14.0)	36.5 (22.3)	0.001
Lifetime anxiety (count (% of group))		14 (31.8%)	25 (55.6%)	20 (83.3%)	25 (61.0%)	<0.001
Lifetime substance (count (% of group))		14 (31.8%)	22 (48.9%)	14 (58.3%)	17 (41.5%)	0.158
SSI (mean (sd))			14.5 (6.5)	19.0 (8.3)	24.1 (7.6)	<0.001
BLS (mean (sd))				2.9 (2.3)	4.1 (1.8)	0.022
SIS total (mean (sd))				17.7 (5.0)	19.5 (6.2)	0.227
SIS-Planning (mean (sd))				7.6 (2.6)	8.5 (3.9)	0.288
Total lifetime attempts (mean (sd))				3.5 (3.6)	1.8 (1.3)	0.007
Age at first attempt (mean (sd))				30.9 (14.0)	61.3 (7.6)	<0.001
Age at most recent attempt (mean (sd))				46.0 (16.4)	62.4 (7.6)	<0.001

Legend: CIRS = Cumulative Illness Rating Scale, HRSD = Hamilton Rating Scale for Depression; SSI = Beck Scale of Suicide Ideation; BLS = Beck Lethality Scale; SIS total = Beck Suicide Intent Scale – total score; SIS planning = Beck Suicide Intent Scale – planning subscale.

Table 2 – Group differences in individual linear regression models predicting FFM dimensions

	estimate	SE	t-ratio	p.value
inverted neuroticism Z-score				
healthy controls - depressed controls	**1.74**	**0.24**	**7.11**	**<.001**
healthy controls - ideators	**2.63**	**0.25**	**10.45**	**<.001**
healthy controls - early-onset attempters	**2.61**	**0.31**	**8.39**	**<.001**
healthy controls - late-onset attempters	**2.00**	**0.26**	**7.79**	**<.001**
depressed controls - ideators	**0.90**	**0.24**	**3.69**	**0.003**
depressed controls - early-onset attempters	**0.88**	**0.31**	**2.87**	**0.036**
depressed controls - late-onset attempters	0.27	0.25	1.08	0.816
ideators - early-onset attempters	-0.02	0.30	-0.08	1.000
ideators - late-onset attempters	-0.63	0.25	-2.55	0.085
early-onset attempters - late-onset attempters	-0.61	0.31	-1.97	0.284
extraversion Z-score				
healthy controls - depressed controls	**0.98**	**0.28**	**3.47**	**0.006**
healthy controls - ideators	**1.61**	**0.29**	**5.52**	**<.001**
healthy controls - early-onset attempters	**2.02**	**0.36**	**5.64**	**<.001**
healthy controls - late-onset attempters	**0.97**	**0.30**	**3.26**	**0.012**
depressed controls - ideators	0.63	0.28	2.24	0.170
depressed controls - early-onset attempters	**1.05**	**0.35**	**2.97**	**0.027**
depressed controls - late-onset attempters	-0.01	0.29	-0.04	1.000
ideators - early-onset attempters	0.42	0.34	1.22	0.741
ideators - late-onset attempters	-0.64	0.29	-2.24	0.169
early-onset attempters - late-onset attempters	**-1.06**	**0.36**	**-2.97**	**0.027**
openness Z-score				
healthy controls - depressed controls	-0.01	0.23	-0.06	1.000
healthy controls - ideators	0.19	0.24	0.80	0.930
healthy controls - early-onset attempters	-0.13	0.30	-0.43	0.993
healthy controls - late-onset attempters	0.24	0.25	0.98	0.863
depressed controls - ideators	0.21	0.23	0.89	0.901
depressed controls - early-onset attempters	-0.11	0.29	-0.39	0.995
depressed controls - late-onset attempters	0.26	0.24	1.08	0.818
ideators - early-onset attempters	-0.32	0.29	-1.13	0.792
ideators - late-onset attempters	0.05	0.24	0.21	1.000
early-onset attempters - late-onset attempters	0.37	0.30	1.25	0.722
agreeableness Z-score				
healthy controls - depressed controls	0.60	0.26	2.29	0.151
healthy controls - ideators	**0.77**	**0.27**	**2.86**	**0.037**
healthy controls - early-onset attempters	**0.96**	**0.33**	**2.89**	**0.034**
healthy controls - late-onset attempters	0.25	0.27	0.90	0.897
depressed controls - ideators	0.17	0.26	0.66	0.964
depressed controls - early-onset attempters	0.36	0.33	1.12	0.799
depressed controls - late-onset attempters	-0.35	0.27	-1.33	0.676
ideators - early-onset attempters	0.19	0.32	0.60	0.975
ideators - late-onset attempters	-0.52	0.26	-1.98	0.279
early-onset attempters - late-onset attempters	-0.71	0.33	-2.17	0.196
conscientiousness Z-score				
healthy controls - depressed controls	**1.31**	**0.29**	**4.50**	**<.001**
healthy controls - ideators	**1.41**	**0.30**	**4.70**	**<.001**
healthy controls - early-onset attempters	**1.27**	**0.37**	**3.42**	**0.007**
healthy controls - late-onset attempters	**0.91**	**0.31**	**2.97**	**0.028**
depressed controls - ideators	0.10	0.29	0.35	0.997
depressed controls - early-onset attempters	-0.04	0.37	-0.11	1.000
depressed controls - late-onset attempters	-0.40	0.30	-1.35	0.658
ideators - early-onset attempters	-0.14	0.36	-0.40	0.995
ideators - late-onset attempters	-0.50	0.30	-1.70	0.435
early-onset attempters - late-onset attempters	-0.36	0.37	-0.98	0.864

Legend: Post-hoc pairwise comparisons of study groups (Tukey's HSD) in separate models for each FFM dimensions, controlling for age, gender and education. Neuroticism is inverted.

Table 3 – Group differences on the subcomponent level in the hierarchical linear regression model predicting conscientiousness

	estimate	SE	z.ratio	p.value
orderliness				
healthy controls - depressed controls	**4.32**	**0.67**	**6.49**	**<.001**
healthy controls - ideators	**4.31**	**0.69**	**6.27**	**<.001**
healthy controls - early-onset attempters	**3.77**	**0.85**	**4.45**	**<.001**
healthy controls - late-onset attempters	**2.41**	**0.70**	**3.44**	**0.006**
depressed controls - ideators	-0.01	0.66	-0.02	1.000
depressed controls - early-onset attempters	-0.54	0.83	-0.65	0.966
depressed controls - late-onset attempters	**-1.91**	**0.68**	**-2.82**	**0.041**
ideators - early-onset attempters	-0.53	0.81	-0.66	0.965
ideators - late-onset attempters	**-1.90**	**0.67**	**-2.81**	**0.042**
early-onset attempters - late-onset attempters	-1.36	0.84	-1.62	0.485
goal-striving				
healthy controls - depressed controls	1.52	0.67	2.28	0.154
healthy controls - ideators	**1.97**	**0.69**	**2.87**	**0.036**
healthy controls - early-onset attempters	1.60	0.85	1.89	0.326
healthy controls - late-onset attempters	1.33	0.70	1.89	0.323
depressed controls - ideators	0.45	0.66	0.68	0.960
depressed controls - early-onset attempters	0.09	0.83	0.10	1.000
depressed controls - late-onset attempters	-0.19	0.68	-0.28	0.999
ideators - early-onset attempters	-0.37	0.81	-0.45	0.991
ideators - late-onset attempters	-0.64	0.67	-0.95	0.876
early-onset attempters - late-onset attempters	-0.27	0.84	-0.33	0.998
dependability				
healthy controls - depressed controls	**1.88**	**0.67**	**2.83**	**0.039**
healthy controls - ideators	**2.04**	**0.69**	**2.97**	**0.026**
healthy controls - early-onset attempters	2.11	0.85	2.48	0.097
healthy controls - late-onset attempters	1.62	0.70	2.31	0.145
depressed controls - ideators	0.16	0.66	0.24	0.999
depressed controls - early-onset attempters	0.22	0.83	0.27	0.999
depressed controls - late-onset attempters	-0.27	0.68	-0.39	0.995
ideators - early-onset attempters	0.07	0.81	0.08	1.000
ideators - late-onset attempters	-0.42	0.67	-0.63	0.971
early-onset attempters - late-onset attempters	-0.49	0.84	-0.58	0.978

Legend: Post-hoc pairwise comparisons of study groups (Tukey's HSD) in the hierarchical mixed-effects model predicting conscientiousness scores (with subject-level intercepts as random effects). There were significant subcomponent ($\chi^2_2 = 709.77$ *$p < 0.001$)*, study group ($\chi^2_4 = 28.81$ *$p < 0.001$)* and study group*subcomponent ($\chi^2_8 = 34.93$ *$p < 0.001$*) effects in the model (see main text for a description of main effects). The model controlled for age, gender and education, letting these variables interact with subcomponent.

Table 4 – Group contrasts in individual negative binomial regression models predicting DSM PD traits

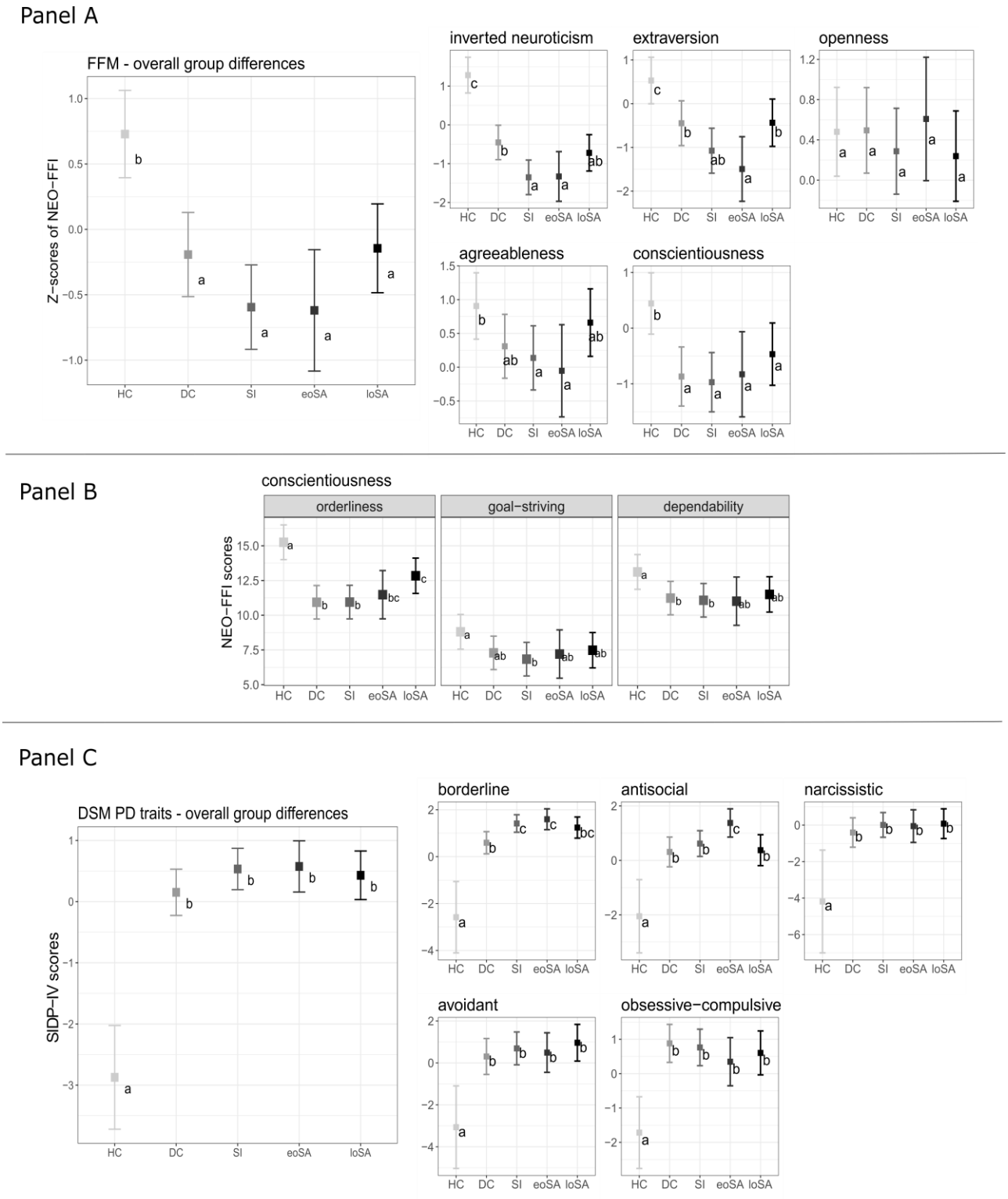
	estimate	SE	z-ratio	p.value
borderline PD traits				
healthy controls - depressed controls	**-3.18**	**0.62**	**-5.12**	**<.001**
healthy controls - ideators	**-4.00**	**0.61**	**-6.56**	**<.001**
healthy controls - early-onset attempters	**-4.18**	**0.61**	**-6.80**	**<.001**
healthy controls - late-onset attempters	**-3.82**	**0.62**	**-6.15**	**<.001**
depressed controls - ideators	**-0.82**	**0.24**	**-3.48**	**0.005**
depressed controls - early-onset attempters	**-1.00**	**0.26**	**-3.91**	**0.001**
depressed controls - late-onset attempters	-0.65	0.25	-2.55	0.081
ideators - early-onset attempters	-0.18	0.22	-0.83	0.922
ideators - late-onset attempters	0.17	0.23	0.76	0.943
early-onset attempters - late-onset attempters	0.35	0.25	1.40	0.628
antisocial PD traits				
healthy controls - depressed controls	**-2.36**	**0.57**	**-4.18**	**<.001**
healthy controls - ideators	**-2.67**	**0.56**	**-4.80**	**<.001**
healthy controls - early-onset attempters	**-3.43**	**0.56**	**-6.10**	**<.001**
healthy controls - late-onset attempters	**-2.43**	**0.57**	**-4.24**	**<.001**
depressed controls - ideators	-0.31	0.28	-1.10	0.809
depressed controls - early-onset attempters	**-1.06**	**0.30**	**-3.55**	**0.004**
depressed controls - late-onset attempters	-0.06	0.30	-0.21	1.000
ideators - early-onset attempters	**-0.76**	**0.27**	**-2.84**	**0.036**
ideators - late-onset attempters	0.24	0.28	0.86	0.913
early-onset attempters - late-onset attempters	**1.00**	**0.31**	**3.27**	**0.010**
narcissistic PD traits				
healthy controls - depressed controls	**-3.78**	**1.13**	**-3.34**	**0.007**
healthy controls - ideators	**-4.20**	**1.12**	**-3.75**	**0.002**
healthy controls - early-onset attempters	**-4.13**	**1.14**	**-3.63**	**0.003**
healthy controls - late-onset attempters	**-4.26**	**1.15**	**-3.72**	**0.002**
depressed controls - ideators	-0.42	0.40	-1.05	0.833
depressed controls - early-onset attempters	-0.35	0.47	-0.74	0.946
depressed controls - late-onset attempters	-0.48	0.43	-1.12	0.797
ideators - early-onset attempters	0.07	0.42	0.16	1.000
ideators - late-onset attempters	-0.07	0.40	-0.17	1.000
early-onset attempters - late-onset attempters	-0.13	0.48	-0.28	0.999
obsessive-compulsive PD traits				
healthy controls - depressed controls	**-2.60**	**0.46**	**-5.67**	**<.001**
healthy controls - ideators	**-2.48**	**0.46**	**-5.44**	**<.001**
healthy controls - early-onset attempters	**-2.06**	**0.49**	**-4.25**	**<.001**
healthy controls - late-onset attempters	**-2.32**	**0.49**	**-4.77**	**<.001**
depressed controls - ideators	0.12	0.30	0.39	0.995
depressed controls - early-onset attempters	0.53	0.36	1.50	0.562
depressed controls - late-onset attempters	0.28	0.33	0.85	0.914
ideators - early-onset attempters	0.42	0.34	1.24	0.727
ideators - late-onset attempters	0.16	0.33	0.49	0.989
early-onset attempters - late-onset attempters	-0.26	0.38	-0.67	0.963
avoidant PD traits				
healthy controls - depressed controls	**-3.37**	**0.84**	**-4.03**	**<.001**
healthy controls - ideators	**-3.76**	**0.83**	**-4.55**	**<.001**
healthy controls - early-onset attempters	**-3.56**	**0.84**	**-4.23**	**<.001**
healthy controls - late-onset attempters	**-4.03**	**0.85**	**-4.73**	**<.001**
depressed controls - ideators	-0.39	0.46	-0.84	0.918
depressed controls - early-onset attempters	-0.19	0.51	-0.36	0.996
depressed controls - late-onset attempters	-0.66	0.47	-1.39	0.635
ideators - early-onset attempters	0.20	0.46	0.43	0.993
ideators - late-onset attempters	-0.27	0.46	-0.58	0.978
early-onset attempters - late-onset attempters	-0.47	0.51	-0.92	0.891

Legend: Post-hoc pairwise comparisons of study groups (Tukey's HSD) in separate models for each DSM PD trait, controlling for age, gender and education. Results are given on the log scale.

Table 5 – Case vignettes

Late-onset case of suicidal behavior
Mr. L is a 65-year-old divorced white male, found unresponsive in his car in a public park after a serious suicide attempt by overdose. Mr. L describes himself as an energetic, organized, highly efficient and reliable person, on whom others also depend (he is paying for both of his children's college education). He has been working as a real estate agent for the last 18 years, but reports that he has suffered the loss of 75% of his life savings since the recession five years earlier - a major stressor in his life. He resigned to killing himself 1.5 years ago, feeling that it was the reasonable solution to his financial crisis, but wanted to wait until after a friend's wedding to avoid interfering with the lives of his loved ones. During this period, Mr. L tried to maintain an external appearance of being successful, independent, and resilient while internally feeling overwhelmed and ashamed. He planned his suicide extensively for more than a year. He states he reconsidered shooting himself in the head because of the mess it would leave for others to clean up. Mr. L wrote ten suicide notes to his children, siblings, and friends, leaving instructions on how to manage his assets in one of them, and preparing a note to put in his shirt pocket the night of the attempt for whomever found him. Mr. L denies that the suicide attempt was an emotional decision. He remains however evasive during the clinical interview and prefers to depersonalize his own emotions by quoting relevant movies and books. He endorses having a vast intellectual curiosity but disliking ambiguity or to let his mind wander without control. When asked whether he wishes he were dead now, he responds that "it would make things a lot simpler" and that he is "ashamed that others have had to come to his rescue".
Early-onset case of suicidal behavior
Mr. E is a 65-year old divorced white male, who attempted suicide at age 16 and currently experiences suicidal ideation with a plan to drive off the road into a tree. Mr. E's current episode of depression began eight years earlier in the context of his divorce, and having to care for his elderly mother who recently moved back to town. Mr. E had not been in good terms with his mother since childhood, feeling that she had abandoned him when she separated from his alcohol-dependent and physically abusive father. Though unstable, Mr. E's family was affluent, and he saw psychiatrists and therapists on and off for depression and suicidal ideation throughout his childhood. He would frequently run away from home or preparatory school to evoke a reaction from his parents, purchasing plane tickets and staying in hotels. At age 16, after a runaway did not have the intended effect, he impulsively attempted suicide by overdose and was subsequently hospitalized. He ultimately completed law school after initially dropping out of college. He later got married and stayed home to care for the children while his wife was finishing her postgraduate studies. Once she regained more time, Mr. E began to feel "superfluous," as he could not give her as much "joy" as the children could, nor remain the children's preferred caregiver. He was deeply suicidal during this time, fearing abandonment, and went so far as to write up a goodbye letter that he later deleted. Mr. E divorced his wife when he was in his late fifties, leaving her for another woman. He later called his ex-wife to apologize. She inferred that this was a "goodbye call," and intervened before he could act on his suicidal thoughts. Mr. E experiences chronic feelings of shame and worthlessness. He often begins his day wishing he had not awakened and reports intermittent suicidal ideation being a "part of [his] daily ritual."

Figure 1 - Group differences in personality traits



Legend: **Panel A** - Group comparisons from the linear mixed-effects model of NEO-FFI Z-scores with subject-level intercepts as random effect (Panel A, left) and from separate linear models predicting Z-scores for each dimension (Panel A, right). Neuroticism is inverted. **Panel B** - Group comparisons on the subcomponent level from the linear mixed-effects model predicting conscientiousness with subject-level intercepts as random effect. **Panel C** - Group comparisons from the main generalized mixed-effect model of SIDP-IV raw scores with subject-level intercepts as random effect (Panel C, left) and separate generalized negative binomial models predicting SIDP-IV scores for each DSM PD (Panel C, right). **All Panels** - Groups sharing a letter are not significantly different (Tukey's HSD). All models controlled for age, gender and education. Error bars represent 95% confidence intervals. Legend: HC, healthy comparison subjects; DC, depressed comparison subjects; SI, suicide ideators; eoSA, early-onset suicide attempters; loSA, late-onset suicide attempters.

Supporting Information

Figure S1 – Pearson correlations between NEO-FFI dimensions in the total sample (n = 200). Legend: N, neuroticism; E, extraversion; O, openness; A, agreeableness; C, conscientiousness.

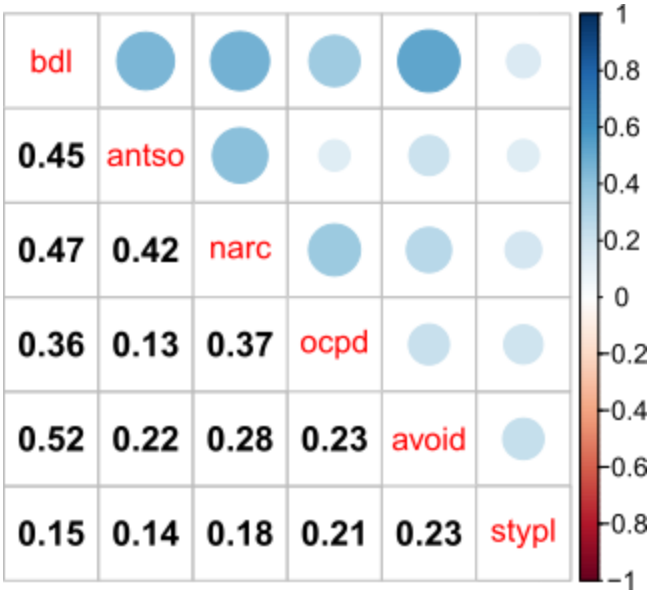


Figure S2 – Pearson correlations between SIDP-IV PD traits treated as continuous variables, in the subsample where this measure was available (n = 160). Legend: bdl, borderline; antso, antisocial; narc, narcissistic; ocpd, obsessive-compulsive; avoid, avoidant; stypl, schizotypal.

	Healthy controls n=37	Depressed controls n=32	Suicide ideators n=36	Early-onset attempters n=26	Late-onset attempters n=29	p-value
Age (mean (sd))	65.8 (8.66)	65.9 (8.08)	61.0 (5.44)	59.7 (6.96)	66.41 (8.97)	0.002
Gender (count (%)):						0.002
Female	25 (67.6%)	14 (43.8%)	16 (44.4%)	19 (73.1%)	9 (31.0%)	
Male	12 (32.4%)	18 (56.2%)	20 (55.6%)	7 (26.9%)	20 (69.0%)	
Education	15.8 (2.7)	15.1 (2.4)	15.1 (2.2)	14.3 (3.0)	14.1 (2.2)	0.021
Race (count (%)):						0.440
African-American	3 (8.1%)	5 (15.6%)	4 (11.1%)	7 (26.9%)	3 (10.3%)	
Asian	0 (0.0%)	1 (3.1%)	0 (0.0%)	1 (3.8%)	1 (3.4%)	
White	34 (91.9%)	26 (81.2%)	31 (86.1%)	18 (69.2%)	25 (86.2%)	
Multiple races	0 (0.0%)	0 (0.0%)	1 (2.8%)	0 (0.0%)	0 (0.0%)	
CIRS (mean (sd))	3.7 (2.1)	5.8 (2.8)	5.5 (2.2)	4.7 (2.6)	5.6 (2.6)	0.011
HRSD (mean (sd))		13.8 (6.1)	16.9 (7.2)	16.9 (6.5)	14.8 (9.0)	0.232
Age of onset of depression (mean (sd))		47.7 (18.5)	39.3 (16.6)	31.1 (14.3)	42.4 (18.4)	0.013
Age of onset of any psychopathology (mean (sd))		36.2 (23.1)	20.1 (14.2)	24.8 (15.3)	32.5 (20.4)	0.010
Lifetime anxiety (count (%))		9 (29.0%)	20 (55.6%)	21 (72.4%)	22 (66.7%)	0.003
Lifetime substance (count (%))		11 (35.5%)	22 (61.1%)	15 (51.7%)	17 (51.5%)	0.217
SSI (mean (sd))			16.0 (6.5)	18.7 (7.5)	23.5 (6.8)	<0.001
BLS (mean (sd))				3.1 (2.2)	4.0 (1.8)	0.094
SIS total (mean (sd))				17.3 (5.1)	19.5 (4.6)	0.087
SIS-Planning (mean (sd))				7.4 (2.7)	8.3 (3.6)	0.301
Total lifetime attempts (mean (sd))				3.8 (3.6)	2.2 (1.6)	0.028
Age at first attempt (mean (sd))				31.4 (14.7)	61.0 (7.9)	<0.001
Age at most recent attempt (mean (sd))				46.8 (16.2)	62.7 (8.0)	<0.001

Table S1 – Characteristics of SIDP-IV subsample. Legend: CIRS = Cumulative Illness Rating Scale, HRSD = Hamilton Rating Scale for Depression; SSI = Beck Scale of Suicide Ideation; BLS = Beck Lethality Scale; SIS total = Beck Suicide Intent Scale – total score; SIS planning = Beck Suicide Intent Scale – planning subscale.

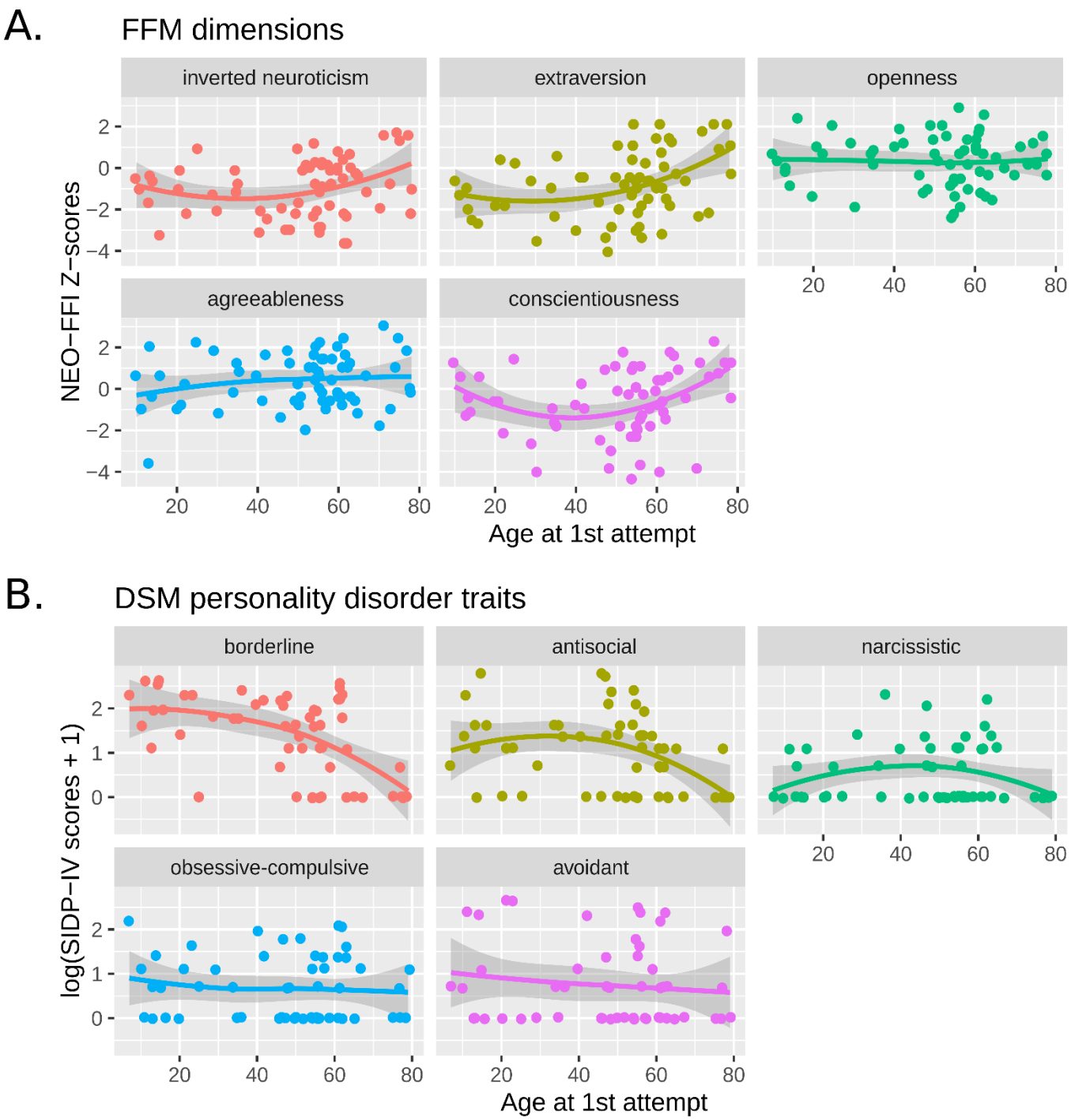


Figure S3 – Personality traits as a function of age at first lifetime attempt. Locally weighted scatterplot smoothing (LOESS) model showing a monotonic relationship between personality traits and age at first attempt for FFM dimensions, n = 200 (panel A) and DSM PD traits, n = 160 (panel B). Dots correspond to single data points, error bars are shown in dark grey. Whereas the relationship for most measured personality dimensions and PD traits is monotonic, conscientiousness and narcissistic PD traits display a biphasic pattern, with a midlife nadir or peak, respectively.