Decision-Making Competence and Attempted Suicide

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ABSTRACT

Objective: The propensity of people vulnerable to suicide to make poor life decisions is increasingly well documented. Do they display an extreme degree of decision biases? The present study used a behavioral-decision approach to examine the susceptibility of low-lethality and high-lethality suicide attempters to common decision biases that may ultimately obscure alternative solutions and deterrents to suicide in a crisis.

Method: We assessed older and middle-aged (42–97 years) individuals who made high-lethality (medically serious) (n = 31) and low-lethality suicide attempts (n = 29). Comparison groups included suicide ideators (n = 30), nonsuicidal depressed participants (n = 53), and psychiatrically healthy participants (n = 28). Attempters, ideators, and nonsuicidal depressed participants had nonpsychotic major depression (*DSM-IV* criteria). Decision biases included sunk cost (inability to abort an action for which costs are irrecoverable), framing (responding to superficial features of how a problem is presented), underconfidence/overconfidence (appropriateness of confidence in knowledge), and inconsistent risk perception. Data were collected between June 2010 and February 2014.

Results: Both high- and low-lethality attempters were more susceptible to framing effects as compared to the other groups included in this study ($P \leq .05$, $\eta_p^2 = 0.06$). In contrast, low-lethality attempters were more susceptible to sunk costs than both the comparison groups and high-lethality attempters ($P \leq .01$, $\eta_p^2 = 0.09$). These group differences remained after accounting for age, global cognitive performance, and impulsive traits. Premorbid IQ partially explained group differences in framing effects.

Conclusions: Suicide attempters' failure to resist framing may reflect their inability to consider a decision from an objective standpoint in a crisis. Failure of low-lethality attempters to resist sunk cost may reflect their tendency to confuse past and future costs of their behavior, lowering their threshold for acting on suicidal thoughts.

J Clin Psychiatry 2015;76(12):e1590–e1597
dx.doi.org/10.4088/JCP.15m09778

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Older adults who attempt suicide often regret this decision, describing it as a "bad choice." A constricted temporal focus on immediate goals and concrete thinking have been theorized to obscure alternatives to suicide in a crisis.[1,2] People often proceed with the suicidal plan even after realizing, in the words of Dostoevsky, its "absurdity and monstrosity"[3] (see also attemptsurvivors.com/our-stories/). According to behavioral decision theory, humans aim to be optimal decision makers by making rational choices as proposed by, for example, expected utility theory.[4] By contrast, suicidal behavior often co-occurs with conditions hallmarked by suboptimal decisions such as gambling and addiction.[5,6] While the evidence is mixed,[7] a number of studies report that, in the laboratory, suicide attempters perform poorly on gambling tasks[8,9] and describe themselves as poor problem solvers,[10,11] suggesting that suicidal behavior is facilitated by poor decision making.

Behavioral decision research has revealed that people often systematically deviate from normative standards for rational decision making (for a review of normative decision theory, see Edwards[4]). For example, they persist with failing plans despite irrecoverable investments, ie, sunk cost bias,[12] and make decisions that are influenced by irrelevant variations in how information is presented, ie, framing effects.[13] Systematic individual differences in such decision-making biases can be captured with a validated measure, the Adult Decision-Making Competence (A-DMC)[14] battery of tasks. This measure has reliability across decision-making tasks and validity for real-world decision outcomes even after controlling for fluid intelligence and socioeconomic status.[14,15] However, neither these insights into decision-making biases nor this measure has yet been applied to characterize decision deficits associated with suicidal behavior. Thus, we investigated whether suicide attempters demonstrate exaggerated decision-making biases.

Our study focused on attempted suicide in older and middle-aged adults, since the suicide rate is high in these age groups.[16] Additionally, older adults who attempt suicide are more similar demographically to those who die by suicide than are younger suicide attempters. Suicide attempts also tend to be more lethal in older adults.[17] Furthermore, most older adults who attempt suicide suffer from depression[18,19]; however, only a minority contemplate suicide, and an even smaller number proceed to act on those thoughts. To characterize the relationship between attempted and contemplated suicide and decision-making competence above and beyond the effects of depression or suicidal ideation, our study groups included older adults with a history of suicide attempt (attempters), those who have contemplated suicide but have never attempted (ideators), depressed individuals with no history of suicide attempt or suicidal ideation (nonsuicidal depressed participants), and psychiatrically healthy older adults. This design allowed us to investigate systematic group differences in decision-making competence, which could suggest or disprove the possibility that decision biases operate at the final stage of the suicidal process: that is, the point at which persons act on suicidal ideas.

Clinical Points

- People vulnerable to suicide make poor life decisions, yet we know little about their decision-making competence.
- We found that suicide attempters are less likely to avoid common decision biases than control groups. Namely, they lacked a flexible and critical mind to avoid the effect of framing and were excessively focused on past negative experiences. Improving decision competence could be a goal of psychotherapy with suicide attempters.

Moreover, suicide attempts are heterogeneous, ranging from high-lethality, with significant medical damage requiring admission to a medical or surgical unit or treatment in an emergency outpatient department, to low-lethality attempts that are not likely to cause significant medical damage. High- and low-lethality attempters often display distinct clinical and biological profiles.[20,21] Earlier studies indicated that low-lethality attempters displayed exaggerated discounting of delayed rewards,[22] while high-lethality attempters were characterized by deficits in cognitive inhibition,[23,24] failure to shift sets,[25] and interference of social emotions with decision making.[26] However, it remains an open question as to how or whether the heterogeneity in the lethality of suicidal behavior maps onto specific decision-making deficits. Tests of biases are one way to capture the decision-making phenotypes of suicide attempters. Thus, our analyses examined decision-making biases in high- and low-lethality suicide attempters separately.

We tested whether older adults who attempted suicide would display lower decision-making competence than the other groups, as seen in lower scores across the following A-DMC tasks:

(1) Resistance to sunk costs: measures the ability to discontinue actions where costs are irrecoverable.[27] Compared to other domains of decision competence, resistance to sunk costs is a more affect-laden process. For example, negative emotions such as anger[28] and anxiety[29] have been shown to increase sunk-cost bias. In our previous studies,[22] low-lethality suicide attempts were associated with maladaptive impulsive behaviors, such as inability to delay gratification. Therefore, low-lethality attempters can be thought of as generally having a lower threshold for acting on their suicidal thoughts, in contrast to high-lethality attempters, who tend to engage in more premeditation and preparation and choose more lethal methods. Thus, we investigated whether low-lethality attempters would be more likely to show deficits in this affectively laden domain of decision competence.

(2) Resistance to framing effects: measures the ability to make decisions that are unaffected by normatively meaningless differences in how information is presented. Resisting framing effects is cognitively demanding, as one needs to conceptualize the problem on an abstract level; thus, performance is most likely affected by cognitive deficits that have been associated with suicide attempts.[24,30–32] Therefore, we investigated whether both high- and low-lethality attempter groups would be overly influenced by framing effects.

(3) Underconfidence/overconfidence: assesses the appropriateness of confidence in one's knowledge. The tendency to overestimate knowledge is sometimes diminished in patients with mood disorders ("depressive realism").[33] Given this, and the association of depression with pessimism, we investigated whether nondepressed participants would be more likely to report confidence that is not justified by their level of knowledge.

(4) Consistency in risk perception: assesses the ability to follow probability rules when thinking about the likelihood of future events. Given our previous findings[9] that suicide attempters ignored probabilities on a gambling task, we investigated whether both attempter groups would have deficits in following probability rules as measured by this task.

Finally, we examined whether group differences in decision competence were epiphenomenal (secondary) to other components of vulnerability to suicide. For example, cognitive impairment[24,25,30,32] and impulsive-aggressive personality traits[34,35] have been recognized as components of individual vulnerability to suicide ("suicidal diathesis"). Studies have shown a negative correlation between cognitive ability and violations of cost-benefit rules, such as resistance to sunk costs[36] and framing errors.[37] In addition, certain maladaptive personality traits that are overrepresented among suicidal people, such as high neuroticism, low conscientiousness, and high impulsivity,[38] have been associated with framing errors.[39,40] Thus, we examined whether group differences in decision-making competence persisted after accounting for cognitive ability, chronic interpersonal difficulties, and impulsivity.

METHOD

Sample and Procedures

The study was conducted at a university teaching hospital and included 171 participants (age range, 42–97 years; mean = 66.3; SD = 9.9). All participants provided written informed consent. Data were collected between June 2010 and February 2014. The University of Pittsburgh Institutional Review Board approved the study.

Suicide attempters (n = 60) had engaged in a self-injurious act with the intent to die within a 2-week period prior to entering the study or had a history of past suicide attempt and current suicidal ideation with a plan at the time of study enrollment. Medical seriousness of attempts was assessed using the Beck Lethality Scale (BLS).[41] For participants with multiple attempts, data for the highest lethality attempt are presented. Following the literature, high-lethality attempters scored ≥ 4 on the BLS, whereas low-lethality attempters incurred no significant medical damage and scored a ≤ 3 on the BLS. Current suicidal ideation was assessed using the Beck Scale for Suicidal Ideation.[42]

Suicide ideators (n = 30) endorsed suicidal ideation with a specific plan but had no lifetime history of suicide attempt.

Table 1. Demographic and Clinical Characteristics (N = 171)

Characteristic	Nonpsychiatric Controls (HC) (n = 28)	Nonsuicidal Depressed Participants (D) (n = 53)	Ideators (I) (n = 30)	Low-Lethality Attempters (LL) (n = 29)	High-Lethality Attempters (HL) (n = 31)	Statistic	*P* Value	Post Hoc Comparisons
Age, mean (SD), y	68.4 (12.0)	69.4 (8.7)	65.1 (10.7)	62.0 (7.4)	64.0 (9.6)	$F = 3.7$	.006	D > LL
Male gender, %	43	45	60	52	52	$\chi^2 = 2.3$	.68	…
White race, %	86	79	87	79	97	$\chi^2 = 7.2$	.51	…
Years of education, mean (SD)	14.8 (2.0)	14.4 (2.6)	15.0(2.9)	14.4 (3.1)	12.8 (3.3)	$F = 2.9$	.02	I > HL
Household income per capita (× 1,000), mean (SD)	24.6 (12.9)	18.4 (20.3)	23.4 (28.3)	17.8 (20.2)	20.3 (18.6)	$F = 0.6$	.67	…
Hamilton Depression Rating Scale score (without suicide items), mean (SD)	2.3 (1.9)	11.9 (5.2)	13.4 (6.3)	17.7 (7.0)	15.1 (8.4)	$F = 27.0$	< .001	HC < D, I, LL, HL; D < LL
Global cognitive functioning: DRS[a] total score, mean (SD)	138 (3.4)	135 (5.3)	133 (8.5)	134 (5.5)	133 (6.6)	$F = 3.2$	.015	HC > HL
Lifetime substance abuse, n (%)	…	5 (10)	11 (37)	8 (28)	9 (29)	$\chi^2 = 9.1$	.03	…
Current substance abuse, n (%)	…	0	7 (23)	5 (17)	3 (10)	$\chi^2 = 7.4$	.06	…
Scale for Suicidal Ideation, mean (SD)	0.04 (0.2)	0.2 (0.7)	15.4 (8.3)	24.5 (8.4)	25.8 (3.9)	$F = 199.0$	< .001	HC, D < I, LL, HL; I < LL, HL
Suicide Intent Scale, mean (SD)	…	…	…	14.9 (5.3)	19.3 (4.5)	$F = 12.0$	.001	…
Suicide Intent Scale, planning, mean (SD)	…	…	…	5.5 (2.9)	8.0 (2.7)	$F = 11.0$	.002	…
Age at first attempt, mean (SD), y	…	…	…	47.1 (16.1)	54.2 (18.3)	$F = 2.4$	.13	…
No. of attempts, mean (SD)	…	…	…	1.6 (0.9)	1.7 (1.1)	$F = 0.1$	.74	…
Intensity of antidepressant pharmacotherapy during current episode, mean (SD)[a]	…	3.9 (1.0)	4.6 (1.7)	5.0 (2.0)	6.0 (3.1)	$F = 6.8$	< .001	DC, I < HL
Inventory of Interpersonal Problems, mean (SD)								
Interpersonal sensitivity	2.4 (2.2)	6.0 (3.9)	9.3 (5.3)	9.2 (3.9)	8.4 (4.4)	$F = 14.6$	< .001	HC < D, I, LL, HL; D < I, LL
Interpersonal ambivalence	2.9 (4.2)	3.7 (3.4)	5.5 (5.0)	6.8 (5.3)	5.7 (5.4)	$F = 3.8$	.006	H < LL; D < LL
Aggression	1.2 (1.5)	4.3 (3.8)	6.2 (4.9)	5.7 (3.5)	4.7 (5.1)	$F = 6.3$	< .001	HC < D, I, LL, HL
SPSI, impulsivity/carelessness, mean (SD)	1.5 (1.7)	4.9 (3.6)	4.7 (3.0)	6.0 (3.7)	7.1 (4.7)	$F = 9.6$	< .001	HC < D, I, LL, HL; D < HL
WTAR, mean (SD)	111.8 (8.5)	106.2 (14.9)	108.6 (15.2)	100.2 (15.3)	98.9 (18.1)	$F = 3.5$	.01	HC > HL

[a]Threshold greater than 3.
Symbol: … = not applicable.
Abbreviations: DRS = Mattis Dementia Rating Scale, SPSI = Social Problem-Solving Inventory, WTAR = Wechsler Test of Adult Reading.

These participants seriously contemplated suicide and communicated some intention to family or medical staff triggering inpatient psychiatric admission or initiation of mental health treatment.

Nonsuicidal depressed participants (n = 53) had no lifetime history of suicide attempt or suicidal ideation. Participants with passive death wish were excluded from the nonsuicidal depressed group.

Suicide attempters, ideators, and nonsuicidal depressed participants were diagnosed with nonpsychotic major depression using the Structured Clinical Interview for *DSM-IV* Axis I Disorders, Patient Edition.[43] Depression severity was measured by the 17-item Hamilton Depression Rating Scale.[44] We excluded individuals with clinical dementia (score < 24 on the Mini-Mental State Examination[45]) and those with a history of neurologic disorders, delirium, or sensory disorders that preclude neuropsychological testing. Participants continued to receive psychotropic medications as clinically indicated. We also included 28 nonpsychiatric controls, who had no lifetime history of mental health treatment and no lifetime diagnosis of *DSM-IV* Axis I disorders (healthy controls). For demographic and clinical characterization of the sample, see Table 1.

Gender, race, and per capita household income were similar across groups. Nonsuicidal depressed participants were older than the suicide attempters. In addition, high-lethality attempters had lower education than nonpsychiatric controls and suicide ideators. Consequently, we included age and education in the regression models as covariates.

A-DMC

The A-DMC is available online (http://www.sjdm.org/dmidi/Adult_-_Decision_Making_Competence.html); for detailed description, see Bruine de Bruin et al.[14] A research specialist administered the A-DMC task at the participants' own pace. More on sample items and scoring can be found in eAppendix 1. Briefly:

Sunk cost. Susceptibility to sunk cost bias is measured by 10 items (eg, *You and your friend have driven halfway to a resort. Both you and your friend feel sick. You both feel that you both would have a much better weekend at home. Your friend says it is "too bad" you already drove halfway because you both would much rather spend the time at home. You agree. Would you be more likely to drive on or turn back?*).

Framing effects. Resistance to framing effects is measured by 7-item pairs of attribute framing

Table 2. Group Differences in Resistance to Sunk Cost Persist After Accounting for Demographic Factors (model 2) and Global Cognition (model 3) (N = 171)

	Group Status			Gender		Race		Education (years)		DRS			
Model	*F*	η_p^2	*df*	*F*	η_p^2	F	η_p^2	*F*	η_p^2	*F*	η_p^2	R^2	Adjusted R^2
1	4.2**	0.09	4	…		…		…		…		0.09	0.07
2	3.9**	0.09	4	0.7	0.00	1.8	0.02	1.6	0.01	…		0.13	0.08
3	3.8**	0.09	4	1.3	0.01	1.2	0.02	0.4	0.00	7.9**	0.05	0.17	0.12

**$P \leq .01$.
Abbreviation: DRS = Mattis Dementia Rating Scale.

(eg, *the quality of ground beef labeled 80% lean or 20% fat, advising a family member about a cancer treatment with a 50% success rate or a 50% failure rate)* and 7-item pairs measuring risky-choice framing tasks. The positive frames and negative frames appear in separate sets with different item orders and are separated by other A-DMC tasks.

Underconfidence/overconfidence. Participants indicate whether statements are true or false (eg, *Alcohol causes dehydration*, true or false?), then assess their confidence in that answer on a scale from 50% (just guessing) to 100% (absolutely sure). The overall score reflects mean confidence minus percent correct across items. Overall, a decision maker who answers 70% of items correctly should express 70% confidence.

Consistency in risk perception. Twenty items ask participants to judge the chance of an event (eg, *What is the probability that you will get into a car accident while driving during the next year? What is the probability that your driving will be accident-free during the next year?*) on a linear scale ranging from 0% (no chance) to 100% (certainty). Scoring is the percentage of consistent risk judgments across related events.

Global cognitive ability was assessed with the Mattis Dementia Rating Scale.[46] Scores on the Mattis Dementia Rating Scale range from 0 to 144, with lower scores indicating more impairment; its subscales assess initiation/perseveration, attention, construction, conceptualization, and memory. The Wechsler Test of Adult Reading (WTAR)[47] was used as an estimate for premorbid intelligence.

Impulsivity was assessed with the Social Problem-Solving Inventory, impulsivity/carelessness subscale.[48]

Chronic interpersonal problems were measured by the Inventory of Interpersonal Problems,[49,50] which assesses interpersonal sensitivity, ambivalence, and aggression indicative of a dysfunctional personality.

Data Analyses

We first examined group differences in overall decision-making competence using a multivariate analysis of variance (ANOVA) with 4 normalized A-DMC subscale scores jointly considered as dependent variables. This analysis was repeated while taking into account possible confounders (demographic characteristics and global cognitive ability). To examine group differences in specific domains of decision making, we performed follow-up ANOVAs using each of the 4 A-DMC subscales as dependent variables. Taking advantage of our 5-group design, we followed up by systematically testing group differences reflecting presumed effects of depression, suicidal ideation, suicide attempt, and attempt lethality using a Helmert contrast (comparing healthy controls vs all depressed subjects, nonsuicidal depressed vs all suicidal subjects [ideators, high-lethality, and low-lethality], suicide ideators vs all attempters, low-lethality vs high-lethality attempters). The second model also included demographic characteristics to test whether group differences were robust to the inclusion of these covariates. A third model included all of the above characteristics as well as the Mattis Dementia Rating Scale score. Finally, in exploratory analyses, we tested potential explanatory variables (impulsivity, interpersonal functioning, depression severity, history of substance abuse, premorbid IQ) that may have accounted for group differences in decision competence.

RESULTS

Group Differences in Overall Decision Competence

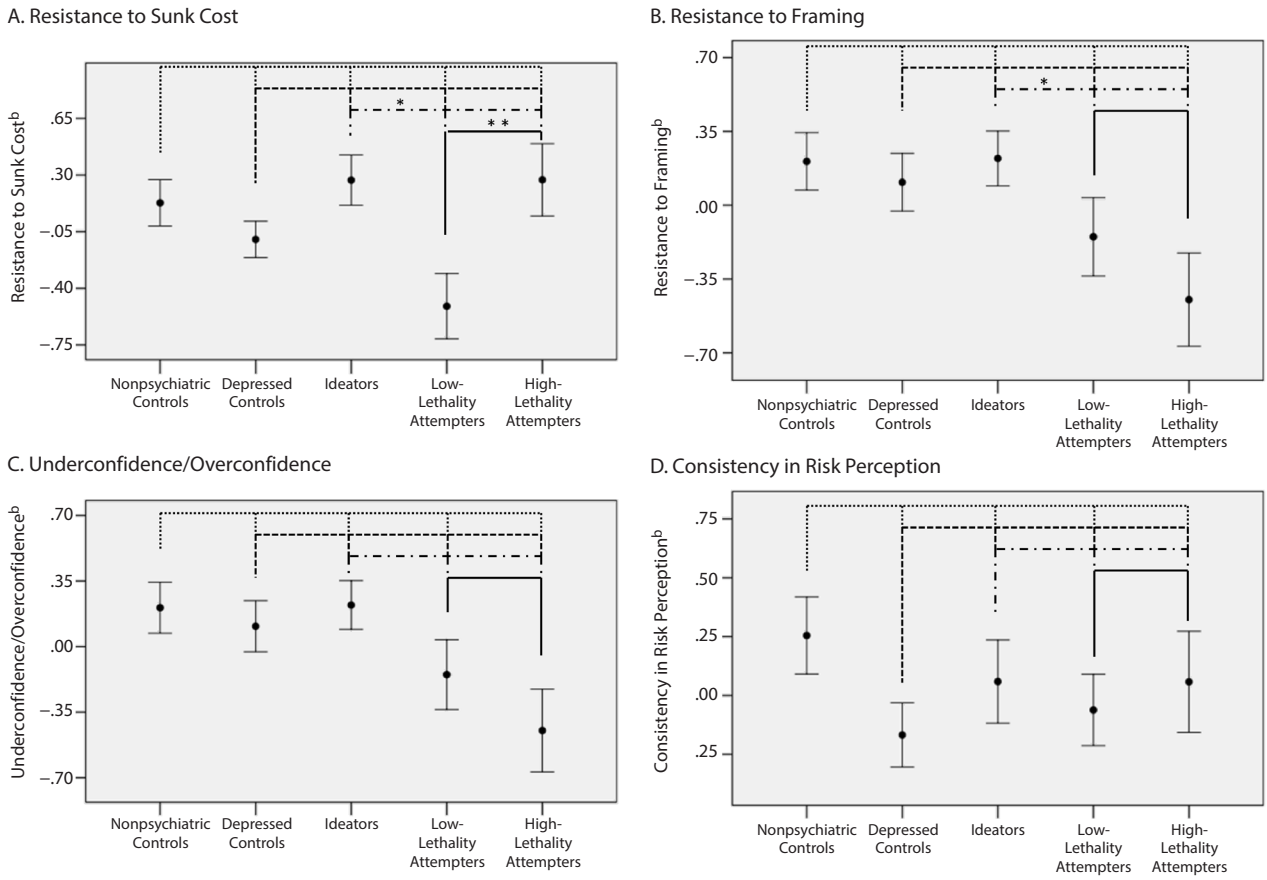
A multivariate ANOVA, using the scores on the 4 A-DMC subscales as dependent variables, indicated significant group differences in decision-making competence (Wilks $\lambda = 0.83$, $F_{16,516.94} = 2.06$, $P = .009$, $\eta_p^2 = 0.05$), which remained after controlling for demographic characteristics (group: Wilks $\lambda = 0.81$, $F_{16,489.44} = 2.23$, $P < .01$, $\eta_p^2 = 0.05$; age: $\eta_p^2 = 0.04$; sex: $\eta_p^2 = 0.07$; race: $\eta_p^2 = 0.06$; education: $\eta_p^2 = 0.05$) and for global cognitive ability (group: Wilks $\lambda = 0.82$, $F_{16,480.28} = 2.04$, $P = .01$, $\eta_p^2 = 0.05$; age: $\eta_p^2 = 0.04$; sex: $\eta_p^2 = 0.07$; race: $\eta_p^2 = 0.06$; education: $\eta_p^2 = 0.05$; global cognitive ability: $\eta_p^2 = 0.07$).

Group Differences Across Domains

Next, we conducted separate univariate ANOVAs on each of the 4 A-DMC subscales. There were significant mean group differences in resistance to sunk costs (Table 2). While all depressed participants did not differ from healthy controls ($P = .07$) and all participants with suicidal ideation did not differ from nonsuicidal depressed participants ($P = .96$), suicide attempters were more susceptible to sunk cost than suicide ideators ($P = .04$). Low-lethality attempters were more susceptible to sunk cost than high-lethality attempters ($P < .002$; Figure 1A).

There was also a significant mean difference in resistance to framing effects across the groups (Table 3). While all depressed participants did not differ from healthy controls ($P = .15$) and all participants with suicidal ideation did not differ from nonsuicidal depressed participants ($P = .44$),

Figure 1. Mean Group Differences in Separate Decision-Making Competencies as Reflected by the Adult Decision-Making Competence Battery of Tasks[a]



[a]Lower scores represent worse performance. Helmert contrasts were performed to investigate the effect of depression, suicidal ideation, suicide attempt, and attempt lethality.
[b]Mean standardized residual, adjusted for age, gender, race, education, and global cognition measured by Mattis Dementia Rating Scale. The vertical bars denote ± 1 standard error.
*$P \leq .05$. **$P \leq .005$.

Table 3. Group Differences in Resistance to Framing Persist After Accounting for Demographic Factors (model 2) and Global Cognition (model 3) (N = 171)

	Group Status			Gender		Race		Education (years)		DRS		Age			
Model	F	η_p^2	df	F	η_p^2	F	η_p^2	F	η_p^2	F	η_p^2	F	η_p^2	R^2	Adjusted R^2
1	2.8*	0.06	4	…		…		…		…		…		0.06	0.04
2	3.4*	0.08	4	2.0	0.01	7.3***	0.08	5.4*	0.03	…		5.8*	0.04	0.23	0.19
3	3.2*	0.07	4	2.0	0.01	7.1***	0.08	5.0*	0.03	0.0	0.00	4.7*	0.03	0.23	0.18

*$P \leq .05$. ***$P \leq .001$.
Abbreviation: DRS = Mattis Dementia Rating Scale.

suicide attempters were more susceptible to framing effects than suicide ideators ($P < .01$; Figure 1B). There was no effect of attempt lethality ($P = .23$).

Contrary to our expectation that depressed participants were more likely to recognize the extent of their knowledge, we failed to find significant group differences in underconfidence/overconfidence ($F_{4,166} = 1.4$, $P = .23$; Figure 1C). An additional analysis examining confidence after controlling for knowledge[51] (ie, whether one is more or less confident than his knowledge would justify) similarly failed to find any group differences ($F_{4,165} = 2.1$, $P = .09$). There were also no group differences in consistency of risk perception among the groups ($F_{4,166} = 1.9$, $P = 0.11$; Figure 1D).

Group Differences in Resistance to Sunk Cost and Framing Effects After Adjustments for Possible Confounders

Group differences in resistance to sunk cost scores remained significant after accounting for age, gender, race, and education (see Table 2). Poorer global cognition (lower Mattis Dementia Rating Scale scores) was associated with poorer resistance to sunk cost ($F_{9,161} = 3.6$, $P < .001$, $\eta_p^2 = 0.05$),

but even after its inclusion in the model, group differences remained ($F_{4,161} = 3.8$, $P < .01$, $\eta_p^2 = 0.09$).

Similarly, group differences remained significant when IQ (WTAR scores) (available on 150/171 participants) was added to the model (group: $F_{4,139} = 2.69$, $P = .03$, $\eta_p^2 = 0.08$; WTAR: $F_{1,139} = 4.29$, $P = .04$, $\eta_p^2 = 0.03$).

Group differences in resistance to framing effects remained significant in the model including age, race, gender, and education (Supplementary eTable 1A) ($F_{4,161} = 3.4$, $P = .01$, $\eta_p^2 = 0.08$), while age, race, and education explained additional variance ($F_{9,161} = 5.3$, $P < .01$, $\eta_p^2 = 0.23$). Including global cognition did not explain any additional or unique variance. However, when premorbid IQ was included in the model, group differences were no longer significant (added to the full model with age, sex, race, education, Mattis Dementia Rating Scale, group: $F_{4,139} = 2.01$, $P = .10$, $\eta_p^2 = 0.06$; WTAR: $F_{1,139} = 1.71$, $P = .19$, $\eta_p^2 = 0.01$).

Additional sensitivity analyses and correlations with the A-DMC subscales and clinical and cognitive variables are reported in eAppendix 1.

Exploratory Analyses

We tested whether group differences in decision-making competence were explained by maladaptive personality traits, particularly impulsivity. Because participants reporting higher interpersonal ambivalence also displayed somewhat lower resistance to both sunk cost and framing (Supplementary eTable 1A), we included these variables in our analyses of group differences. After accounting for age, gender, race, and education, interpersonal ambivalence explained no additional variance in resistance to sunk cost ($F_{4,155} = 1.56$, $P = .21$, $\eta_p^2 = 0.01$) but predicted lower resistance to framing ($F_{4,155} = 5.91$, $P = .02$, $\eta_p^2 = 0.04$), with group differences remaining significant. Impulsivity (Social Problem-Solving Inventory, impulsivity/carelessness subscale) did not explain additional unique variance in resistance to sunk costs or shared variance with group. Impulsivity explained a small proportion of variance in resistance to framing shared with group, but it did not increase the total variance explained. Group differences remained significant. We performed additional analyses to account for depression severity. HDRS-16 scores (without the suicide item) did not explain any additional variance in resistance to framing or in sunk cost ($P > .61$, $\eta_p^2 < 0.01$) when added to the full model (age, sex, education, Mattis Dementia Rating Scale, group, WTAR). In participants with major depression, lifetime history of substance use disorders did not explain any additional variance in resistance to framing ($P = .54$, $\eta_p^2 = 0.01$) when added to the full model. It did predict lower resistance to sunk cost ($F_{2,91} = 3.58$, $P = .03$, $\eta_p^2 = 0.07$), but significant group differences remained ($F_{3,91} = 3.13$, $P = .029$, $\eta_p^2 = 0.09$).

DISCUSSION

We found significant group differences in overall decision-making competence. Subsequent analyses revealed that suicide attempters were more susceptible to framing effects than nonpsychiatric controls, depressed nonsuicidal individuals, and ideators, a difference partially explained by premorbid IQ. Low-lethality attempters were more susceptible to sunk cost than nonpsychiatric controls, suicide ideators, and high-lethality attempters.

What are the psychological underpinnings of susceptibility to sunk cost? When compared to other decision-making abilities, resistance to sunk cost appears to rely less on fluid intelligence.[14] Rather, it is impaired in individuals prone to regret and rumination about losses.[52] Inability to resist sunk costs can be thought of as a form of entrapment.[53] To the extent that these group differences in the ability to resist sunk costs from the past can be generalized to the suicidal crisis, suicide attempters' decisions may be driven by their stronger focus on painful past experiences.

We found that suicide attempters were susceptible to framing bias. The ability to resist framing effects is exemplified by a subject giving the same response to a pair of equivalent prospects, eg, one presented in a gain and another in a loss frame.[54] Suicide attempters were impaired on this cognitively demanding task. Susceptibility to framing effects was modestly correlated with age, global cognition, IQ, ambivalence in interpersonal relationships, and impulsive or careless social problem-solving style. Of these, only IQ partially explained the group differences in susceptibility to framing effects; results from large epidemiologic studies demonstrate a relationship between IQ and death by suicide and suicide attempt.[55,56] It is possible that the inability to conceptualize the problem at a higher abstract level inhibits the search for alternative solutions in a suicidal crisis.

Decision making is often thought of as a balance between deliberative and affective processes. From this perspective, diminished ability to resist sunk costs and framing effects may be particularly detrimental in the face of extreme affects,[57] propelling a suicidal crisis.

Our prediction that depressed participants would differentially recognize the extent of their knowledge compared to nonpsychiatric controls was not supported. It is possible, however, that our measure of general knowledge was not adequately sensitive to capture domain-specific misjudgment of confidence. For example, overconfidence has been related to perceived knowledge in gambling[58] and substance use[15] in samples characterized by those risky behaviors. Tasks that assess knowledge about depressive illness, self-efficacy, or both may be more sensitive indicators of confidence misjudgment in depressed individuals than general knowledge questions.

Consistency in risk perception was relatively similar among the groups and modestly correlated with interpersonal aggression but not with cognitive abilities. Those who indicated higher interpersonal aggression perceived risk less consistently. Impulsive-aggressive traits are more pronounced among younger suicidal individuals,[34] who may show a greater impairment in this domain.

Our results resonate with the entrapment theory of suicide[53] and the conceptualization of suicidal crisis as a state

of entrapment and ruminative flooding,[59] indicating that the experience of entrapment may be shaped by an excessive focus on past losses and an inability to flexibly conceptualize one's situations. Even more relevant to our results is Baumeister's escape theory, where death is sought to end "aversive […] awareness of one's painful life situation."[1(p107)] It is easy to see how excessive attention to sunk costs—irrecoverable losses—would contribute to such an aversive self-awareness.

We found that older people with a history of suicide attempts display heterogeneity in decision competence that somewhat mirrors the clinical presentation of the attempt. Decision-making abilities of suicide ideators, on the other hand, were more similar to that of nonsuicidal depressed controls than to suicide attempters, suggesting that decision biases may operate at the final stage of the suicidal process, that is, the point at which persons act on suicidal ideas.

Our study is limited by a cross-sectional design. We focused on older adults with depression, as it is the most common antecedent of late-life suicide.[18,60] Although we found group differences in decision-making competence, we were unable to directly study the application of decision-making competence during the suicidal crisis, which would be possible only with a prospective design.

It is also unclear to what extent our findings can be generalized to other populations. In addition, we were not able to explore potential life-span changes in decision-making skills.

Future research may take a more integrative perspective by examining how susceptibility to biases, such as those described here, relates to altered decisions and behavior in a suicidal crisis, and neural signals during decision making and learning tasks, by looking specifically at the interaction between emotional states and decision-making outcomes in suicide attempters (eg, Eldar and Niv[61]).

In summary, attempted suicide appears to be associated with specific decision biases. Poor decisions can also result in an accumulation of financial, occupational, or interpersonal problems that, in turn, precipitate the suicidal crisis. Individual differences in decision-making competence may guide intervention. Decision-making competence can be improved,[62] offering a possible avenue for preventing the escalation of a suicidal crisis. One way to address this vulnerability in psychotherapy with suicidal individuals is mindfulness meditation, provided that these skills can be applied in a suicidal crisis. Mindfulness meditation has been shown to improve resistance to sunk-cost bias through decreased focus on past and future and decreased negative affect.[63] Another approach would be a modification of cognitive-behavioral therapy, which has been successfully used in suicidal patients,[64] specifically targeting the tendency to dwell on irrecoverable losses. While the role of framing effects in suicidal behavior is presently less clear, a case can be made for fostering a strategic approach to decisions in learning-based therapies.

Submitted: January 6, 2015; accepted May 29, 2015.

Potential conflicts of interest: None reported.

Funding/support: Provided by National Institute on Aging grant NIA-K18-AG042166 and National Institute of Mental Health grants NIMH-R01 MH085651, MH100095, and K23-MH086620 (Bethesda, Maryland); the American Foundation for Suicide Prevention (New York, New York); and the European Union Seventh Framework Programme (FP7-People-2013-CIG-618522).

Role of the sponsors: The study sponsors had no role in the design and conduct of the study, collection of the data, data analyses or interpretation, and preparation or review of the manuscript.

Acknowledgment: The authors thank Natalie Truty, BS; Laura Kenneally, BS; and Jonathan Wilson, BS, of the University of Pittsburgh Medical Center for their assistance in data collection as well as preparation of this article. None of the acknowledged individuals have any conflicts of interest to disclose.

Supplementary material: See accompanying pages.

REFERENCES

1. Baumeister RF. Suicide as escape from self. *Psychol Rev*. 1990;97(1):90–113.
2. Ringel E. The presuicidal syndrome. *Suicide Life Threat Behav*. 1976;6(3):131–149.
3. Dostoevsky F. *Crime and Punishment*. Moscow, Russia: The Russian Messenger; 1866.
4. Edwards W. The theory of decision making. *Psychol Bull*. 1954;51(4):380–417.
5. Manning V, Koh PK, Yang Y, et al. Suicidal ideation and lifetime attempts in substance and gambling disorders. *Psychiatry Res*. 2015;225(3):706–709.
6. Dougherty DM, Mathias CW, Marsh DM, et al. Suicidal behaviors and drug abuse: impulsivity and its assessment. *Drug Alcohol Depend*. 2004;76(suppl):S93–S105.
7. Gorlyn M, Keilp JG, Oquendo MA, et al. Iowa gambling task performance in currently depressed suicide attempters. *Psychiatry Res*. 2013;207(3):150–157.
8. Jollant F, Bellivier F, Leboyer M, et al. Impaired decision making in suicide attempters. *Am J Psychiatry*. 2005;162(2):304–310.
9. Clark L, Dombrovski AY, Siegle GJ, et al. Impairment in risk-sensitive decision-making in older suicide attempters with depression. *Psychol Aging*. 2011;26(2):321–330.
10. Gibbs LM, Dombrovski AY, Morse J, et al. When the solution is part of the problem: problem solving in elderly suicide attempters. *Int J Geriatr Psychiatry*. 2009;24(12):1396–1404.
11. D'Zurilla TJ, Chang EC, Nottingham EJ 4th, et al. Social problem-solving deficits and hopelessness, depression, and suicidal risk in college students and psychiatric inpatients. *J Clin Psychol*. 1998;54(8):1091–1107.
12. Arkes HR, Blumer C. The psychology of sunk cost. *Organ Behav Hum Decis Process*. 1985;35(1):124–140.
13. Tversky A, Kahneman D. The framing of decisions and the psychology of choice. *Science*. 1981;211(4481):453–458.
14. Bruine de Bruin W, Parker AM, Fischhoff B. Individual differences in adult decision-making competence. *J Pers Soc Psychol*. 2007;92(5):938–956.
15. Parker AM, Fischhoff B. Decision-making competence: external validation through an individual-differences approach. *J Behav Decis Making*. 2005;18(1):1–27.
16. Centers for Disease Control and Prevention National Center for Injury Prevention and Control. National suicide statistics at a glance. 2012. CDC Web site. http://www.cdc.gov/violenceprevention/suicide/statistics/aag.html#C. Updated December 11, 2014. Accessed October 20, 2015.
17. De Leo D, Padoani W, Scocco P, et al. Attempted and completed suicide in older subjects: results from the WHO/EURO Multicentre Study of Suicidal Behaviour. *Int J Geriatr Psychiatry*. 2001;16(3):300–310.
18. Conwell Y, Duberstein PR, Cox C, et al. Relationships of age and axis I diagnoses in victims of completed suicide: a psychological autopsy study. *Am J Psychiatry*. 1996;153(8):1001–1008.
19. Waern M, Runeson BS, Allebeck P, et al. Mental disorder in elderly suicides: a case-control study. *Am J Psychiatry*. 2002;159(3):450–455.
20. Leyton M, Paquette V, Gravel P, et al. alpha-[11C]Methyl-L-tryptophan trapping in the orbital and ventral medial prefrontal cortex of suicide attempters. *Eur Neuropsychopharmacol*. 2006;16(3):220–223.
21. Oquendo MA, Placidi GP, Malone KM, et al. Positron emission tomography of regional brain metabolic responses to a serotonergic challenge and lethality of suicide attempts in major depression. *Arch Gen Psychiatry*. 2003;60(1):14–22.
22. Dombrovski AY, Szanto K, Siegle GJ, et al. Lethal forethought: delayed reward discounting differentiates high- and low-lethality suicide attempts in old age. *Biol Psychiatry*. 2011;70(2):138–144.
23. Richard-Devantoy S, Annweiler C, Beauchet O,

et al. P03-470—cognitive inhibition in suicidal depressed elderly. *Eur Psychiatry*. 2011;26(1):1640.
24. Keilp JG, Sackeim HA, Brodsky BS, et al. Neuropsychological dysfunction in depressed suicide attempters. *Am J Psychiatry*. 2001;158(5):735–741.
25. McGirr A, Dombrovski AY, Butters MA, et al. Deterministic learning and attempted suicide among older depressed individuals: cognitive assessment using the Wisconsin Card Sorting Task. *J Psychiatr Res*. 2012;46(2):226–232.
26. Szanto K, Clark L, Hallquist M, et al. The cost of social punishment and high-lethality suicide attempts in the second half of life. *Psychol Aging*. 2014;29(1):84–94.
27. Brockner J, Rubin JZ. *Entrapment in Escalating Conflicts: A Social Psychological Analysis*. New York, NY: Springer-Verlag; 1985.
28. Coleman MD. Sunk cost, emotion, and commitment to education. *Curr Psychol*. 2010;29(4):346–356.
29. Moon H, Hollenbeck JR, Humphrey SE, et al. The Tripartite Model of Neuroticism and the suppression of depression and anxiety within an escalation of commitment dilemma. *J Pers*. 2003;71(3):347–368.
30. Keilp JG, Sackeim HA, Mann JJ. Correlates of trait impulsiveness in performance measures and neuropsychological tests. *Psychiatry Res*. 2005;135(3):191–201.
31. Richard-Devantoy S, Berlim M, Jollant F. A meta-analysis of neuropsychological markers of vulnerability to suicidal behavior in mood disorders. *Psychol Med*. 2014;44(8):1663–1673.
32. Gujral S, Dombrovski AY, Butters M, et al. Impaired executive function in contemplated and attempted suicide in late life [published online ahead of print February 6, 2013]. *Am J Geriatr Psychiatry*.
33. Alloy LB, Abramson LY. Depressive realism: four theoretical perspectives. In: Alloy LB, ed. *Cognitive Processes in Depression*. New York, NY: Guilford Press; 1988:223–265.
34. McGirr A, Renaud J, Bureau A, et al. Impulsive-aggressive behaviours and completed suicide across the life cycle: a predisposition for younger age of suicide. *Psychol Med*. 2008;38(3):407–417.
35. Mann JJ, Waternaux C, Haas GL, et al. Toward a clinical model of suicidal behavior in psychiatric patients. *Am J Psychiatry*. 1999;156(2):181–189.
36. Larrick RP, Nisbett RE, Morgan JN. Who uses the cost-benefit rules of choice? Implications for the normative status of microeconomic theory. *Organ Behav Hum Decis Process*. 1993;56(3):331–347.
37. Stanovich KE. *Who is Rational? Studies of Individual Differences in Reasoning*. New York, NY: Psychology Press; 1999.
38. Baud P. Personality traits as intermediary phenotypes in suicidal behavior: genetic issues. *Am J Med Genet C Semin Med Genet*. 2005;133C(1):34–42.
39. Soane E, Chmiel N. Are risk preferences consistent? the influence of decision domain and personality. *Pers Individ Dif*. 2005;38(8):1781–1791.
40. Lauriola M, Russo PM, Lucidi F, et al. The role of personality in positively and negatively framed risky health decisions. *Pers Individ Dif*. 2005;38(1):45–59.
41. Beck AT, Beck R, Kovacs M. Classification of suicidal behaviors: I. quantifying intent and medical lethality. *Am J Psychiatry*. 1975;132(3):285–287.
42. Beck AT, Kovacs M, Weissman A. Assessment of suicidal intention: the Scale for Suicide Ideation. *J Consult Clin Psychol*. 1979;47(2):343–352.
43. First MS, Gibbon M, Williams JBW. *Structured Clinical Interview for DSM-IV Axis I Disorders, Patient Edition (SCID-I/P)*. Version 2.0. New York, NY: Biometrics Research, New York State Psychiatric Institute; 1995.
44. Hamilton M. A rating scale for depression. *J Neurol Neurosurg Psychiatry*. 1960;23(1):56–62.
45. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12(3):189–198.
46. Mattis S. *Dementia Rating Scale (DRS): Professional Manual*. Odessa, FL: Psychological Assessment Resources; 1988.
47. Wechsler D. *The Wechsler Test of Adult Reading: WTAR*. San Antonio, TX: Psychological Corporation; 2001.
48. D'Zurilla TJ, Nezu AM. Development and preliminary evaluation of the Social Problem-Solving Inventory. *Psychol Assess J Consult Clin Psychol*. 1990;2(2):156–163.
49. Horowitz LM, Rosenberg SE, Baer BA, et al. Inventory of Interpersonal Problems: psychometric properties and clinical applications. *J Consult Clin Psychol*. 1988;56(6):885–892.
50. Pilkonis PA, Kim Y, Proietti JM, et al. Scales for personality disorders developed from the Inventory of Interpersonal Problems. *J Pers Disord*. 1996;10(4):355–369.
51. Parker AM, Stone ER. Identifying the effects of unjustified confidence versus overconfidence: lessons learned from two analytic methods. *J Behav Decis Making*. 2014;27(2):134–145.
52. van Putten M, Zeelenberg M, van Dijk E. Who throws good money after bad? action vs state orientation moderates the sunk cost fallacy. *Judgm Decis Mak*. 2010;5(1):33–36.
53. Williams JMG, Crane C, Barnhofer T, et al. Psychology and suicidal behaviour: elaborating the entrapment model. In: Hawton K, ed. *Prevention and Treatment of Suicidal Behaviour: From Science to Practice*. 1st ed. Oxford, UK: Oxford University Press; 2005: 71–89.
54. Levin IP, Gaeth GJ, Schreiber J, et al. A new look at framing effects: distribution of effect sizes, individual differences, and independence of types of effects. *Organ Behav Hum Decis Process*. 2002;88(1):411–429.
55. Andersson L, Allebeck P, Gustafsson JE, et al. Association of IQ scores and school achievement with suicide in a 40-year follow-up of a Swedish cohort. *Acta Psychiatr Scand*. 2008;118(2):99–105.
56. Gunnell D, Löfving S, Gustafsson JE, et al. School performance and risk of suicide in early adulthood: follow-up of two national cohorts of Swedish schoolchildren. *J Affect Disord*. 2011;131(1–3):104–112.
57. Peters E, Hess TM, Västfjäll D, et al. Adult age differences in dual information processes: implications for the role of affective and deliberative processes in older adults' decision making. *Perspect Psychol Sci*. 2007;2(1):1–23.
58. Goodie AS. The role of perceived control and overconfidence in pathological gambling. *J Gambl Stud*. 2005;21(4):481–502.
59. Yaseen ZS, Gilmer E, Modi J, et al. Emergency room validation of the revised Suicide Trigger Scale (STS-3): a measure of a hypothesized suicide trigger state. *PLoS ONE*. 2012;7(9):e45157.
60. Conwell Y, Duberstein PR, Caine ED. Risk factors for suicide in later life. *Biol Psychiatry*. 2002;52(3):193–204.
61. Eldar E, Niv Y. Interaction between emotional state and learning underlies mood instability. *Nat Commun*. 2015;6:6149.
62. Jacobson D, Parker A, Spetzler C, et al. Improved learning in US history and decision competence with decision-focused curriculum. *PLoS ONE*. 2012;7(9):e45775.
63. Hafenbrack AC, Kinias Z, Barsade SG. Debiasing the mind through meditation: mindfulness and the sunk-cost bias. *Psychol Sci*. 2014;25(2):369–376.
64. Brown GK, Ten Have T, Henriques GR, et al. Cognitive therapy for the prevention of suicide attempts: a randomized controlled trial. *JAMA*. 2005;294(5):563–570.

Editor's Note: We encourage authors to submit papers for consideration as a part of our Focus on Suicide section. Please contact Maria A. Oquendo, MD, at moquendo@psychiatrist.com.

Supplementary material follows this article.

THE JOURNAL OF
CLINICAL PSYCHIATRY
THE OFFICIAL JOURNAL OF THE AMERICAN SOCIETY OF CLINICAL PSYCHOPHARMACOLOGY

Supplementary Material

Article Title: Decision-Making Competence and Attempted Suicide

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DOI Number: 10.4088/JCP.15m09778

List of Supplementary Material for the article

1. eAppendix 1 ADMC Sample Items and Scoring

2. eTable 1 Correlation Between Resistance to Sunk Cost and Resistance to Framing and Other Measures in the Depressed Participants

Disclaimer

This Supplementary Material has been provided by the author(s) as an enhancement to the published article. It has been approved by peer review; however, it has undergone neither editing nor formatting by in-house editorial staff. The material is presented in the manner supplied by the author.

SUPPLEMENTAL MATERIAL

ADMC Sample Items and Scoring:

Resistance to Sunk Costs: is the mean of 10 items, using a rating scale from 1 (most likely to choose the sunk cost option) to 6 (most likely to choose the normatively correct option). For example:

You are in a hotel room for one night and you have paid $6.95 to watch a movie on pay TV. Then you discover that there is a movie you would much rather like to see on one of the free cable TV channels. You only have time to watch one of the two movies. Would you be more likely to watch the movie on pay TV or on the free cable channel?

1	2	3	4	5	6
Most likely to watch pay TV					Most likely to watch free cable

Resistance to Framing Effects: presents fourteen item pairs, constituted of two positive and negative frames, or situations, that are logically equivalent. Performance is measured by the mean absolute difference between ratings for the positive or negative versions of each item. The positive frames and negative frames appear in separate sets with different item orders and are separated by other A-DMC tasks. For example, purchasing ground beef that is 80% lean or contains 20% fat:

Imagine the following situation. You are entertaining a special friend by inviting them for dinner. You are making your favorite lasagna dish with ground beef. Your roommate goes to the grocery store and purchases a package of ground beef for you. The label says 80% lean ground beef.

What's your evaluation of the quality of this ground beef?

1	2	3	4	5	6
Very low					Very high

Overconfidence/Underconfidence: assesses how well participants recognize the extent of their knowledge. Participants indicate whether statements are true or false, then assess their confidence in that answer on a scale from 50% (just guessing) to 100% (absolutely sure). For example, a decision maker who answers 70% of items correctly should express 70% confidence. Over/underconfidence equals one minus the absolute difference between mean confidence and percentage correct across items, so that higher scores reflect better performance.

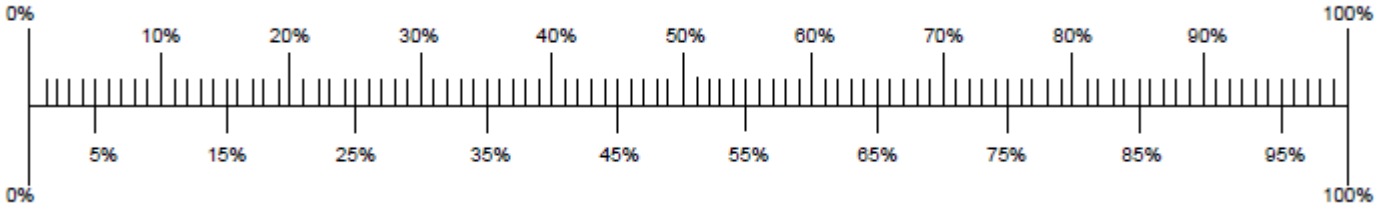
Problems with in-laws contribute to more than 30% of divorces.

This statement is [True / False].

50%	60%	70%	80%	90%	100%
Just guessing					Absolutely sure

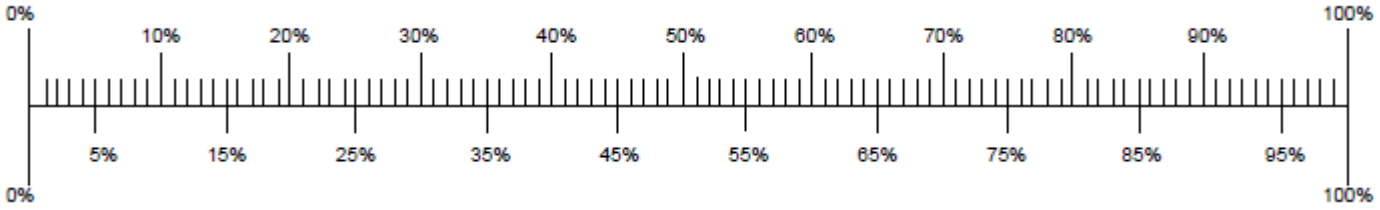
Consistency in Risk Perception: Twenty items ask participants to judge the chance of an event happening to them on a linear scale ranging from 0% (no chance) to 100% (certainty). Scoring is the percentage of consistent risk judgments across related events.

What is the probability that you will move your permanent address to another state some time during the next year?



No chance Certainty

What is the probability that you will keep your permanent address in the same state during the next year?



No chance Certainty

Supplementary eTable 1a. Correlation between *Resistance to Sunk Cost* and *Resistance to Framing* and other measures

		ADMC		Demo-graphic	Cognition	Interpersonal			
ADMC		Sunk Cost	Resistance to Framing	Age	Mattis Dementia Rating Scale	IIPSensitivity	IIPAmbivalence	IIPAggression	SPSI Impulsivity Carelessness Style
Resistance to Framing	Pearson R	.01							
Demographic									
Age	Pearson R	-.13	-.13						
Cognition									
Mattis Dementia Rating Scale	Pearson R	**.23****	.16	-.34**					
Interpersonal									
IIPSensitivity	Pearson R	-.01	-.05	-.34**	.06				
IIPAmbivalence	Pearson R	-.134	**-.17***	-.14	-.15	.38**			
IIPAggression	Pearson R	.05	-.02	-.20*	.03	.71**	.49**		
Impulsivity/Social Problem Solving									
SPSI Impulsivity Carelessness Style	Pearson R	-.10	**-.17***	-.17	-0.75	.30**	.54**	.37**	
Depression									
Hamilton 16***	Pearson R	-.02	-.01	-.29**	-.02	.24**	.22*	.15**	.30**

Sample size for assessments (mean) = 142, range 140 -148

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

*** No suicide Items used

Susceptibility to sunk cost bias was moderately correlated with poor global cognition (DRS scores) and modestly correlated with struggle in interpersonal relationships (IIP Ambivalence Subscale). Inability to resist framing effects was modestly correlated with age, global cognition, struggle in interpersonal relationships, and impulsive/careless social problem solving style (SPSI Impulsivity/Carelessness).

Supplementary eTable 1b. Correlation between *Over/Underconfidence* and *Consistency in Risk Perception* and other measures

		ADMC		Demo-graphic	Cognition	Interpersonal			
ADMC		Over/Under Confidence	Consistency in Risk Perception	Age	Mattis Dementia Rating Scale	IIPSensitivity	IIPArrbivalence	IIPAggression	SPSI Impulsivity Carelessness Style
Consistency in Risk Perception	Pearson R	-.14							
Demographic									
Age	Pearson R	.03	-.06						
Cognition									
Mattis Dementia Rating Scale	Pearson R	**.22****	.01	-.34**					
Interpersonal									
IIPSensitivity	Pearson R	-.10	-.02	-.34**	.06				
IIPAmbivalence	Pearson R	**-.22****	-.12	-.14	-.15	.38**			
IIPAggression	Pearson R	-.10	-.14	-.20*	.03	.71**	.49**		
Impulsivity/Social Problem Solving									
SPSI Impulsivity Carelessness Style	Pearson R	**-.17***	-.10	-.17	-0.75	.30**	.54**	.37**	
Depression									
Hamilton 16***	Pearson R	.02	.09	-.29**	-.02	.24**	.22*	.15**	.30**

Sample size for assessments (mean) = 142, range 140 -148

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Overconfidence/Underconfidence was moderately correlated with poor global cognition (DRS scores) and with struggle in interpersonal relationships (IIP Ambivalence Subscale) and modestly correlated with impulsivity (SPSI Impulsivity/Carelessness). Consistency in Risk Perception modestly correlated with interpersonal aggression (IIP Aggression Subscale).

Sensitivity analyses

To ensure that group differences were not distorted by partial effects of age [1], we equated all 5 groups on age by excluding the oldest participants from the non-psychiatric control (8 dropped) and the depressed non-suicidal groups (11 dropped). In this sample of 152 participants, group differences in resistance to sunk cost ($F[4,142]=3.61$, $p=0.008$, $\eta_p^2=0.09$) and resistance to framing ($F[4,142]=4.27$, $p=0.003$, $\eta_p^2=0.11$) remained after controlling for gender, race, age, and Dementia Rating Scale score.

References

1. Miller GA, Chapman JP. Misunderstanding analysis of covariance. Journal of abnormal psychology 2001 Feb;110(1):40-48.