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Research report

Cognitive reactivity: Investigation of a potentially treatable marker of suicide risk in depression

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ABSTRACT

Background: Suicidal ideation is the most stable symptom of depression across episodes. This relative stability may be brought about by increased cognitive reactivity to sad mood (CR) during periods of remission. The idea is that a network of depressive cognitions, which include suicidal ideation, becomes strengthened with each episode of depression. Consequently, the whole network may be more easily re-activated, for instance by an episode of low mood. We examined the association between reactivity of suicidal cognitions during recovery and the presence of suicidal ideation and behavior during the previous depressive episode.
Methods: In a case–control design, the CR profiles of recovered depressed participants with ($N=355$) and without ($N=250$) a history of suicidal ideation were compared. Structured clinical interviews were used to determine diagnoses and prior symptoms. Cognitive reactivity profile was measured with the Leiden Index of Depression Sensitivity-Revised (LEIDS-R).
Results: Suicidal ideation during a depressive episode was associated with a distinct CR profile during remission: elevated hopelessness reactivity scores. This relationship between prior suicidality and current CR was independent of anxiety disorder comorbidity. Moreover, a history of suicide attempt(s) was also associated with a distinct CR profile. These individuals had both higher hopelessness reactivity and higher aggression reactivity than the non-suicidal and suicidal ideation groups.
Limitations: Symptoms during the previous depressive episode were assessed retrospectively.
Conclusions: This is the first study to show that CR may underlie the relative stability of suicidal symptoms independent of anxiety comorbidity and that suicidal ideation and suicidal behavior are associated with distinct patterns of CR. Since CR is a potentially treatable vulnerability marker of depression recurrence, this has important clinical implications.

1. Introduction

Major depression is characterized by high relapse and recurrence rates (Mueller et al., 1999) resulting in psychosocial disability (Judd et al., 2000). Few studies have explored the stability of symptoms across recurrent episodes of depression. There is evidence that the symptom profile of depression is relatively unstable across different episodes, however suicidal behaviour shows a robust correlation across episodes (Oquendo et al., 2004a). The same holds true for suicidal ideation (Lewinsohn et al., 2003; Williams et al., 2006). At the same time, suicidal ideation and behaviour are common symptoms of major depression, also compared to other disorders (Bolton et al., 2008; Kessler et al., 2005, 1999; Oquendo et al., 2004b; Sokero et al., 2003). Between 37% and 58% of patients experience suicidal ideation during a depressive episode (Kessler et al., 2005; Sokero et al., 2003). The risk of a nonfatal suicide attempt among depressed inpatients is around 40% within 5 years after the first episode (Malone et al., 1995). The known risk factors for suicide attempt and ideation (Bernal et al., 2007; Borges et al., 2008; Kessler et al., 1999; Nock et al., 2008; Oquendo et al., 2006;

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Sokero et al., 2003) mostly refer to demographic and clinical characteristics which are informative in identifying groups at risk but insufficient in predicting individual course of suicidality (Beautrais, 2004). Considering the high recurrence rates of major depression (Robinson and Sahakian, 2008), better understanding of factors that render the remitted individual vulnerable to relapse and suicidal risk are warranted.

A cognitive account of vulnerability to depressive relapse, based on Teasdale's differential activation hypothesis (Teasdale, 1998), has recently been extended to suicidality (Lau et al., 2004). This model assumes that the association that is formed between depressed mood and dysfunctional cognitions during a depressive episode remains intact during remission. Consequently, relatively small changes in mood may re-activate these cognitions in remitted depressed patients. The ease with which maladaptive cognitions are triggered by non-pathological low mood is referred to as cognitive reactivity (CR) (Ingram et al., 1998; Lau et al., 2004). Experimental studies using sad mood inductions have demonstrated that formerly depressed patients have higher CR than never-depressed individuals (Segal et al., 1999; Van der Does, 2002). High CR scores during remission also increase the risk of depressive relapse (Segal et al., 1999, 2006).

Euthymic recovered depressed patients have higher CR scores overall, but recently it was observed that recovered patients who had been suicidal during their latest episode (SI+ patients) score higher on one aspect of CR compared to recovered patients who had not been suicidal (SI− patients) (Williams et al., 2008). Taking advantage of the fact that a new self-report measure of CR contains several subscales, the authors were able to demonstrate that suicidal ideation in the past is associated with higher scores on only the hopelessness/suicidality subscale of the Leiden Index of Depression Sensitivity-Revised (LEIDS-R). An important implication of this finding is that this aspect of CR may explain why suicidal ideation is more likely than the other symptoms of depression to recur across episodes (Oquendo et al., 2004a; Williams et al., 2006). Furthermore, since levels of CR are indicative of the risk for depressive relapse (Segal et al., 2006) this easily administered measure may yield clinically important information.

The Williams et al. study provided preliminary evidence for the differential activation hypothesis of suicidality, but the authors discussed that the patterns of hopeless/suicidal reactivity should be regarded with caution. Limitations in the Williams et al. study prompted the present research. Firstly, although the results showed some signs of specificity of hopeless/suicidal reactivity in relation to history of suicidality, it is possible that the study lacked the statistical power to detect differences in the other aspects of CR. Secondly, anxiety comorbidity–a factor which increases risk of suicidality (Sareen et al., 2005)–was not measured. Thirdly, the question of which aspect of CR could be underlying suicidal behaviour was not addressed, as the samples included few prior attempters. Prior research has found differences in breadth and chronicity of diagnoses of depression and severity of symptoms between suicide ideators and attempters (Rudd et al., 1996), indicating that different degrees and aspects of CR may characterize the two groups.

The present research addressed these limitations. We measured CR in previously depressed participants of The Netherlands Study of Depression and Anxiety (NESDA), which is a large cohort study. We expect that SI+ recovered depressed patients will demonstrate higher scores on only the hopelessness reactivity subscale of the LEIDS-R. The large sample size allows several additional analyses. We investigated the role of anxiety disorder comorbidity, as it is associated with an increased risk of suicidal ideation and behavior, but its role in influencing CR patterns has not yet been explored. Finally, we investigated whether the CR hopelessness/suicidality reactivity profile of recovered depressed patients who had engaged in suicidal behavior was higher from those who had suffered from suicidal ideation only.

2. Methods

2.1. Participants

Participants were selected from an ongoing 8-year longitudinal cohort study: The Netherlands Study of Depression and Anxiety (NESDA). NESDA has included 2981 individuals (18–65 years of age) and aims to investigate the long-term course of depression and anxiety disorders. The rationale, methods and procedure have been described in detail elsewhere (Penninx et al., 2008). In brief, participants were recruited from three locations in The Netherlands, and at each site from three different settings: 564 participants were recruited from the community, 1610 through primary care and 807 were recruited from mental health care organizations. Participants completed a four-hour assessment at one of the research sites and also filled out questionnaires at home. The baseline measurement took place between September 2004 and February 2007. The study protocol was approved by the Ethical Review Board of each participating center. All participants signed an informed consent form. All participants completed the measurements listed below. For the present study, participants who were non-depressed at baseline but had a history of major depression were selected.

2.2. Measures

2.2.1. Assessment of psychopathology

The diagnoses of depressive (major depressive disorder and dysthymia) and anxiety (panic disorder, social phobia, generalized anxiety disorder, agoraphobia) disorders were established using the lifetime Composite International Diagnostic interview (CIDI–WHO version 2.1) (Robins et al., 1988), which allows diagnoses on the basis of DSM-IV criteria. It has high interrater reliability (Wittchen et al., 1991), high test–retest reliability (Wacker et al., 2006) and high validity for depressive and anxiety disorders (Wittchen, 1994). The CIDI interviews were conducted by trained clinical research staff. The CIDI sections for lifetime alcohol abuse and dependency were also administered. History of suicidal ideation during a previous episode was also established via the CIDI. An interviewer-rated 6-item scale, adopted from Beck's Suicidality Scale, was used to identify participants who had made a suicide attempt (Beck et al., 1979).

2.2.2. Cognitive reactivity

The Leiden Index of Depression Sensitivity-Revised (LEIDS-R) (Van der Does, 2002; Williams et al., 2008) is a self-report measure of cognitive reactivity to sad mood. In several studies, the LEIDS-R has been found to be sensitive to depression history (Moulds et al., 2008; Van der Does, 2002, 2005) The LEIDS-R has 34 items scored on a 0–4 Likert scale ranging from “not at all”

to "very strongly" and covers six subscales. Participants are asked to indicate whether and how their thinking patterns change when they experience mild dysphoria. The names of the subscales and sample items are: *Hopelessness/Suicidality* (HOP: When I feel sad, I feel more hopeless about everything.); *Acceptance/Coping* (ACC: When I am sad, I feel more like myself.); *Aggression* (AGG: When I feel down, I lose my temper more easily.); *Control/Perfectionism* (CTR: When I am in a sad mood, I become more bothered by perfectionism.); *Risk Avoidance* (RAV: When I feel down, I take fewer risks.); *Rumination* (RUM: When I feel sad, I spend more time thinking about the possible causes of my moods.). The median time period between the collection of interview data and filling-out the LEIDS-R was approximately 9 days.

2.2.3. Covariates

Depressive symptom severity during the past week was measured with the 30-item self-report version of the Inventory of Depressive Symptomatology (IDS, range 0–84), which is highly correlated with observer-rated scales (Rush et al., 1996; Trivedi et al., 2004). Current suicidality was measured using the IDS-item 18 (range 0–3). Anxiety symptomatology during the past week was measured using the 21-item Beck Anxiety Inventory (BAI) (Beck et al., 1988). Number of previous depressive episodes was established via the CIDI. Sociodemographic characteristics included age, gender, and education in years and were also considered as covariates.

2.2.4. Statistical analyses

Data were analyzed using SPSS 15.0. Participant characteristics of the SI+ and SI− groups were compared using *t*-tests and chi-square tests. Effect sizes were calculated using Cohen's *d* (Cohen, 1988), defined as the difference between two means divided by the pooled standard deviation. Multivariate analysis of covariance (MANCOVA) was used to examine the differences between SI+ and SI− groups on the subscales of the LEIDS-R. A separate ANCOVA was conducted for the LEIDS-R total due to high correlation with its subscales. Covariates used in all analyses were current suicidal ideation (IDS-item 18) and the total IDS-score (minus item 18); the inclusion of IDS-item 18 as a separate covariate was done to increase the stringency of testing. Separate MANCOVAs were performed to examine CR of participants with and without lifetime anxiety disorder (AD+ and AD−). The BAI total was added as an additional covariate in the analysis with the AD+ sample. Logistic regression was carried out to examine which aspects of CR predict prior suicidal ideation; IDS-total and IDS-suicidality were entered first in the model. A hierarchical multiple regression was used to examine which of the non-core DSM-IV major depressive disorder symptoms–other than suicidal ideation–were related to the Hopelessness/Suicidality aspect of CR. CR differences between suicidal ideators, attempters and non-suicidal participants were examined using a MANCOVA, with IDS-total and IDS-suicidality as covariates.

3. Results

3.1. Participant flow

Of 2981 NESDA participants, 771 had no current (past 6 months) major depressive disorder or dysthymia diagnoses at baseline, but at least one episode of major depression in the past. Of these, 696 participants had valid LEIDS-R scores (73 did not return the questionnaire package, two had missing items). For 80 of the 696 participants presence or absence of suicidiality during prior depression was undetermined during the CIDI interview. This led to a sample of 616 previously depressed participants, 355 of whom had a history of suicidal ideation (SI+) whereas 261 did not (SI−). However, for 11 participants in the SI− group, CIDI scores conflicted with the scores on the Beck Suicidality Scale (suicide attempt reported). These participants were excluded, leading to final sample sizes of $N=250$ (SI−) and $N=355$ (SI+).

3.2. Data screening

Data were checked for normal distribution assumptions, outliers and homogeneity of variances. Square root transformations on the LEIDS-R subscales reduced heterogeneity of variance, as well as skewness and kurtosis within the range of ± 1. Analyses were conducted with transformed values; tables include untransformed values. Total LEIDS-R scores remained untransformed.

3.3. Participant characteristics

Table 1 shows the demographic characteristics of SI+ and SI− participants. The two groups did not differ in age ($t\,(603)=0.34$, $p>0.05$), gender ($\chi^2\,(1)=0.38$, $p>0.05$) or nationality ($\chi^2\,(1)=0.19$, $p>0.05$). The SI+ group was more likely to be recruited from primary care or mental health care, whereas a higher percentage of the SI− group was recruited from the community ($\chi^2\,(2)=10.74$, $p=0.005$). The SI+ group reported higher depression symptoms (total IDS) ($t\,(601)=$

Table 1
Participant characteristics (means ± standard deviations).

	Past SI− ($N=250$)	Past SI+ ($N=355$)	*P* value
Age	43.3 ± 13.1	43.7 ± 12.3	.74
Gender (% female)	70.4%	72.7%	.54
Dutch nationality	98.0%	97.5%	.66
Education (#years)	12.5 ± 3.2	12.6 ± 3.2	.80
Previous MDD (#episodes)	3.1 ± 7.9	3.5 ± 7.7	.54
Respondent sampling frame			
Primary care	60.8%	69.6%	.005
Mental health care	8.0%	10.7%	
General population	31.2%	19.7%	
Current symptoms			
Depression (IDS)***	16.0 ± 9.4	19.4 ± 10.2	<.001
Anxiety (BAI)***	8.6 ± 7.3	11.6 ± 9.0	<.001
Current anxiety diagnoses (past 6 months) (% yes)			
Social phobia	14.4%	26.2%	<.001
Panic disorder (+agoraphobia)	10.0%	13.8%	.16
Panic disorder (−agoraphobia)	5.6%	6.5%	.66
Generalized anxiety disorder	4.4%	10.1%	.009
Any current anxiety diagnosis	30.0%	46.2%	.001
Lifetime anxiety diagnoses			
Social phobia	24.4%	39.2%	<.001
Panic disorder (+agoraphobia)	12.0%	22.5%	.001
Panic disorder (−agoraphobia)	11.2%	14.1%	.30
Generalized anxiety disorder	20.4%	35.5%	<.001
Any lifetime anxiety diagnosis	54.4%	77.2%	<.001

Abbreviations: SI = suicidal ideation; IDS = Inventory of Depressive Symptoms; BAI = Beck Anxiety Index; MDD = Major Depressive Disorder.

4.15, $p<0.001$), higher anxiety symptoms (t (602) = 4.37, $p<0.001$), more current anxiety diagnoses (χ^2 (3) = 17.41, $p<0.001$) and lifetime anxiety diagnoses (χ^2 (1) = 34.86, $p<0.001$). However, the two groups did not differ in the number of previous depressive episodes (t (603) = 0.61, $p>0.05$).

3.4. Cognitive reactivity and prior suicidality

The LEIDS-R scores of the SI+ and SI− groups are shown in Table 2. MANCOVA with IDS-total and IDS-suicidality as covariates showed that the SI+ group had significantly higher scores than the SI− group on the Hopelessness/Suicidality subscale [F (1, 597) = 22.6, $p<0.001$] (d = 0.65) and on the Aggression subscale [F (1, 597) = 5.17, p = 0.02] (d = 0.27) but not on the other subscales. The two groups also significantly differed on LEIDS-R total score [F (1, 597) = 4.31, p = 0.04)] (d = 0.34). The IDS-total was significantly related to all LEIDS-R subscales ($p<0.001$), whereas IDS-suicidality was only related to Hopelessness/Suicidal reactivity ($p<0.001$) and LEIDS-R total (p = 0.01).

A hierarchical logistic regression analysis was conducted to examine whether CR scores predict previous suicidal ideation above and beyond current suicidality and current symptom severity. IDS-total and IDS-suicidality were entered in the first block and the LEIDS-R subscales in the second block. As shown in Table 3, current suicidality was a significant predictor, but of the CR subscales only the Hopelessness/Suicidality was significant. In a separate analysis, LEIDS-R total score also predicted prior suicidality but less strongly (odds ratio 1.013 (95%CI: 1.001–1.025), p = 0.035).

A repeated measures ANOVA with the six LEIDS-R subscales as within- and group (SI+, SI−) as between-subjects factor yielded a significant interaction between the subscales scores and group [F (5, 3015) = 9.12, $p<0.001$] indicating that the size of the group difference in Hopelessness/Suicidal reactivity deviated significantly from the general trend of higher reactivity in those with previous suicidal ideation [F (1, 603) = 18.81, $p<0.001$].

Since the HOP subscale contains 3 hopelessness items and 3 suicidality items, we examined hopelessness and suicidal reactivity separately, using MANCOVA with the same covariates. This revealed that the SI+ group scored significantly higher on both suicidal reactivity [F (1, 597) = 45.07, $p<0.001$] and on hopelessness reactivity [F (1, 597) = 5.55, p = 0.02].

Table 2
Previous suicidality and current cognitive reactivity (means & standard deviations (SD)).

	Past SI−		Past SI+		P value*
	Mean	SD	Mean	SD	
Hopelessness/Suicidality	3.1	2.6	5.3	4.3	<.001
Acceptance/coping	1.5	2.2	1.7	2.2	.67
Aggression	4.0	3.4	5.0	4.0	.02
Control/perfectionism	5.5	3.9	6.1	3.9	.29
Risk aversion	8.0	4.4	8.9	4.3	.19
Rumination	8.8	4.5	9.5	4.3	.68
LEIDS-R total	30.9	15.6	36.4	16.5	.04

*Controlled for current symptoms (IDS-total) and suicidality (IDS-suicidality).
Abbreviations: SI = suicidal ideation; LEIDS-R = Leiden Index of Depression Sensitivity-Revised; IDS = Inventory of Depressive Symptoms.

Table 3
Predicting previous suicidality from LEIDS-R subscales.

		B	S.E.	Wald	P value	Exp(B)	95,0% C.I.	
1	IDS-suicidality	1.06	.22	23.866	.00	2.896	1.89	4.44
	IDS-total	0.002	.01	.032	.86	1.002	.98	1.02
2	RUM	−0.31	.17	3.426	.06	0.737	.53	1.02
	HOP	0.58	.13	19.183	.00	1.794	1.38	2.33
	ACC	−0.01	.11	.011	.92	0.988	.80	1.23
	AGG	0.14	.12	1.483	.22	1.150	.92	1.44
	CTR	0.03	.12	.061	.80	1.032	.81	1.32
	RAV	−0.06	.15	.173	.68	0.938	.69	1.27

Abbreviations: IDS = Inventory of Depressive Symptoms; RUM = Rumination; HOP = Hopelessness/Suicidality; ACC = Acceptance/coping; AGG = Aggression; CTR = Control/perfectionism; RAV = Risk aversion.

3.5. Cognitive reactivity and anxiety disorder comorbidity

Repeating the analyses after including only participants without a lifetime anxiety disorder (SI+: N = 79, SI−: N = 113) gave essentially the same results. Again, the SI+ scored significantly higher only on the Hopelessness/Suicidality subscale of the LEIDS-R (Mean ± SD) (SI+: 3.92 ± 3.23 vs. SI−: 2.83 ± 2.59) [F (1, 188) = 5.97, p = 0.015]. There were no significant differences between the groups on the rest of the subscales or on the LEIDS-R total score (all p's>0.05). The effect remained significant after controlling for current symptoms (current suicidal ideation was not a significant covariate). Finally, repeating the analyses using only participants with lifetime anxiety diagnoses (SI+: N = 274, SI−: N = 135) gave exactly the same pattern of results. Anxiety symptoms (BAI scores) were included as an additional covariate, and all findings remained the same.

3.6. Symptom profiles and Hopelessness/Suicidal reactivity

In order to examine whether previous suicidal ideation is the only symptom that is related to subsequent hopelessness/suicidal reactivity, we compared this aspect of reactivity in groups defined on the basis of presence or absence of the non-core depression symptoms that participants had in the past. In a multiple regression analysis with the hopelessness/suicidal CR subscale as dependent variable, forced entry of current symptomatology in the first step showed that IDS-

Table 4
Hopelessness/Suicidality scores (means and standard deviations (SD)) as a function of symptoms experienced during the prior depressive episode.

	Symptoms of depression						
	Weight change	Sleep	Agitation/ retardation	Fatigue	Concentration	Guilt*	Suicidal ideation*
No							
Mean	3.99	4.54	3.62	4.19	4.44	2.55	3.11
SD	3.47	3.75	3.18	3.97	4.09	3.08	2.63
N	167	56	235	57	18	109	250
Yes							
Mean	4.57	4.40	4.92	4.43	4.41	4.82	5.33
SD	3.94	3.83	4.12	3.81	3.82	3.85	4.25
N	435	546	367	545	584	493	355

*$p<0.001$.

suicidality ($\beta = .28$, SE = .22, $p < 0.001$) and IDS-total ($\beta = .31$, SE = .02, $p < 0.001$) were significant predictors ($R^2 = .22$). Stepwise entry of previous depressive symptoms revealed that previous suicidal ideation entered in the second step ($\beta = .18$, SE = .29, $p < 0.001$; $R^2 = .25$) and previous worthlessness/guilt entered in the third step ($\beta = .13$, SE = .36, $p < 0.001$; $R^2 = .27$) The rest of the symptoms were not significant predictors of Hopelessness/Suicidal reactivity ($p > 0.05$)(for means and standard deviations see Table 4).

3.7. Cognitive reactivity and suicidal ideation vs. behaviour

Sixteen percent ($N = 57$) of the SI+ participants had actually made a suicide attempt. The CR scores of these participants (SA+) were compared with the scores of the remainder of the SI+ group ($N = 296$) and the SI− group ($N = 250$), in a MANCOVA with IDS-total and IDS-suicidality as covariates. This time, the three groups differed on hopelessness reactivity [F (2, 596) = 12.41, $p < 0.001$] and on aggression reactivity [F (2, 596) = 5.26, $p = 0.005$] (see Fig. 1). Planned contrasts showed that the SA+ had significantly higher HOP scores than the SI+ ($p = 0.004$), who in turn scored higher than the SI− ($p < 0.001$). The difference in aggression reactivity was not significant between SI+ and SI− ($p = 0.09$), whereas SA+ scored significantly higher than SI+ ($p = 0.004$) and SI− ($p < 0.001$). There were no significant differences among the three groups on total LEIDS-R scores [F (2, 596) = 2.60, $p = 0.08$]. Current symptom severity was a significant covariate for all the subscales and for the total LEIDS-R ($p < 0.05$) and current suicidality was significantly related only to the Hopelessness/Suicidality subscale ($p < 0.001$) and to the total score ($p < 0.05$).

4. Discussion

Previously depressed individuals with a history of suicidal ideation had higher Hopelessness/Suicidal reactivity scores compared to recovered depressed participants without such history. This difference remained significant after controlling for current depression and current suicidal ideation. The finding was robust, as it appeared in participants with and without anxiety comorbidity. Furthermore, the previously suicidal group also reported higher aggression reactivity. This reactivity, however, was largely driven by a subgroup of participants who had made a suicide attempt. Of all aspects of CR, only Hopelessness/Suicidal reactivity predicted a history of suicidal ideation, even after controlling for participants' depressive symptoms and suicidal ideation at the time of measurement. Furthermore, apart from suicidal ideation, guilt was the only past symptom that was significantly related to current Hopelessness/Suicidal reactivity. When examined separately, both items measuring suicidal reactivity and items measuring hopelessness reactivity differentiated the SI+ and SI− groups, which argues against the possibility that the relationship is simply a tautological one, caused by similar wordings in instruments.

The results support the differential activation model of suicidality (Lau et al., 2004; Williams et al., 2008). The model assumes that during a depressive episode an association is formed between sad mood and suicidal and hopelessness cognitions, so that in the future, a mild mood fluctuation acts as a prime to re-activate such cognitions, increasing the risk of relapse. The unique association of the past symptoms of guilt and suicidality with current Hopelessness/Suicidal reactivity was replicated (Williams et al., 2008). These two symptoms

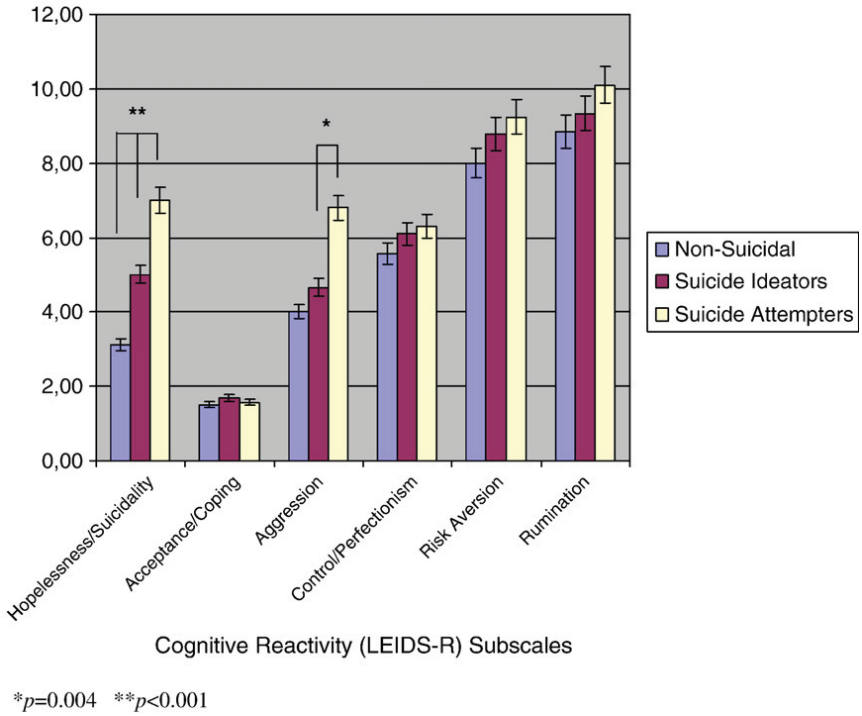

Fig. 1. Cognitive reactivity scores of previously depressed non-suicidal participants ($N = 248$), former suicide ideators ($N = 296$) and suicide attempters ($N = 57$). *$p = 0.004$ **$p < 0.001$.

are strongly associated with a history of attempted suicide (Bolton et al., 2008), and seem to form a distinct dimensional subtype of depression with a high degree of correlation between siblings with depression, forming a possible phenotypic marker (Korszun et al., 2004). From a cognitive viewpoint, suicidal individuals are likely to entrap themselves between feelings of guilt about the past and feelings of hopelessness about the future, subsequently seeing suicide as the only 'solution'. Considering the large sample sizes and the robustness of findings across sub-samples with and without anxiety comorbidity, this study provided a much stronger test of the suicidal reactivity model than previous studies (Williams et al., 2008).

The present study also revealed an interesting difference in cognitive reactivity profile between patients with a previous suicide attempt and those with suicidal ideation only. Participants who had made a suicide attempt in the past had significantly higher scores on both hopelessness/suicidal and aggression reactivity. This finding illustrates the conceptual path that may link suicidal cognition and suicidal behaviour. Recently, Mann et al. found that a remote suicide attempt (250 days prior to assessment) was best predicted by lifetime aggression whereas a recent suicide attempt (within a month prior to assessment) was predicted by current suicidal ideation but not aggression (Mann et al., 2008). Suicidal ideation was not useful in identifying remote attempters in that study. This is in line with the cognitive reactivity model, which predicts that in a remitted euthymic state, participants' latent suicidal ideation may not be accessible and only becomes overt when primed by a sad mood. Aggression has previously been found to predict suicide attempts (Oquendo et al., 2004b), however explicit trait-like measures of aggression fail to predict suicide attempts in the short-term(Mann et al., 2008). Hence, cognitive reactivity may be a more appropriate tool for uncovering aggressive cognitive tendencies.

Suicidality is an indicator of a more severe depression as it inevitably increases risk for mortality (Harris and Barraclough, 1997). The recognition of precise risk factors of suicidal ideation and behaviour has important clinical and societal implications. It is not the first time that hopelessness is implicated as a risk factor for suicidal ideation (Beck et al., 1990; Wetzel et al., 1980) or aggression for suicidal behaviour (Oquendo et al., 2004b). The present findings clearly support the differential activation model of suicidality (Lau et al., 2004). When measuring cognitive risk factors during remission, 'resting levels' are not as important as 'reactivity patterns': how easily cognitions can be re-activated when mood deteriorates. Practice guidelines for the assessment and treatment of suicidal behaviors still rely on explicit measurements of risk factors (APA, 2003) without examining latent cognitive response patterns that arise in the face of mild negative mood. This may be a very likely explanation for the fact that in spite of a dramatic increase in treatments no significant decrease in suicidal thoughts or attempts has occurred (Kessler et al., 2005). It is highly probable that reduction in hopelessness itself after treatment does not rescue the individual from vulnerability to relapse, an important point for clinicians when deciding to reduce treatment. Unless hopelessness and suicidal reactivity is tested and found to be reduced when the mood of the patient is challenged, the susceptibility to suicidality is still there, and is likely to be expressed within the next mood fluctuation. As Segal et al. demonstrated, recovered depressed patients with high cognitive reactivity following a mood induction were more likely to relapse (Segal et al., 1999, 2006). Further, research examining neurobiological abnormalities in recovered depressed patients points towards evidence that a great part of negative biases in information processing and emotional appraisal occur at a non-conscious level or are not subjectively manifested as depressive symptoms (Bhagwagar and Cowen, 2008).

The present study has some limitations, in particular the cross-sectional design and the retrospective assessment of previous depressive symptoms. The large sample sizes though, and the robustness of findings across sub-samples increase confidence in the reliability of our findings. History of suicidal ideation was measured retrospectively in an interview, allowing for the possibility of recall bias, and participants' cognitive reactivity was assessed later, but not in the same testing session. Furthermore, previous studies have shown that correlates of suicidal risk in retrospective studies have been predictive in prospective studies (Mann et al., 2008, 1999; Oquendo et al., 2004b). Nevertheless, a prospective study is needed to confirm the causal relationship between the specific patterns of cognitive reactivity and future suicidal ideation and behavior.

The present findings provide further evidence of a specific vulnerability profile of suicidality in depression. Future treatments and prevention programs assessing and tackling suicidal vulnerability should take into account levels of cognitive reactivity to sad mood, as opposed to assessment of cognitions under normal conditions.For example, in a study on Mindfulness-Based Cognitive Therapy, a treatment designed to prevent relapse/recurrence of depression, it was recently shown that mindfulness practices significantly reduced cognitive reactivity (LEIDS-R scores), compared to a control group (Raes et al., 2009). The present evidence, as indicated by the specificity of hopelessness/suicidal and aggression reactivity, provides further assistance for the development and implementation of such prevention approaches.

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Conflict of interest

All authors declare that they have no conflicts of interest.

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