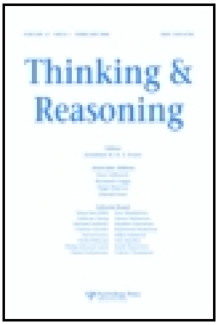

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The grim reasoner: Analytical reasoning under mortality salience

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The human species enjoys uniquely developed capacities for analytical reasoning and rational decision making, but these capacities come with a price: They make us aware of our inevitable physical death. Drawing on terror management theory and dual-process theories of cognition, we investigate the impact of mortality awareness on analytical reasoning. Two experiments show that experimentally induced thoughts of death impair analytical reasoning performance, just as cognitive load would. When made aware of their own mortality, reasoners allocate their executive resources to the suppression of this disturbing thought, therefore impairing their performance on syllogisms that require analytic thought. This finding has consequences for all aspects of rational thinking that draw on executive resources, and calls for an integrated approach to existential psychology and the psychology of rational thought.

Keywords: Mortality salience; Analytical reasoning; Executive resources; Cognitive load.

Executive resources are a limited but critically important commodity, required for a wide range of high-level analytical thinking such as reasoning, decision making, or moral judgement. Ironically, executive resources might also be required for another purpose; that of forgetting we are going to die. The irony is that our awareness of death is likely to be the product of the same, uniquely developed cognitive capacities that enable analytical thinking. The awareness of death might be born out of the capacity for analytical thought, only to

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impair analytical thinking in return, because suppressing the idea of death taps into the very resources that are required for analytical thought.

In this article we explore the possibility that analytical thinking is disrupted by the awareness of death. We draw on terror management theory and dual-process models of cognition to make our theoretical case. We then report two experiments that combine manipulations and measures stemming from terror management research and reasoning research.

Although there are many dual-process models of cognition (Epstein, 1994; Evans, 2007; Evans & Over, 1996; Kahneman & Frederick, 2005; Sloman, 1996; Stanovich, 1999), they all distinguish between an intuitive form of thought (unconscious, rapid, automatic) and an analytical form of thought (conscious, slow, deliberative). One critical difference between these two forms of thought (see Evans, 2008, for a review) is that analytical thinking appears to require executive resources, whereas intuitive thinking does not. Dual-process research in reasoning (De Neys, 2006; DeWall, Baumeister, & Masicampo, 2008), judgement and decision making (Kahneman & Frederick, 2005; Whitney, Rinehart, & Hinson, 2008), and moral judgement (Greene, 2007; Greene, Morelli, Lowenberg, Nystrom, & Cohen, 2008) has repeatedly shown that analytical thinking cedes ground to intuitive thinking when executive resources are unavailable.

Any context that compromises the availability of executive resources should thus disrupt analytical thinking, and contexts that prompt individuals to consider their own mortality are likely to qualify in this category. According to terror management theory (Greenberg, Pyszczynski, & Solomon, 1986), people deploy a battery of cognitive defences when prompted to consider their own mortality, and these defences seem to be different as a function of whether the idea of death is consciously or unconsciously activated. According to the dual-process model of terror management theory (Goldenberg & Arndt, 2008; Hayes, Schimel, Arndt, & Faucher, 2010; Pyszczynski, Greenberg, & Solomon, 1999), the primary defence against conscious thoughts of death is to suppress them, whereas the primary defence against unconscious thoughts of death is to maintain self-esteem and faith in one's cultural world view. These two lines of defence may be used sequentially: Conscious thoughts of death might be turned unconscious by thought suppression, at which stage they trigger the second line of defence. Finally, and critically, the defence against conscious (but not unconscious) thoughts of death is assumed to require executive resources.

The overwhelming majority of experiments inspired by terror management theory focused on the second wave of defence mechanisms, triggered by unconscious thoughts of death. Practically speaking, this means that experimenters first activate conscious thoughts of death, then wait for 5 to 10 minutes before moving on to the rest of the experiment. As a consequence there is only limited and indirect evidence that executive resources are engaged during these 5 to 10 minutes. Our objective in this article is to obtain direct evidence that conscious thoughts of death mobilise executive resources and immediately disrupt analytical thinking.

Arndt, Greenberg, Solomon, Pyszczynski, and Simon (1997) found that individuals who were reminded of their mortality, but then denied access to executive resources by a cognitive load manipulation, displayed greater accessibility of death-related thoughts. This suggests that executive resources would normally have been deployed to suppress thoughts of death, without providing direct evidence of an immediate disruption of analytical thinking. More recently, Gailliot, Schmeichel, and Baumeister (2006) found that participants who were reminded of their mortality showed impaired performance on two tasks that they undertook 5 minutes later, after a distraction task: the Stroop task and a selection of easy analytical reasoning problems borrowed from a GRE preparation book. These results were interpreted as evidence of depleted self-control resources, also known as ego depletion (Schmeichel, Vohs, & Baumeister, 2003). Impaired performance after a delay and a distraction task would suggest that participants used up their self-control resources in order to suppress death thoughts, and that these resources were no longer available for the rest of the experiment.

These findings are suggestive, but they do not offer conclusive evidence that analytical thinking should immediately be disrupted by conscious thoughts of death: The fact that analytical thinking is impaired after a delay and a distraction task does not allow the conclusion that it was impaired while participants were entertaining conscious thoughts of death, at a time when their resources were not yet depleted. In short, and quite straightforwardly, the question of whether conscious thoughts of death disrupt analytical thinking can only be answered by having participants perform a task requiring analytical thinking at the same time that they are entertaining conscious thoughts of death. These are the two pillars of the research strategy we will apply in this article: we will use a well-calibrated task measuring analytical thinking, and we will have participants take this task immediately after they are prompted to consider their own mortality. To induce conscious thoughts of death, we use the standard *mortality salience* manipulation developed in terror management research. Traditionally, this manipulation requires people to write a few sentences about what they think will happen when dying and once physically dead. This manipulation also includes a control group, in which participants have to think about extreme pain, which ensures that the effects of the mortality salience manipulation are not merely driven by its emotionally aversive character (for a review on positive and negative effects of mood on cognitive performance, see Blanchette & Richards, 2010).

Importantly, we presented our measure of analytical thinking immediately after the mortality salience manipulation, without delay or distraction, in order to zero in on the immediate effects of conscious thoughts of death. To measure analytic thinking we use the *belief bias* task, which is the typical paradigm that cognitive psychologists and neuroscientists use to investigate dual-process accounts of reasoning.

EXPERIMENT 1

Method

The 138 participants (103 women, mean age = 32 years, *SD* = 14) were recruited through a French online scientific research platform (www.risc.cnrs.fr) and were randomly assigned to one of the three groups (death, pain, control) of a between-participant design.

Mortality salience manipulation. Our manipulation was straightforwardly adapted from that of Greenberg et al. (1990), which has been used in dozens of experiments. Participants in the Death group had to "briefly describe the emotions that the thought of your own death arouses in you" and "jot down, as specifically as you can, what you think will happen to you physically as you die and once you are physically dead". Participants in the Pain group answered similar questions about extreme pain. Extreme pain was chosen as a control in order to rule out the possibility that the effects of the Death manipulation might be due to its emotionally aversive character. A third group, in which participants were not primed, was used as a control baseline.

Reasoning task. Our reasoning task was the classic belief bias task introduced by Evans, Barston, and Pollard (1983), and subsequently used in numerous investigations of dual-process reasoning (e.g., De Neys, 2006; Goel & Dolan, 2003). Participants solved eight problems (to control for order effects, 16 different versions of the questionnaire were built). Four of these were *conflict* problems, and four were *no-conflict prob*lems. Conflict problems are such that they have valid but unbelievable conclusions, or invalid but believable ones. For example:

(1) a. No healthy person is unhappy;
b. There are unhappy persons who are astronauts;
c. Therefore, there are astronauts who are not healthy.

In this example the conclusion is logically valid but unbelievable. *No-conflict prob*lems are such that the validity of the conclusion is consistent with its believability: The conclusion is either valid and believable, or it is invalid and unbelievable. For example:

(2) a. There are well trained dogs that are bad;
b. No bad dog is a police dog;
c. Therefore, there are well trained dogs that are not police dogs.

Correctly solving conflict problems requires engaging executive resources (De Neys, 2006; Stanovich & West, 2000), to a greater extent than for solving no-conflict problems. We calculated the participants' performance on conflict and no conflict syllogisms separately, as the percentage of syllogisms correctly solved.[1] We expect an interaction between mortality salience and the type of problem. If mortality salience diverts the resources required to process the problems analytically, then it should specifically decrease performance on the conflict problems.

CRT covariate. Individual differences in the ability to inhibit responses can account for substantial variance in the responses to conflict items in the belief bias task. In order to improve the statistical power of our Pain-Death-Control between-group comparison, we used a covariate meant to assess such individual differences.[2] We used a French version of the Cognitive Reflection Test (Frederick, 2005) to this purpose. The CRT consists of three very short questions that all have an intuitively appealing but incorrect answer. For example, an item of the CRT:

A bat and a ball cost \$1.10 in total. The bat costs \$1.00 more than the ball. How much does the ball cost?

Participants responded to the three questions right at the start of the experiment, and scored one point per correct answer.

Results and discussion

Figure 1 displays the reasoning performance (percentage of correct responses) of participants on conflict and no-conflict problems, as a function of their mortality salience group (Death or Pain).

[1] There are different ways of analysing belief bias data that correspond to different levels of theoretical sophistication. Here we use the simplest of all analyses, a comparison between performance on conflict problems and performance on no-conflict problems. In the Appendix to this article we provide the other indices and statistics that can be useful to specialists of belief bias.

[2] For the sake of completeness, were the covariate not to be included in the analyses, the results would be the following. Experiment 1: Mortality Salience $F = 4.2$, $p = .018$; Conflict $F = 10.8$, $p = .001$; Conflict × Mortality Salience $F = 7.5$, $p = .007$. Replication of Experiment 1: Mortality Salience $F = 5.1$, $p = .007$; Conflict $F = 12.2$, $p = .001$; Conflict × Mortality Salience $F = 4.1$, $p = .05$. Experiment 2: Mortality Salience $F = 4.6$, $p = .03$; Load × Mortality Salience $F = 1.3$, $p = .26$, Load on Pain group, $F = 2.03$, $p = .08$, Load on Death group, $F = 0.2$, $p = .44$.

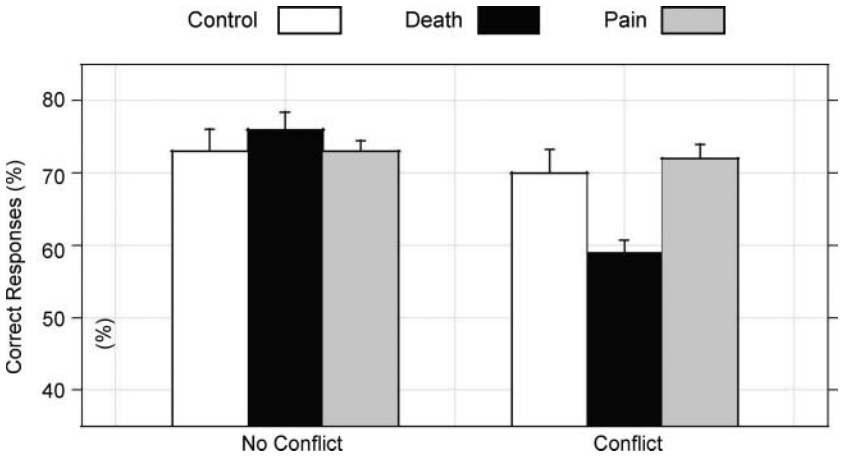

Figure 1. Percentage of correct answers (Experiment 1) as a function of mortality salience group, for conflict as well as no-conflict problems. Errors bars indicate standard errors of the mean.

Visual inspection of Figure 1 hints at two phenomena. First, and quite as expected, conflict problems are harder to solve than no-conflict problems. Second, and most importantly in regard to our current purposes, mortality salience appears to have a detrimental effect for conflict problems, but not for no-conflict problems. This is the interaction we were looking for.

We conducted an analysis of variance, where the reasoning score is entered as a dependent variable, and where predictors are the experimental group, the problem type and where the CRT is entered as a covariate. The ANOVA detected a marginal effect of the problem type, reflecting the greater difficulty of conflict problems, $F(1, 133) = 3.7$, $p = .057$, $n^2_p = .03$. More importantly, the analysis detected a significant interaction effect between mortality salience and problem type, $F(2, 133) = 3.7$, $p = .027$ $n^2_p = .05$, reflecting the fact that the relative difficulty of conflict problems, as compared to that of no-conflict problems, was greater under mortality salience. For conflict problems, participants under mortality salience were less likely to respond correctly than participants in the other groups, $t(136) = 2.6$, $p = .012$, which was not the case for no-conflict problems, $t(136) = 0.9$, $p = .36$.

The analysis also detected a main effect of the CRT covariate, $F(1, 133) = 5.2$, $p = .024$, $n^2_p = .04$. Unsurprisingly, this effect reflected a better performance from high-CRT participants. The analysis did not detect any other significant effect, other than a marginally detected effect of problem type, linked to a better performance on no-conflict problems, $F(1, 133) = 3.0$, $p = .085$, $n^2_p = .02$.

So far our findings are in line with the hypothesis that mortality salience (compared to pain salience and to a control baseline) impairs performance on conflict problems, which require executive resources to a greater degree than no-conflict problems. Before we move on, we offer a replication of this finding. This replication aims at consolidating our first findings, and will also be useful to address one curious aspect of our data. Participants seemed to do very well on conflict problems in the Pain and control groups, to the extent that we do not appear to replicate the classic belief bias effect. Before we comment on this aspect of the data, we attempt to replicate it.

Replication

The 126 participants (86 women, mean age = 30 years, $SD = 9$) were recruited through the same French online scientific research platform. They completed an online questionnaire in which they were randomly assigned to one of the two groups of a mortality salience manipulation (Pain vs Death), and solved the same problems as in the main study.[3]

Figure 2 displays the reasoning performance of participants as a function of problem type and mortality salience group. We conducted an analysis of variance where the reasoning score was entered as the dependent variable, the mortality salience group was the predictor, and the CRT was the covariate. The ANOVA detected a main effect of the problem type, reflecting the greater difficulty of conflict problems, $F(1, 123) = 16{:}0$, $p <$:001, $n^2_p =$:12. More importantly, the analysis detected a marginal interaction effect between mortality salience and problem type, $F(1, 123) = 3{:}1$, $p =$:08, $n^2_p =$:02 (this is a conservative two-tailed p-value; the one-tailed p-value would be significant and in line with our prediction). Planned contrasts supported our prediction that mortality salience would impair performance on conflict problems, $t(124) = 3.2$, $p = .002$, but not on no-conflict problems, $t(124) = 0.9$, $p = .38$. Finally, we found a significant interaction between problem type and CRT, $F(1, 123) = 5.1$, $p = .026$, $n^2_p = .04$, suggesting that high-CRT participants performed better on the conflict problems than low-CRT participants, while CRT did not predict performance on no-conflict problems.

Although we did obtain a main effect of problem type on performance in this replication study, a more detailed look at the results (see Appendix)

[3] We also measured participants' thinking style with the Rational-Experiential Inventory (Epstein, Pacini, Denes-Raj, & Heier, 1996). Because this scale was not involved in any statistically significant result, we do not discuss it further.

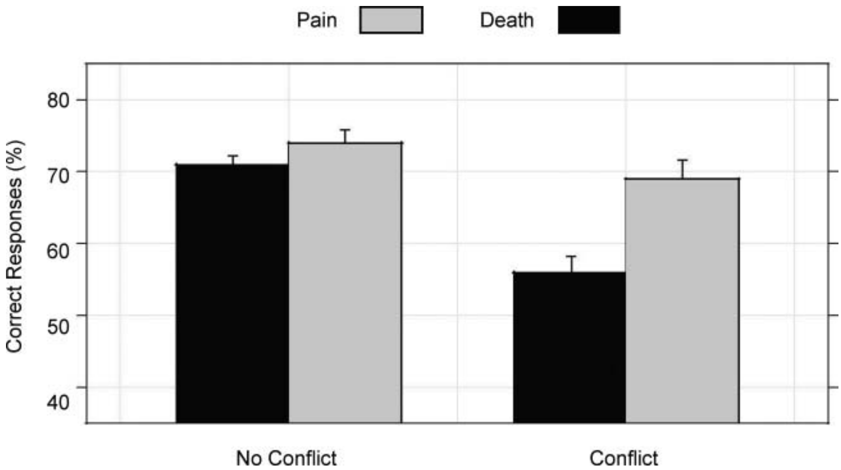

Figure 2. Percentage of correct answers (Replication of Experiment 1) as a function of mortality salience group, for conflict as well as no-conflict problems. Errors bars indicate standard errors of the mean.

suggests that, once more, participants did very well on conflict problems in the Pain condition. One possible (and plausible) explanation for this unusual level of performance is that participants were recruited through an online platform whose users might be more educated and better cognitively equipped than the average student population. We will come back to this explanation after we report the results of Experiment 2, in which participants were recruited on campus.

The main result of the replication study is in line with that of the main study: Mortality salience impairs performance on conflict problems, but leaves performance intact on no-conflict problems. This is the result we were expecting, and which we will explore further in Experiment 2. A specific goal of this second experiment is to compare the effect of mortality salience to that of a standard concurrent load manipulation. In addition to obtaining a comparison of the two effects, we are interested in their interaction. We reason that, if participants under mortality salience are already engaging their executive resources to suppress thoughts of death, then even a high-load concurrent task should not impair reasoning performance any further. What should be impaired by a high-load concurrent task, though, is the effectiveness of thought suppression: We expect that, under high concurrent load, participants under mortality salience should not only reason incorrectly on conflict problems, but also be unable to fully suppress thoughts of death. To test this prediction we included a death thought accessibility measure at the end of the experiment.

EXPERIMENT 2

Method

Participants and design. The 123 participants (mean age = 22 years, $SD = 5$) were recruited on campus at the University of Toulouse, and randomly assigned to the four groups of a 2 × 2 between-participant design, manipulating mortality salience and concurrent cognitive load. A measure of the CRT covariate was included at the start of the experiment, and a measure of death-thought accessibility was included at the end of the experiment.

Materials and measures. The mortality salience manipulation, the reasoning task, and the CRT variable were the same as in Experiment 1. We now detail the novel aspects of Experiment 2; that is, the concurrent load manipulation and death thought accessibility measure.

Concurrent load manipulation. We used a standard spatial storage task known as the Dot Memory task (Bethell-Fox & Shepard, 1988; De Neys, 2006; Miyake, Friedman, Rettinger, Shah, & Hegarty, 2001) and based our manipulation on that of De Neys (2006) who used it to demonstrate that conflict problems relied on the mobilisation of executive resources. Before every reasoning problem, a 3 × 3 matrix was flashed on a mural screen for 850 ms. Some cells in the matrix were filled with dots. Participants had to memorise the location of the dots, which varied for each matrix. After responding to the reasoning problem participants had to reproduce the configuration of the dots in an empty matrix. Participants in the low-load condition saw easy matrices, similar to that presented in the left panel of Figure 3. Participants in the high-load condition saw difficult matrices, similar to that presented in the right panel. It is well established that the memorisation of these difficult patterns burdens executive resources (Bethell-Fox & Shepard, 1988; Miyake et al., 2001). Memorisation of the low-load pattern, on the contrary, is less taxing on executive resources (De Neys, 2006) and is used here as a control. For each participant and each problem we recorded the number of dots that the participant correctly placed in the empty matrix.

Death thought accessibility. We developed a French version of the classic Death Thoughts Accessibility task (Greenberg, Pyszczynski, Solomon, Simon, & Breus, 1994; Harmon-Jones et al., 1997). The task features a series of 18 short words, in which two consecutive letters are missing. Participants must fill in letters to form the first word that springs to their mind. Critically, six words are such that they have two possible completions, one related to death, and one that is not. For example, COFF_ _ can be completed as "coffee" or "coffin". In our French adaptation of the task we made sure that

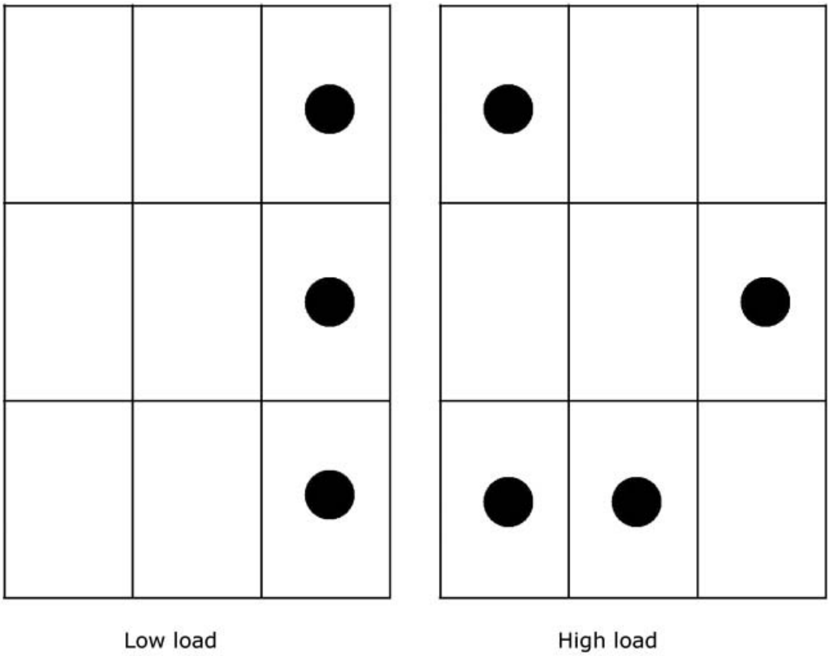

Figure 3. Dot memory task.

the two completions would have roughly the same frequency in everyday language (as assessed through a lexical database). Our measure of interest was the percentage of death-related completion among these six items.

Results and discussion

Mahalanobis distance computations (Mahalanobis, 1936) identified four multivariate outliers, which were removed from subsequent analyses, leaving a final sample of 119 participants.

Before we describe the results, we note that participants showed excellent performance in the Dot Memory task. In the low-load condition the mean number of correctly localised dots was 2.9, out of 3. In the high-load condition this mean number was 3.4, out of 4. Thus participants correctly reproduced 86–98% of dot patterns, suggesting that, as instructed, they gave high priority to the memorisation task.

Reasoning task. Figure 4 displays the percentage of correct answers to conflict problems as a function of problem type, mortality salience condition, and cognitive load. Visual inspection suggests that mortality salience

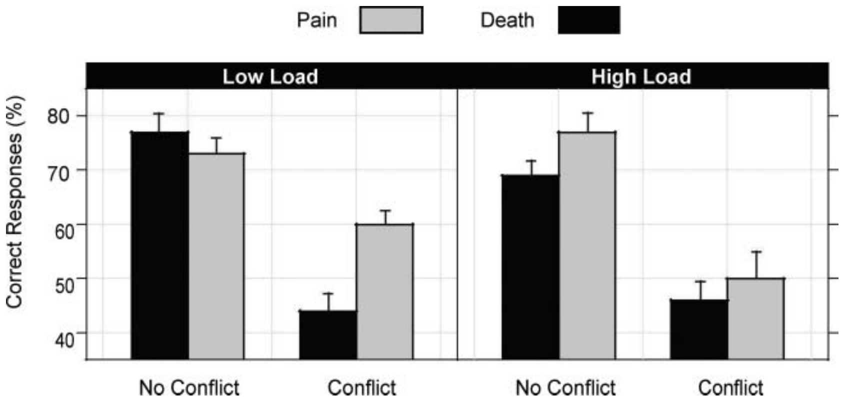

Figure 4. Percentage of correct answers (Experiment 2) as a function of cognitive load and mortality salience group, for conflict as well as no-conflict problems. Errors bars indicate standard errors of the mean.

impaired reasoning to a substantial extent, and that high concurrent load did not further impair reasoning than mortality salience already did. An analysis of variance was conducted with reasoning performance as the dependent variable, mortality salience and concurrent load as dummy variables, and CRT score as a continuous covariate. Overall, the analysis detected a marginal three-way interaction between mortality salience, problem type and load condition, $F(1, 118) = 3.4$, $p = .07$, $n^2_p = .03$.

For the sake of simplicity, and to make results easily comparable with those of the two first experiments, we decomposed the sample by load condition. In the low-load condition (which serves as a replication of the previous experiments) the ANOVA detected as usual a main effect of problem type, $F(1, 57) = 18.2$, $p < .001$, $n^2_p = .25$, and more importantly a significant interaction between mortality salience and problem type, $F(1, 57) = 6.3$, $p = .02$, $n^2_p = .10$. *T*-tests confirm the effect of mortality salience on conflict problems, $t(56) = 3.0$, $p = .005$, and find no effect on no-conflict problems, $t(56) = 0.6$, $p = .56$. No other significant effect was detected by the ANOVA in the low-load condition (all *F*s < 1.24, all *p*s $>$ .27). In the high-load condition the ANOVA detected a main effect of problem type, $F(1, 60) = 24.7$, $p < .001$, $n^2_p = .30$, but no significant interaction between mortality salience and problem type, $F(1, 60) = 0.01$, $p = .91$, $n^2_p < .001$. *T*-tests did not detect any effect, either for conflict problems, $t(59) = 0.5$, $p = .59$, or no-conflict problems, $t(59) = 1.3$, $p = .19$. A main effect of CRT was detected, $F(1, 60) = 11.1$, $p = .001$, $n^2_p = .16$. The analysis did not detect any other effect in the high load condition (all *F*s < 2.17, all *p*s $> .15$).

TABLE 1
Percentage of death-related completions as a function of cognitive load and mortality salience group

	Pain	*Death*
Low load	18 (17)	16 (15)
High load	17 (18)	28 (19)

Word completion task. Table 1 displays the percentage of death-related completions as a function of mortality salience and cognitive load. Perhaps unsurprisingly, death-related completions were very rare in the Pain group. More interestingly, death-related completions were still very rare under mortality salience in the low-load condition, and more frequent under mortality salience in the high-load condition.

An analysis of variance was conducted, using the same predictors as for the reasoning task, only with the percentage of death-related completions as the dependent variable. This analysis detected a marginal interaction effect reflecting the fact that death-related completions increased in only one case; that is, for participants under mortality salience and high cognitive load, $F(1,\ 118) = 3.9$, $p = .05$, $n^2_p = .03$ (two-tailed). Planned contrasts showed that the effect of cognitive load was significant for participants in the death thought condition, $F(1, 57) = 6.3$, $p = .02$, $n^2_p = .10$, but not for participants in the pain thought group, $F(1, 60) = 0.3$, $p = .60$, $n^2_p = .005$. For these participants, the percentage of death-related completions rose to 28%, as compared to the less than 16% rate observed for other participants. Hence, as expected, cognitive load prevented participants under mortality salience from correctly suppressing death-related thoughts, and consequently these thoughts remained highly accessible.

GENERAL DISCUSSION

The aim of this article was to provide direct evidence that conscious thoughts of death would immediately impair analytical reasoning, under the assumption that the suppression of death thoughts would mobilise executive resources, which would accordingly not be available for analytical thinking. Two experiments provided convergent support for our claim. We were particularly interested in the interaction between mortality salience and problem type in the belief bias task. Planned contrasts showed that mortality salience impaired performance on conflict problems, but not on no-conflict problems. Furthermore, cognitive load did not impair reasoning any further than mortality salience already did, but it impaired the suppression of death thoughts. Individuals under mortality salience did not reason worse when cognitively burdened, but they thought more about death at the end of the experiment.

Before we move on to the implications of our results, we must comment on three issues related to the interpretation of our data: the magnitude of our mortality salience effect, the fact that we did not record our participants' mood, and our choice to use the simplest of all possible indices of belief bias.

First, our samples were relatively large and able to detect small effects. Thus it is interesting to comment on the magnitude of the mortality salience effect. Let us consider as a reference the magnitude of the dot memory task effect. In our Experiment 2 the dot memory task had an effect on belief bias which was comparable to the original effect in De Neys (2006). Now, across our experiments, the magnitude of the mortality salience effect was one to three times as large as the dot memory task effect. We can tentatively conclude that mortality salience is equivalent to a very high cognitive load—and we have obtained convergent evidence for this claim, in the domain of moral judgement (Trémolière, De Neys, & Bonnefon, 2012).

Second, we did not consider the possibility that our mortality salience manipulation might have affected participants' mood, which would in turn have affected their reasoning performance. The reason we did not record mood, and did not consider the possibility that it might have mediated the effect of mortality salience, is grounded in the literature on mortality salience. The effect of mortality salience on mood has been measured many times, and has not been detected as significant. Mortality salience had no detectable effect on the Positive and Negative Affective Scale (Tremayne & Curtis, 2007; Watson, Clark, & Tellegen, 1988), on the Brief Mood Introspection Scale (Gailliot et al., 2006), on the Multiple Affect Adjective Checklist (Greenberg et al., 1995), or on pulse rate or skin conductance (Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989), or on facial electromiography (Arndt, Allen, & Greenberg, 2001). Overall, the literature on mortality salience strongly suggests that negative mood can be ruled out as a mediator.

Third, we made a choice to run the simplest possible analysis of belief bias data: a comparison of reasoning performance on conflict and no-conflict problems. The literature on belief bias features two other strategies, which gain in theoretical sophistication what they lose in expositional simplicity. One of these strategies relies on the computation of three indices (Belief, Logic, Interaction), and the other strategy focuses on the endorsement rates of the four types of problems used in the Belief × Validity design. We believe that the choice of the simplest analysis is appropriate to the goal of this article, which is to introduce the effect of mortality salience, rather than to test a novel theoretical account of belief bias. Nevertheless, for the interest of expert readers, we offer alternative statistics in the Appendix.

Our research breaks with the standard practice in mortality salience research, of measuring behaviour only after a delay and distraction. We rather focus on what happens immediately after a mortality salience induction. Our hypothesis is that during this period, executive resources are mobilised to suppress death thoughts, which in turn impairs mental activities that would ordinarily rely on these executive resources. Our present results support this hypothesis, and are consistent with other recent findings. For example, Trafimow and Hugues (2012) observed that the accessibility of death thoughts was high immediately after the mortality salience manipulation, and then decreased to very low levels after some minutes. This is consistent with the idea that mortality salience activates death thoughts which are suppressed in the few minutes that follow the manipulation. In parallel, we have observed that a mortality salience manipulation had the immediate effect of decreasing moral utilitarianism (Trémolière et al., 2012). This is also consistent with the idea that the suppression of death thought impairs judgements that require effortful cognitive processing.

The effect of mortality salience on reasoning presumably reflects the broader phenomenon of thought suppression, which is known to tap cognitive resources (for a review, see Wenzlaff & Wegner, 2000). This phenomenon has been studied in many other contexts, which may provide other stimuli that could prove detrimental to reasoning (for examples of different stimuli, see Erskine & Georgiou, 2010; Garland, Carter, Ropes, & Howard, 2012).

Our findings echo the deep irony that we mention in the introduction of this article. We can consider abstractly the prospect of our own death at any given time, because of our ability to think analytically. But the very resources that we use to think analytically are then immediately mobilised to suppress thoughts of death. Ironic as it is, this aspect of our cognition has important consequences for a wide range of high-level mental activities, such as reasoning, economic decisions, and moral judgements, all intertwined (Bonnefon, 2009) and all known to depend on whether or not they can tap into executive resources. It is a disheartening prospect that we cannot use executive resources when making decisions or issuing judgements in situations that might remind us of our own mortality, such as choosing life insurance or arguing about assisted suicide. Other mortality salience contexts can be such that attentional resources are very much needed. Military strategising is one example, just as are legal deliberations involving murder or the death penalty. If mortality salience is triggered during these activities, with detrimental effect on executive resources, then research is called for in order to understand these detrimental effects and to devise debiasing strategies.

Hitherto, terror management research has been conducted in relative isolation from cognitive research on reasoning, judgement, and decision making. The present findings point to the importance of taking into account the perverse effects of mortality salience on high-level rational mental activities, as well as of investigating potential remedies such as glucose intake (Gailliot et al., 2007; Masicampo & Baumeister, 2008). We hope that a further integration of the two fields might help point to ways to overcome the grim but fascinating consequences of thinking about our own death.

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APPENDIX

Alternative belief bias statistics

For the sake of comparability with some of the literature on belief bias, we provide alternative statistics in this Appendix. We first report the endorsement rate of the four types of problem, in each experiment and each condition. We then report the Belief, Logic, and Interaction indices in each experiment and each condition. We offer only cursory comments on these data, since they are not the focus of our analysis.

Table A1 offers the most detailed look at our descriptive statistics. Two trends must be noted, which were not immediately apparent in the analysis

TABLE A1
Percentage (*SD*) endorsement of the four types of conclusions in Experiment 1, its replication, and Experiment 2

	No conflict		*Conflict*	
	VB	*IU*	*VU*	*IB*
Experiment 1				
Control	65 (34)	20 (35)	82 (30)	42 (38)
Pain	63 (34)	16 (30)	85 (29)	35 (38)
Death	75 (37)	22 (34)	75 (37)	58 (41)
Replication				
Pain	70 (35)	21 (34)	77 (30)	36 (40)
Death	67 (35)	24 (35)	66 (33)	55 (41)
Experiment 2				
Pain (Low load)	65 (37)	18 (30)	66 (35)	45 (37)
Death (Low load)	69 (37)	15 (27)	44 (40)	57 (36)
Pain (High load)	73 (37)	20 (28)	57 (41)	57 (39)
Death (High load)	60 (42)	21 (34)	53 (43)	61 (38)

V, B, I, and U respectively stand for Valid, Believable, Invalid, and Unbelievable.

offered in the main text. First, most of the effect of mortality salience appears to be driven by the Invalid-Believable problems, a result that could be expected by such accounts of belief bias as the selective processing account (Stupple, Ball, Evans, & Kamal-Smith, 2011). Second, participants did very well on conflict problems in Experiment 1 and its replication, while their performance was more in line with usual results in Experiment 2. We suspect that the participants of Experiment 1 and its replication, who were recruited through an online scientific platform, were better educated and cognitively equipped than participants in Experiment 2, who were recruited on campus.

Table A2 reports the Logic, Belief, and Interaction indices for our three experiments. The logic index measures the difference between acceptance of valid and invalid conclusions. It corresponds to VB + VU – IB – IU, where VB is the number of Valid-Believable conclusions accepted by the reasoner (VU the number of Valid-Unbelievable conclusions, IB the number of Invalid-Believable conclusions, IU the number of Invalid-Unbelievable conclusions). The belief index measures the difference in acceptance of believable and unbelievable conclusions; it corresponds to VB + IB – VU – IU. Finally, the interaction index measures the extent to which belief bias is greater on invalid than valid conclusions, and it corresponds to VU + IB – VB – IU. Overall, Table A2 suggests that the effect of mortality salience is mostly focused on the Belief index.

TABLE A2
Logic, Belief, and Interaction indices in all experiments

	Death	*Pain*
Experiment 1		
Logic	1.47 (1.6)	1.82 (1.35)
Belief*	0.67 (1.11)	0.06 (1.2)
Inter	0.78 (1.34)	0.67 (1.21)
Replication		
Logic*	1.08 (1.37)	1.8 (1.49)
Belief*	0.62 (1.2)	0.17 (1.33)
Inter	0.59 (1.24)	0.43 (1.27)
Experiment 2		
Logic (Low load)	0.81 (1.33)	1.35 (1.31)
Belief* (Low load)	1.33 (1.18)	0.52 (1.21)
Inter (Low load)	0.37 (1.24)	0.58 (1.12)
Logic (High load)	0.61 (1.28)	1.07 (1.41)
Belief (High load)	0.94 (1.34)	1.07 (1.68)
Inter (High load)	0.68 (1.35)	0.4 (1.1)

The symbol * indicates that, within a given experiment, the index is significantly different between the Pain and Death condition at the .05 level.