Defending one's worldviews under mortality salience –

Testing the validity of an established idea

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Ethics statement

All studies in this paper were conducted in full accordance with the Ethical Guidelines of the German Association of Psychologists (DGPs) and the American Psychological Association (APA). Moreover, the studies are part of a research project supported by the German research foundation (DFG) for which we received ethics approval by the ethics committee of the University of Kassel.

Data availability statement

Data, the material and the preregistration protocols of the all studies are available on the Open Science Framework (see https://osf.io/qkwyn/?view_only=1af6ce8e2c62481b90f388236c5f6f97).

Abstract

Terror management theory (TMT) posits that mortality salience (MS) leads to more negative perceptions of persons who oppose one's worldview and to more positive perceptions of persons who confirm one's worldview. Recent failed replications of classic findings have thrown into question empirical validity for this established idea. We believe, that there are crucial methodological and theoretical aspects that have been neglected in these studies which limit their explanatory power; thus, the studies of this registered report aimed to address these issues and to directly test the worldview defense hypothesis. First, we conducted two preregistered lab studies applying the classic worldview defense paradigm. The stimulus material (worldview-confirming and -opposing essays) was previously validated for students at a German university. In both studies, the MS manipulation (between-subjects) was followed by a distraction phase. Then, in Study 1 ($N = 131$), each participant read both essays (within-subjects). In Study 2 ($N = 276$), the essays were manipulated between-subjects. Credibility attribution towards the author was assessed as the dependent variable. In both studies, the expected interaction effects were not significant. In a third highly powered (registered) study ($N = 1356$), we used a previously validated worldview-opposing essay. The five classic worldview defense items served as the main dependent measure. The MS effect was not significant. Bayesian analyses favored the null hypothesis. An internal meta-analysis revealed a very small (Hedges' $g = .09$) but nonsignificant ($p = .058$) effect of MS. Altogether, the presented studies reveal challenges in providing strong evidence for this established idea.

250 words

Keywords: mortality salience; terror management theory; worldview defense; replications; registered report

One core hypothesis of terror management theory (TMT; Greenberg et al., 1986) is that people are motivated to defend and to validate their own worldviews when being confronted with their own death, referred to as mortality salience (MS) hypothesis. Since the first empirical paper (Rosenblatt et al., 1989), the MS hypothesis has been addressed in more than 1,500 studies (Benjamin et al., 2020). However, the high estimated prevalence of questionable practices in past social psychological research cast doubt on the positive correlation between the number of studies showing a certain effect and the actual validity of this effect (John et al., 2012; Simonsohn et al., 2014). The goal of (re-)increasing credibility of scientific claims positions replicability of original findings at the center of the research.

Recently, several studies failed to replicate the classic findings of Greenberg et al. (1992; see also Greenberg et al., 1994), decreasing confidence in its validity (e.g., Klein et al. 2019). We believe, however, that important methodological and theoretical aspects were neglected in these studies. Based on available knowledge from the TMT literature but also from personal communication with original TMT experts, in this registered report, we present three preregistered studies addressing these limitations in an effort to directly test the validity of the MS hypothesis. These studies apply the classic worldview defense paradigm but vary in their closeness to the original studies by Greenberg et al. (1992, 1994; cf. Brandt et al., 2014).

Basic Propositions of Terror Management Theory

TMT assumes a conflict between the innate desire to live and the awareness of one's own death as a natural and inevitable event (Greenberg et al., 1986; Pyszczynski et al., 2015), producing an omnipresent potential for paralyzing anxiety. To cope with this threat, TMT posits that it is necessary to maintain the belief that we are valuable parts of a meaningful, important, and enduring existence. The proposed anxiety buffer thus consists of two interrelated components: first, faith in a culturally derived worldview that gives meaning and purpose to human life, along with faith in the provided norms and standards, and second, the belief that one is meeting or exceeding these norms and standards. That is, certainty about the

validity of one's worldview and one's value are crucial for the effectiveness of the anxiety-buffering system.

The Mortality Salience Hypothesis

Although different hypotheses derived from the theory have been tested, by far most research has been addressing the MS hypothesis (Pyszczynski et al., 2015) which states that being confronted with one's own mortality should increase one's need for protection provided by one's worldviews. Consequently, MS is predicted to lead to worldview defense, meaning more positive responses to anyone or anything that bolsters one's worldviews and conversely more negative responses to anyone or anything that threatens them. A meta-analysis across 277 studies yielded a moderate to strong effect of MS ($f = .37$) across diverse aspects of the anxiety buffer (Burke et al., 2010). These calculations are based on the theoretically "best" conditions for expected MS effects when there were moderators included, leading to an overrated effect size for simple main effects of MS. A re-analysis of this data by Burke et al. (2018), however, finds signs of publication bias; a conservative adjustment estimated $f = 0.16$ and a more liberal adjustment estimated $f = 0.31$ (see also Rodríguez-Ferreiro et al., 2019). Meanwhile, the number of studies has increased to more than 1,500 (Benjamin et al., 2020). At the same time, preregistered and high-powered studies on MS effects are rare (for exceptions, see Dunn et al., 2020; Schindler et al., 2019a; Vail et al., 2019).

The Classic Worldview Defense Paradigm

To be able to adequately assess to what degree "replications" of MS studies can increase or decrease confidence in the validity of the MS hypothesis, it is important to know the standard procedure in the literature. We call this the "classic" worldview defense paradigm.

MS Manipulation

According to the meta-analysis of Burke et al. (2010), nearly 80% of the 277 studies used the two open-ended short-answer questions that ask participants to write about their emotions that

the thought of their own death arouses in them and to jot down what will happen to them as they physically die. In the majority of studies (about 62%), the control condition contained the same questions regarding aversive topics such as dental pain or paralysis.

Delay

Burke et al. (2010) reported that in nearly 93% of all studies, reactions on MS were assessed after one or more delay tasks. In fact, MS effects were stronger after a long delay. The most common delay task (about 48%) was the Positive and Negative Affective Schedule (PANAS; Watson et al. 1988), or its expanded form (PANAS-X; Watson & Clark, 1992), asking participants about their present mood. Importantly, there are theoretical reasons for applying such delay tasks. According to the proposed cognitive architecture of terror management, there are proximal and distal reactions on MS (Arndt et al., 2002). Proximal reactions are immediate and direct forms of defense provoked by conscious death-related processes primarily to remove death thoughts from focal attention. In contrast, distal reactions are provoked by accessible but unconscious death-thoughts. These reactions are the core components of the anxiety-buffering system, meaning that people have little or no awareness of typical MS reactions such as worldview defense (Pyszczynski et al., 2015). Thus, for testing the MS hypothesis by using explicit MS manipulations, it is crucial to include delay tasks to allow death thoughts fade from consciousness.

Dependent Measure

The MS hypothesis on worldview defense was tested by using a wide range of dependent variables. According to the meta-analysis of Burke et al. (2010), the most common measure (used in 8.7% of the 277 experiments) was the participants' attitude toward the author of an essay that disagreed with their worldview (often by criticizing the participants' country). This paradigm was first used in the article by Greenberg et al. (1992). Here, American participants were presented an anti-U.S. essay (worldview-opposing) and a pro-U.S. essay (worldview-confirming). Afterwards, five items were included that referred to

author evaluations (i.e., how likable / intelligent / knowledgeable is the author) and evaluations of the essay itself. According to the MS hypothesis, MS leads to more negative evaluations of the author of the anti-U.S. essay (and the essay itself) and more positive evaluations of the author of the pro-U.S. essay.

Available Replication Studies on MS Effects

When speaking of replication, it is helpful to distinguish between two contexts or aims of studies (Erdfelder & Ulrich, 2018; Fiedler, 2017): *discovery* and *justification* (or verification). Studies in the discovery context can, for example, aim to address generalizations of theories or predictions by deviating from the original study in at least one relevant aspect (*conceptual replications*). For such aims, minimizing false negatives is crucial, pointing to the importance of exploration. Studies in the justification context aim to test the reliability of a previous finding and to mirror the original study as exactly as possible (*close replication*). Importantly, conceptual replications can also be relevant in a justification context, especially when they are designed in a way that outcomes inconsistent with a prior claim would decrease confidence in this claim (Nosek & Errington, 2020). Although both contexts play an important role in the research process, the context of justification (especially regarding close replications) was until recently largely neglected in psychology (Open Science Collaboration, 2015). This is problematic because “a science that cannot say no to anything does not actually have the capacity to grow” (Brannigan, 2004, p. 11).

To date, replicability of MS effects has hardly been investigated. To our knowledge, there is in fact only one published close replication study in TMT research. In one study (64 participants per cell), Rodríguez-Ferreiro et al. (2019) replicated a study of Goldenberg et al., (2001; 10 participants per cell), testing the idea that participants under MS should react with more positive evaluations of an essay describing humans as distinct from animals. However, Rodríguez-Ferreiro et al. failed to find a significant MS effect.

More important for the present work are two unpublished articles (available as preprints) addressing the classic worldview defense findings of Greenberg et al. (1992, 1994). An overview of the central study characteristics can be found in Table 1. Sætrevik and Sjøstad (2019) report two studies using the classic MS manipulation and essay-based author evaluations as dependent measures. Results of both studies did not reveal a significant MS effect; However, we believe that both studies lack several important aspects to be regarded as strict tests of the MS hypothesis. First, sensitivity power analyses for an ANOVA showed that power in Study 1 ($N = 101$) was only high to detect a large effect of MS. In contrast, power in Study 2 ($N = 783$) was high to detect a small effect of MS. Second, Study 1 did not include any delay task while Study 2 at least used a short delay task (PANAS). Still, Study 2 was conducted online via MTurk where it was suggested (cf. Schindler et al., 2019a, Study 2) that a short delay was insufficient with participants who were likely more focused on finishing quickly to make money and then move on to other studies (e.g., Wood et al., 2017). Third, although both studies applied the original pro- and anti-U.S. essays as stimulus material (note that Study 1 used an adapted version for Norway), author evaluations were not assessed as the first variable but only after a Stroop task and two further essays (Study 1) or a measure of ingroup identification (Study 2). Including such measures might attenuate MS effects on following variables through producing error variance (when using additional unvalidated essays) or by providing participants the chance of early threat regulation, for example, by self-affirmation (Schmeichel & Martens, 2005). Finally, although Study 2 is sufficiently powered, data collection via MTurk has been recently shown to produce problematic data quality if no additional measures are taken (Chmielewski & Kucker, 2020), and no such measures have been reported for Study 2. Taken together, the two studies of Sætrevik and Sjøstad (2019) have several limitations and fail to fulfill central aspects of the classic worldview defense paradigm. Therefore, independent from their results, they should be interpreted as studies in

the context of discovery, rather than as studies in the context of justification. Conclusions about the validity of the MS hypothesis are limited.

The second preprint article refers to a large-scale replication project called Many Labs 4 (ML4; Klein et al., 2019). Here, the role of original author involvement for improving replicability was tested by using the classic study of Greenberg et al. (1994, Study 1). Across 21 labs ($N = 2220$), no significant MS effect occurred independent from original author involvement. Klein et al. (2019) interpreted the results as an important data point not supporting the MS hypothesis. However, for evaluating the weight of this project for the validity of the MS hypothesis, it is important to note that only 9 labs ($n = 799$) applied the classic worldview defense paradigm (expert protocol). The remaining 13 labs were free in their operationalization choices and partly showed strong divergences (e.g., no delay, different essays). Therefore, when assessing the findings in the context of justification, if anything, only the data of the 9 expert labs should be analyzed. Moreover, these expert labs also included a measure of importance of American identity to be able to exclude participants only indicating low or moderate importance, because the pro- or anti-U.S. essays should be relevant only for participants with high importance. Thus, an even more accurate analysis would only include data of the 9 expert labs and only include participants indicating a high importance of their American identity (i.e., higher than 6 on a 9-point scale; see exclusion set 3 in Klein et al., 2019). This would, however, cut the number of participants roughly in half and substantially reduce power to detect a small effect. In a recent comment (available as preprint), Chatard et al. (2020) further challenged the conclusion of Klein et al. (2019). First, they mentioned problems of data quality because much of the data was collected in the wake of the presidential election of Donald Trump, possibly influencing the responses to essays that praise or criticize the U.S. Second, Chatard et al. (2020) identified a divergence from the preregistered protocol regarding sample exclusion. When following the protocol by excluding samples with fewer than 40 participants per cell, they reported small but significant MS

effects for the remaining 6 expert labs for the preregistered exclusion set 2 (white Americans; $n=352$) and 3 (white Americans who report a high importance of their American identity; $n=211$). Corresponding Bayesian analyses on these subsamples revealed weak and inconsistent evidence for or against an overall MS effect, while results using the whole data set speak against a mortality salience effect (Haaf et al., 2020). In any case, the ML4 project was primarily not initiated to provide a strict test of the validity of the MS hypothesis, but to test original author involvement. Nevertheless, findings in the expert labs can be interpreted in the context of justification, revealing inconclusive evidence for or against the validity of the MS hypothesis given the re-analysis by Chatard et al. (2020). Context effects (change in the political climate after President Trump's election) are likely, potentially increasing error variance that limits the explanatory power of the ML4 findings.

Table 1

Overview of characteristics of available studies aiming to replicate findings of Greenberg et al. (1992, 1994).

	Sætrevik & Sjøstad (2019)		Klein et al. (2019)
	Study 1	Study 2	expert labs only
<i>N</i>	101	783	799
Sample origin	Norway	U.S.	U.S.
Detectable effect size with 90% power	$f = 0.32$	$f = 0.12$	$f = 0.12$
Data collection	lab	online (MTurk)	in 9 labs
MS manipulation	classic	classic	classic
Control group	dental pain	dental pain	watching TV
Delay	none	PANAS	PANAS-X and MEQ
Number of essays	2 (within)	2 (within)	2 (within)
Essays	adapted versions of pro- and anti-U.S. essays (counterbalanced)	original versions of pro- and anti-U.S. essays (counterbalanced)	original versions of pro- and anti-U.S. essays (counterbalanced)
Variables assessed before WD	Stroop task & evaluations of pro- and anti-democracy essays	measure of ingroup identification	none
Significant MS effect	no	no	no
Major limitations	low power, no delay, WD not assessed first	short delay, WD not assessed first, problematic data quality (MTurk)	distortion by context effects (data collection during presidential election of Donald Trump)

Note. Detectable effect size was calculated with G*Power by applying a sensitivity power analysis for an ANOVA (fixed effects, omnibus, one-way) assuming power = .90, alpha = .05 and two groups. WD = worldview defense. MEQ = morning-eveningness questionnaire.

The Present Research

According to the MS hypothesis, people are motivated to defend and to validate their own worldviews when being confronted with their own death. Despite the vast number of studies providing evidence for this idea, recent studies showed nonsignificant MS effects when aiming to replicate classic findings of Greenberg et al. (1992, 1994). These findings question the empirical validity of the MS hypothesis, at least at first glance. We argue, however, that there are crucial methodological and theoretical aspects that have been neglected in these studies, thus limiting their explanatory power. Based on available knowledge from the TMT literature but also from personal communication with original TMT experts, we present three preregistered studies that provide fair and strict tests of the MS hypothesis in the context of justification. This seems especially important in light of the limitations of recently failed replication attempts (Klein et al., 2019; Sætrevik & Sjøstad, 2019).

In line with Chatard et al. (2020), we argue that it seems theoretically unjustified to simply predict a main effect of MS without knowing anything about the target population and the potential sample. A main effect is only justified and likely to occur if participants on average hold one unitary worldview. The less often this is the case, the more individual differences of that worldview come into play. Thus, beyond applying the classic worldview defense paradigm, one important rule for a fair test is: “know your target population.” That is, when aiming to test the idea whether a group of participants on average defends its worldview by devaluating an author of a certain essay, it is crucial to have information about the group’s worldviews. Thus, validating the used essays on the basis of a sample from the target population seems indispensable (cf. Henrich et al., 2010).

We regard our studies as conceptual replications relevant in the context of justification varying in their closeness to the original studies (cf. Brandt et al., 2014). All studies applied the classic worldview defense paradigm. However, they deviated in noteworthy ways from

the original study of Greenberg et al. (1992, Study 2): First, data was collected from Germans and included corresponding essay material that was previously validated on the basis of the respective target populations. Second, as the dependent measure, in the first two studies we used five items assessing credibility. This was based on the idea that credibility constitutes a strong method of validating others' and consequently one's own worldviews given that low attributed credibility provides an effective shelter: With one stroke, all an opposing person believes and says loses its weight. Notably, although not regarded as one of the classic items, one study of Greenberg et al. (1992, Study 1) also included "honest" as an item. Moreover, analyzing items assessing author evaluation (in contrast to essay evaluation) yielded stronger MS effects (e.g., Greenberg et al., 1994, Study1). We therefore think that credibility evaluations provide a valid and sensitive measure of worldview defense that should also be highly correlated to the classic items. In the registered Experiment 3, we tested the MS hypothesis in a German sample by using validated essay material and the classic worldview defense items.

Data, detailed material and preregistration protocols of all studies are available on the OSF (<https://osf.io/qkwyn/>). In the studies, we report all measures, manipulations, and exclusions.

Validation Study 1 (German sample)

When investigating MS effects and worldview defense reactions, valid assumptions about the target population's worldviews are crucial. To that effect, validating the stimulus material a priori is a fundamental step. In the studies of Greenberg et al. (1992, 1994), the worldviews in the essays referred to patriotism and national identification. In contrast to U.S. samples, however, these aspects presumably do not reflect a strong aspect relevant to worldviews of students from German universities (our target population), so using anti- or pro-Germany essays is problematic. In this validation study, we tested pro- and anti-essays on three different worldview aspects that we deemed to be essential for our participants.

Method

Participants and Design

We aimed for twenty participants for each essay. Recruiting took place on the campus of a German university. Sixty-three people, all students, participated ($M_{\text{age}} = 23.84$, $SD = 3.46$; 55.6% females). More than 85% of all participants indicated a tendency to vote in favor of green and/or left-wing political parties. Participants were randomly assigned to a 3 (topic) $\times$ 2 (type of essay) $\times$ 2 (order of essays) mixed experimental design, with the first and third factor as between-subjects manipulation and the second factor as within-subjects manipulation.

Stimulus Material

We chose three topics that we assumed to be essential for our target population: refugees in Germany, gender justice, and introduction of tuition fees. For each topic, we created one presumably worldview-confirming and one worldview-opposing essay. Each participant was tasked with reading both the confirming and the opposing essay of only a single topic. The essays crafted for each topic were about the same in word count. All essays can be found on the OSF.

Measures

Parallel to Reinhard and Sporer (2008), we assessed attributed credibility of each essay's author by using five adjectives when describing the author: honest, credible, reliable, trustworthy, and sincere. The scale ranged from 1 (*fully disagree*) to 10 (*fully agree*). Reliabilities for all six authors were high (all α s $> .82$). To reduce demanding effects, we also included five distraction adjectives: brave, glibly, sensitive, denying, and kind. We further asked participants a) whether they agree with the author's opinion and b) to what degree the author's worldview contradicts / conforms to their own worldview. For both items, the scale ranged from 1 (*fully disagree / fully contradicts my worldview*) to 7 (*fully agree / fully conforms to my worldview*).

Results & Discussion

For each of the three topics, we ran separate 2 (essay type) $\times 2$ (order of essays) mixed ANOVAs on credibility attribution and the two items on worldview agreement. Detailed results can be found on the OSF.

Results for the refugee topic revealed a large main effect of essay, $F(1, 15) = 36.09, p < .001, \eta^2_p = .71$, indicating that credibility attribution to the worldview conforming author was higher ($M = 8.00, SD = 1.05$) than to the worldview opposing author ($M = 4.38, SD = 1.80$). Neither the order effect nor the interaction effect between essay and order was significant, $ps > .517$. Parallel to that, analyses of the two items on worldview agreement also yielded a significant effect of essay, $F(1, 15) = 43.18, p < .001, \eta^2_p = .74$, but no significant effects of order or the interaction, $ps > .362$.

According to the results, we decided to use the essays on refugees. First, the large main effect showed that these essays were clearly conforming or opposing participants' worldviews. This was further supported by the two additional items on worldview agreement. Second, according to the means, there were no problems with floor or ceiling effects. Third, in contrast to the other two topics, signs of order effects were ranked as weak.

Experiment 1

Method

Sample Size

The required sample sizes were computed using G*Power 3.1 (Faul et al., 2009). We preregistered a collection of a minimum of 120 participants and actually collected data from 135 participants. The required sample size of 120 participants is based on a power analysis for an ANOVA (repeated measures, within-between interaction; number of measurements = 2), assuming a small effect of $f = 0.15$. Type I error rate was set at $p < .05$ and power level to 90%. A positive correlation of $r = 0.5$ between the two measures was assumed. In hindsight, however, this assumption is not justified. Moreover, analyzing credibility attributions of the

two authors in the validation study showed a negative correlation of $r = -.35$. A power analysis assuming such a correlation results in 318 participants. Accordingly, our study is underpowered to detect a small effect (post hoc power analysis revealed a power of 55% for $f = 0.15$). Fortunately, according to a sensitivity power analysis, we were able to detect a small to medium effect ($f = 0.20$) with a power of 80%.

Participants and Design

Two participants were excluded due to technical problems during data collection. Checking the content of the answers on the two open-ended questions about death (or dental pain) revealed that all participants wrote something meaningful. One participant was excluded because of voting for a right-wing extremist party, resulting in a final sample of 132 participants ($M_{\text{age}} = 23.86$, $SD = 4.78$; 60.6% females). Six participants were non-students. Over 90% of all participants indicated a tendency to vote in favor of green and/or left-wing political parties. Participants were randomly assigned to a 2 (MS vs. dental pain) $\times$ 2 (essay type: pro vs. anti- refugees) $\times$ (order of essays) mixed experimental design, with the first and third factor as between-subjects manipulation and the second factor as within-subjects manipulation.

Procedure and Measures

Participants were seated in front of a computer and began by reading general instructions. As an initial task, they were then asked to deeply inhale then exhale ten times. This short relaxation exercise was included to enhance an experiential mode of thinking that prior research has suggested as important for generating MS reactions (cf. Simon et al., 1997). Afterwards, participants received the classic MS (or dental pain control) treatment, consisting of two open-ended, short-answer questions. In the MS condition, participants were asked to a) write about the emotions that the thought of their own death arouses in them and b) to jot down what they think would happen to them as they physically die. Participants in the control condition answered the same questions regarding dental pain. Using dental pain as a control

topic makes it possible to investigate the uniqueness of MS effects beyond general negative events.

After the MS manipulation, we included two commonly used distraction tasks (e.g., Klein et al., 2019; Schindler et al., 2019a): the 60 items of the PANAS-X and the morningness-eveningness questionnaire (Horne & Ostberg, 1976).

Next, each participant had to read two essays: one positing a positive position and the other positing a negative position towards refugees in Germany. We assessed attributed credibility of each essay's author by using five adjectives described in the validation study. Reliabilities for both authors were high (both α s > .91).

We then included 17 items on social desirability (Stöber, 1999) to account for potential biases. Finally, we assessed demographic variables (i.e., gender, age, native language, country of birth, field of study, and political party preference).

Results

We conducted a 2 (MS) $\times$ 2 (essay type) $\times$ 2 (order of essays) mixed-factors ANOVA, with credibility attribution to the author as dependent variable. MS and order of essays were between-subjects factors and type of essay was a within-subjects factor. Results yielded a large main effect of essay type, $F(1, 128) = 141.02, p < .001, \eta^2_p = .52$, indicating that the author of the pro-refugee essay was attributed higher credibility ($M = 7.35, SD = 1.75$) than was the author of the anti-refugee essay ($M = 4.56, SD = 2.07$). Furthermore, a main effect of order of essay occurred, $F(1, 128) = 5.62, p = .019, \eta^2_p = .04$. No MS main effect was obtained, $p = .685$. Most importantly, the two-way interaction between MS and essay type was not significant, $p = .363$. Descriptive results are displayed in Table 2. Including social desirability as covariate or the exclusion of outliers (2 *SD*s above or beyond the means) yielded parallel results.

Table 2

Means (and Standard Deviations) of Credibility Attribution as a Function of MS, Essay type and Order of Essay in Study 1.

Order	MS	Pro-refugees essay			Anti-refugees essay		
		<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>
Order collapsed	MS	7.54	1.76	63	4.53	2.14	63
	Dental pain	7.18	1.74	69	4.59	2.01	69
Pro-refugees first	MS	7.69	1.86	35	5.14	2.09	35
	Dental pain	7.62	1.55	32	4.39	2.07	32
Anti-refugees first	MS	7.35	1.63	28	3.76	1.98	28
	Dental pain	6.80	1.83	37	4.77	1.97	37

Note. Credibility attribution ranges from 1 to 10. Higher means indicate more credibility.

Unexpectedly, the three-way interaction was significant, $F(1, 128) = 5.52, p = .020$, $\eta^2_p = .04$. Simple effects analyses revealed significantly lower credibility in the anti-refugee condition under MS ($M = 3.76, SD = 1.98$) compared to the dental pain condition ($M = 4.77, SD = 1.97$), but only when the anti-refugee essay was presented first, $F(1, 128) = 3.95, p = .049$, $\eta^2_p = .03$. All other simple MS effects were not significant, all $ps > .130$. To further investigate the nature of the three-way interaction, we conducted a 2 (MS) $\times$ 2 (essay type) ANOVA for each order condition separately. The interaction effect was significant when the anti-refugee essay was presented first, $F(1, 63) = 4.93, p = .030$, $\eta^2_p = .07$. Again, the simple MS effect was significant in the anti-refugee condition $F(1, 63) = 4.17, p = .045$, $\eta^2_p = .06$. The MS effect in the pro-refugee condition was not significant, $p = .209$. The interaction effect was not significant when the pro-refugee essay was provided first, $p = .294$.

Discussion

Results of this study did not support the MS hypothesis. The expected interaction effect between MS and essay type on person evaluation was not significant. There was, however, an order effect: When the anti-refugee essay was presented first, the expected interaction occurred, revealing less credibility attribution to the anti-refugee author under MS.

Post hoc exploration led us to the idea that reading a worldview-confirming essay first might have diminished the need for defense when reading the opposing essay afterwards. This is indeed supported by findings showing that affirming a valued aspect of one's worldview reduces worldview defense reactions after MS (Schmeichel & Martens, 2005). However, this explanation remains highly speculative given that our within-manipulation of essay type was applied in many MS experiments without producing relevant order effects (e.g., Greenberg et al., 1992, 1994; Schmeichel & Martens, 2005). To completely exclude order effects, we replicated Study 1 by manipulating essay type between-subjects.

Experiment 2

Method

Sample Size

We preregistered a collection of a minimum of 265 participants and actually collected data from 281 participants. The required sample size of 265 participants is based on a priori power analysis for an ANOVA (fixed effects, special, main effects, and interactions), assuming a small to medium interaction effect of $f = 0.20$. Type I error rate was set at $p < .05$ and power level to .90. According to a sensitivity power analysis, were able to detect a small effect ($f = 0.17$) with a power of .80.

Participants and Design

All participants wrote something meaningful concerning the questions on death (or dental pain). Five participants were excluded because of voting for right-wing extremist parties, resulting in a final sample of 276 participants ($M_{\text{age}} = 23.01$, $SD = 4.68$; 57.2% females). Eight participants were non-students. Nearly 80% of participants indicated a tendency to vote in favor of green and/or left-wing political parties. Participants were randomly assigned to a 2 (MS vs. dental pain) $\times$ 2 (essay type: pro vs. anti-refugees) between-subjects design.

Procedure and Measures

The procedure was exactly the same as in Study 1, except that each participant was presented only one of the two essay types.

Results

Main Analyses

We conducted a 2 (MS) $\times$ 2 (essay type) ANOVA with credibility attribution as dependent variable. Results yielded a large main effect of essay type, $F(1, 272) = 95.46, p < .001, \eta^2_p = .26$, indicating that the author of the pro-refugee essay was attributed higher credibility ($M = 6.99, SD = 2.13$) than the author of the anti-refugee essay ($M = 4.60, SD = 1.91$). No main effect of MS occurred, $p = .542$. Most importantly, the two-way interaction between MS and essay type was not significant, $p = .297$. Descriptive results are displayed in Table 3. Including social desirability as covariate or the exclusion of outliers (2 SDs above or beyond the mean) yielded parallel results.

Table 3

Means (and Standard Deviations) of Credibility Attribution as a Function of MS and Essay type in Study 2.

MS	Pro-refugees essay			Anti-refugees essay		
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>
MS	7.04	2.09	67	4.41	1.81	71
Dental pain	6.94	2.17	72	4.81	2.01	66

Note. Credibility attribution ranges from 1 to 10. Higher means indicate more credibility.

Non-Preregistered Exploratory Analyses

The delay between the MS manipulation and the dependent measure is suggested to play a crucial role (Burke et al., 2010). In this study, participants needed 618 sec (about 10 min) on average ($SD = 230.18$) to get from the MS manipulation to the essay. Including this variable as moderator in a multiple regression analysis with MS and essay type (and all possible interactions) as further factors revealed no interaction effects, all $ps > .450$. One might also assume that MS effects are increasing the more time participants are spending

writing about their death. Participants took 214 sec (about 3.5 min) on average ($SD = 122.01$) to go from the MS manipulation to the next page. Including this variable as moderator in a multiple regression analysis with MS and essay type (and all possible interactions) as further factors revealed no interaction effects, all $ps > .177$.

Testing our hypothesis presumes a positive worldview towards refugees. Assuming this worldview to be especially represented in German green and left-wing political parties, we analyzed the subsample ($n = 215$). Results of an ANOVA yielded no significant interaction effect between MS and essay type, $p = .206$. Finally, we excluded psychology students ($n = 78$), given that they potentially add a substantial amount of error variance due to their psychological knowledge. The interaction effect approached the conventional level of significance, $F(1, 194) = 2.89$, $p = .091$, $\eta^2_p = .02$. Simple MS effects were also not significant, $ps > .143$.

Discussion

Results of this second study also failed to support our hypothesis. The expected interaction effect between MS and essay type on credibility attribution was not significant. Exploratory analyses did not reveal moderation effects of delay time between the MS manipulation and the dependent measure or the time participants spent on writing about death. Furthermore, analyzing subsamples did not reveal any significant interaction effects.

In this study, we calculated the required sample size by assuming a small to moderate interaction effect ($f = .20$), leading to a required sample size of 265 participants. This may seem adequate looking at the adjusted effect sizes of the meta-analysis of Burke et al. (2010) and especially regarding the low cell sizes (between 11 and 14) in the studies of Greenberg et al. (1992, 1994). However, when investigating interaction effects, required sample sizes crucially depend on the assumed nature of the interaction and on whether one additionally aims to get significant simple effects (Giner-Sorolla, 2018). Our calculations were based on the least extensive case: the effect size of a crossover interaction (i.e., MS increases /

decreases credibility attribution depending on the essay) without aiming for significant simple effects (for significant simple effects, we would have had to double the sample size). Given that the means in Study 2 only show lower credibility of the anti-refugee author under MS, but no stronger credibility of the pro-refugee author, the assumption of a crossover interaction can be questioned. Furthermore, given that the MS induction refers to a subtle reminder of death (Pyszczynski et al., 2015), its effect on worldview-related aspects (i.e., strong attitudes)—at least in experiments—should be rather small than moderate. This impression of MS effects was confirmed by one of the original TMT authors in a personal communication. In short, small changes regarding the assumptions in power analyses can pose huge consequences for the required sample size. It is thus not guaranteed that our studies were sufficiently powered given that the expected effect could be even smaller than assumed. At the same time, assuming MS effects to be small implies that most MS studies were underpowered, meaning that the evidence for the MS hypothesis stands on shaky ground. This conclusion all the more underlines the need for high-powered, properly designed studies.

Registered Experiment

The so-far presented studies were planned to test the MS hypothesis by applying the classic worldview defense paradigm. In comparison to the studies of Greenberg et al. (1992, 1994), notable divergences refer to the used worldview aspect (refugees) and credibility attribution as the dependent measure. However, the used essays were successfully pretested and the expected effects on credibility attribution were highly intuitive regarding worldview defense via person evaluation. Thus, our studies are designed in a way that outcomes consistent with a prior claim increase confidence in the claim and outcomes inconsistent with a prior claim would decrease confidence in the claim (cf. Nosek & Errington, 2020). In this regard, the two studies are relevant in a justification context, adding valid data points that decrease confidence in the MS hypothesis. Nevertheless, these divergences (novel essays, novel dependent variable) also put the studies into the context of discovery with testing

generalizability and finding boundary conditions. To increase closeness to the original studies of Greenberg et al. (1992, 1994), in Experiment 3, we relied on the classic items instead of credibility attribution. Moreover, we increased power to be able to detect small effects.

We would acknowledge the value of a further close replication using the classic worldview defense paradigm. Although, in light of ML4 (Klein et al., 2019), one might judge such studies as redundant, each additional properly conducted close replication study would be informative by increasing or decreasing trust in the idea—independent from the outcome of ML4. Besides, the available data of ML4 that can be interpreted in a justification context (i.e., in-lab studies, high American identity) includes only about 400 participants (and even fewer in Chatard et al.'s recalculation). With this sample size, only an effect of $d = .28$ can be found with sufficient power (80%). Furthermore, there are issues of context effects. So, ML4 is far away from providing a final word. Nevertheless, we decided against conducting a close replication using the original pro- and anti-U.S. essays. First, the U.S. are in the midst of a) a tough election battle and shortly before the presidential elections, b) a massive civil rights movement (“black lives matter”) and c) a pandemic with high numbers of daily new infections. All these phenomena must be considered as potential context effects for MS reactions—especially in the context of justification. Controlling for all these aspects is hard and a null result would be too open for post hoc explanations. Second, for the registered experiment, we validated an essay promoting a worldview that opposes universal norms and values and is therefore less dependent on specific target populations and contexts (other than patriotism and national identification). Validating and using such material therefore especially qualifies for close replications.

In sum, Experiment 3 can be regarded as a conceptual replication in the context of justification because it is designed in a way that outcomes inconsistent with a prior claim would decrease confidence in this claim (Nosek & Errington, 2020). Data for this experiment was collected after in-principle acceptance of this registered report.

Validation Study 2

For a proper test of the MS hypothesis, it is first important to confirm whether participants of the target population actually perceive the provided essay as worldview-opposing or -confirming. Individual worldviews are largely shaped by social norms and values. Honesty is one of the most important values in all cultures (e.g., Geißler et al., 2013; Schwartz, 1994), presumably because it has served to enhance group harmony and success over the course of human evolution. Recently, in two experiments by Schindler et al. (2019b) there was less dishonest behavior under MS especially when the norm of honesty was made salient. Thus, we assumed an essay that promotes dishonesty, manipulation and recklessness for achieving own goals to be norm violating and to be worldview-opposing to most people. Note that because social norms define the cultural part of one's worldview, by using such an essay we test the original *cultural* worldview defense hypothesis. In favor of higher power, we decided to only use and validate worldview-opposing essays because MS reactions on the such essays (compared to worldview-confirming essays) have been found to be typically stronger (e.g., Greenberg et al., 1994).

Method

Stimulus Material, Design, and Participants

We tested two worldview-opposing essays: one referred to a competitive jungle social worldview (Duckitt et al., 2002) and one was based on items on Machiavellianism (Christie & Geis, 1970). Both essays can be found on the OSF. Participants were randomly assigned to a 1×2 (essay type) between-subjects design. We aimed for 100 participants for each essay. We collected data from German people via the recruiting platform Respondi (target population), and 205 people participated. We excluded participants who reported having thought about the Corona pandemic during the study ($n = 14$), who indicated to know TMT ($n = 14$) or who indicated that we should not use their data due to a lack of attention and random responding

($n = 10$). Finally, the sample included 182 participants ($M_{\text{age}} = 46.77$, $SD = 13.86$; 51.1% females).

Measures

We included the classic five worldview defense items on author and essay evaluation (Greenberg et al., 1994): “To what extent do you think the essay makes valid points,” “To what extent do you agree with the arguments in the essay,” “How much do you think you would like the person who wrote this essay,” “How intelligent do you think the person who wrote this essay is,” “How knowledgeable do you think the person who wrote this essay is.” For all five items, the scale ranged from 1 (*not at all valid/not at all/not at all/not at all intelligent/not at all knowledgeable*) to 9 (*extremely/a great deal/a great deal/extremely intelligent/extremely knowledgeable*). Reliabilities for both essays were high (α s = .93 and .87). We further asked participants to what degree the author’s worldview contradicts / conforms to their own worldview. The scale ranged from 1 (*fully contradicts my worldview*) to 7 (*fully conforms to my worldview*).

Results & Discussion

The evaluation of the competitive jungle worldview-essay was below the midpoint of a 9-point scale ($M = 3.71$, $SD = 1.85$). Worldview agreement was also below the midpoint of a 7-point scale ($M = 2.95$, $SD = 1.88$). The correlation between worldview agreement and author evaluation was strong, $r(84) = .56$, $p < .001$. The evaluation of the Machiavellian essay was also negative ($M = 3.61$, $SD = 1.58$). Accordingly, worldview agreement was also below the midpoint of a 7-point scale and even lower than the competitive jungle essay ($M = 2.55$, $SD = 1.68$). The correlation between worldview agreement and author evaluation was strong, $r(98) = .62$, $p < .001$.

Results of this validation study revealed that both essays lead to negative evaluations and oppose the sample’s worldview. Thus, both essays are qualified as stimulus material. However, evaluations of the Machiavellian essay were more negative and also correlated

stronger with worldview agreement. Reliability was also a bit higher (increasing statistical power). At the same time, floor effects seem unlikely. We thus decided to use this essay in the.

Experiment 3

Based on the results of Validation Study 2, we decided to test the MS hypothesis in a conceptual replication by using only a validated worldview-opposing essay. In contrast to a 2×2 between design (as in Experiment 2), this leaves us with much more power given that MS effects regarding worldview-opposing essays have been suggested to be stronger compared to worldview-confirming essays (e.g., Greenberg et al. 1994). The detailed material for this study can be found on the OSF.

Hypotheses

According to results of Validation Study 2, and parallel to the classic findings, we expected a main effect of MS on evaluations of an essay/author promoting reckless behavior, manipulation and deception to achieve one's goals (i.e., violation of social norms). Specifically, we expected evaluations to be significantly more negative in the MS condition (vs. control condition). We would interpret a significant main effect (with $p < .05$) as support for the worldview defense hypothesis. A null effect of MS would decrease confidence in the validity of the MS hypothesis. If responses would be significantly more positive in the MS condition, this would clearly contradict the hypothesis.

According to results of Validation Study 2, we assumed that the vast majority of our participants would disagree with the Machiavellian essay. Hypothesizing a main effect of MS was therefore justified. Nevertheless, participants were assumed to vary in their disagreement, and some might even agree with the essay because they are Machiavellian themselves. We therefore included a measure of trait Machiavellianism to exploratory analyze whether individual differences in Machiavellianism moderate the MS effect.

Method

Sample Size

The classic literature (e.g., Cohen, 1988) regards effect sizes that are lower than $f = .10$ as theoretically uninteresting. We therefore calculated sample size with this effect size. In their reanalysis of the ML4 data, Chatard et al. (2020) reported MS effects of $d = .27$ and $.25$; in Experiment 2 of the present work, the MS effect in the worldview-opposing essay condition was $f = .11$. Thus, using $f = .10$ is a justified and conservative choice. We set power to 95% to equalize the beta with the alpha error. An a priori power analysis for an ANOVA (fixed effects, omnibus, one-way; $f = .10$; alpha level = .05; power = .95; number of groups = 2) revealed that we need a minimum of 1302 participants to detect a significant effect (given there is a true effect). Due to potential exclusions (see below), we first aimed to collect data from 1450 individuals. After collecting data from about 300 participants, we checked for potential dropout based on our exclusion criteria. We noticed that the dropout would be higher than expected, that is, around 20 to 30%, so to reach a final sample of 1302 participants, we decided to seek out 1900 participants.

Participants

Data collection took place from 10 to 16 October 2020, after in-principle acceptance of this registered report. 1908 participants completed the survey in its entirety, while 435 participants aborted the study before finishing (158 withdrew at the page with the two MS questions; 95 withdrew at the page with the two questions on dental pain). From these 1908 participants, we dropped 552 participants based on our exclusion criteria (see below), leaving a final sample of 1356 participants ($M_{\text{age}} = 48.95$, $SD = 13.92$; 50.7% females; $n = 611$ in the MS condition and $n = 745$ in the dental pain condition). Over half of the participants reported to be employees ($n = 764$). Participation lasted 1009 sec (about 17 min) on average ($SD = 1647.16$, $Median = 711$ sec).

Outliers and Exclusions

Given the limited range (1 to 9) of our assessments and that all scores are theoretically meaningful, we did not exclude any outliers. To reduce error variance, we took several measures. First, we checked the content of the answers on the two open-ended questions about death (or dental pain) and excluded participants ($n = 156$ in the MS condition; $n = 61$ in the dental pain condition) who did not write anything meaningful concerning the questions (i.e., any answer that could not be interpreted in a reasonable way and that could not be plausibly related to the questions in the broadest sense). Two independent coders checked the answers according to detailed coding criteria (see OSF); interrater reliabilities were high for both conditions, Cohen's kappas $> .79$, $ps < .001$. Second, we excluded participants ($n = 6$) who finished the questionnaire in under 3 min 30 sec (about 2 sec per item or page). Third, we excluded participants ($n = 106$) who indicated knowing the "Terror Management Theory." Fourth, we excluded participants ($n = 95$) who explicitly indicated that we should not use their data due to a lack of attention and random responding. Fifth, we excluded participants ($n = 256$) who thought of the Corona pandemic during the study or who used the words "pandemic" or "Corona" or related words in the dental pain condition ($n = 2$). Sixth, we only included participants who complete the survey in its entirety.

Design

There was a between-subjects manipulation: MS vs. dental pain control condition. We used the two classic open-ended questions as a MS manipulation. In the original work of Greenberg et al. (1992, 1994), a TV control condition was used; however, at the moment (and probably for the next months) this control group is likely to trigger news about the Corona pandemic. We therefore choose dental pain as an aversive, but also very typical, control group in MS research.

Measures

Essay. We applied the previously validated worldview-opposing essay promoting dishonesty, manipulation and recklessness to pursue own goals:

In my eyes, people are losers when they can be easily tricked. I have often experienced that I can get what I want if I tell people what they want to hear. If I want, I can persuade anybody to do anything! But that's not why I would describe myself as cold-hearted. Other people are responsible for themselves if they let themselves be tricked. Besides, I am not alone in such behavior, because lies are a part of life. Everyone knows that sometimes a person must pretend to like other people to get something from them. So we should all tacitly accept that we cannot always act morally to achieve our goals. For me, it is quite natural to take what I am entitled to.

Worldview defense. Worldview defense was assessed by using the classic five items (three items on author evaluation and two items on essay evaluation; see Validation Study 2). Reliability was high, $\alpha = .86$. The five items were averaged so that lower scores indicate more negative evaluations.

Machiavellianism. The nine items of the short Dark Triad questionnaire (Jones & Paulhus, 2014) were used to assess Machiavellianism (e.g., “It’s not wise to tell your secrets”). The scale ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). Reliability was good, $\alpha = .80$.

Control variables. To control for potential effects of the Corona pandemic, we assessed perceived general threat with one item: “To what extent do you personally feel generally threatened by the Corona pandemic?”; the scale ranged from 1 (*not at all*) to 7 (*extremely*).

Procedure

First, the MS manipulation was implemented. Next, after using the PANAS-X and the morningness-eveningness questionnaire as distraction tasks (see also Experiment 1 and 2), participants were asked to read the essay and give their evaluations. Finally, individual differences in Machiavellianism, the demographic information and the Corona items were assessed.

Results

Main Analyses

We conducted a one-way ANOVA using MS (MS vs. dental pain) with worldview defense as dependent variable. Results yielded no significant difference between the MS condition ($M = 3.95$, $SD = 1.65$) and the dental pain condition ($M = 4.09$, $SD = 1.65$), $F(1, 1354) = 2.69$, $p = .101$, $\eta^2 = .002$, $f = 0.05$, 95% CI $f = [-0.01; 0.10]$. There was also no significant effect when including perceived threat by the Corona pandemic as covariate, $p = .103$. Bayesian analyses revealed a BF_{10} of 0.23, suggesting moderate evidence for the null hypothesis (Lee & Wagenmakers, 2013). That is, the data are 4.33 times more likely under the null hypothesis than under the MS hypothesis.

Explorative Analyses

Our worldview defense measure included both author and essay evaluation. Given that author evaluation has been suggested to be more sensitive towards MS (Greenberg et al. 1994; see also ML4), we analyzed separately the MS effect on the averaged three items on author evaluation. The difference between the MS condition ($M = 4.12$, $SD = 1.62$) and the dental pain condition ($M = 4.28$, $SD = 1.62$) was not significant, $F(1, 1354) = 2.91$, $p = .088$, $\eta^2 = .002$, $f = 0.05$, 95% CI $f = [-0.01, 0.10]$. The same result was obtained when including perceived threat by the Corona pandemic as covariate, $p = .090$. Bayesian analyses revealed a BF_{10} of 0.26, again suggesting moderate evidence for the null hypothesis.

We further tested whether individual differences in Machiavellianism moderate the MS effect by conducting a linear regression analysis. MS as factor was effect-coded, and Machiavellianism was z -standardized. The model showed that Machiavellianism was significantly positively associated with worldview defense, $b = 0.86$, $p < .001$. The interaction between the two predictors was not significant, $b = -0.01$, $p = .764$. Surprisingly, in this model, the effect of MS was significant, $b = -0.08$, $p = .035$, indicating that evaluations were more negative in the MS condition compared to the dental pain condition. Comparing the

parameters of regression models with and without Machiavellianism revealed that the MS effect was a bit stronger when including Machiavellianism (-0.08 vs. -0.07) and the standard error was a bit lower (0.04 vs. 0.05), resulting in a significant MS effect. Using Bayesian statistics for this linear regression resulted in the following: of all five models (MS, Machiavellianism, MS + Machiavellianism, MS*Machiavellianism, null model), the best model referred to Machiavellianism as single predictor, with a BF_M of 15.06, suggesting strong evidence. Adding MS as predictor only revealed a BF_M of 3.29. The worst model referred to MS as single predictor.

Parallel to Experiment 2, we investigated the moderating role of a) the delay between the MS manipulation and the dependent measure and b) the time participants spent on writing about their death. In this study, participants needed 495 sec (about 8 min) on average ($SD = 681.09$, $Median = 382$) to get from the MS manipulation to the essay. Including this variable as moderator in a multiple regression analysis with MS and the interaction as further factors revealed no significant effects, all $ps > .103$. Participants took 141 sec (about 2 min) on average ($SD = 586.66$, $Median = 74.00$) to go from the MS (or dental pain) questions to the next page. Including this variable as moderator in a multiple regression analysis with MS and the interaction as further factors revealed no significant effects, all $ps > .102$.

Non-Preregistered Explorative Analyses

We investigated perceived threat by the Corona pandemic as potential moderator. Including this variable as moderator in a multiple regression analysis with MS and the interaction as further factors revealed no significant effects, all $ps > .103$.

We further investigated age as potential moderator. Including this variable as moderator in a multiple regression analysis with MS and the interaction as further factors revealed no significant effects, all $ps > .104$.

Given the large variance in participation time ($M = 1008.84$, $SD = 1647.16$), we additionally excluded participants ($n = 22$) who took longer than two SDs above the mean—

that is, longer than about 72 min—and then re-ran the main analyses. Results of a one-way ANOVA showed no significant effect of MS, $F(1, 1332) = 2.49, p = .115, \eta^2 = .002, f = 0.04$, 95% CI $f = [-0.01, 0.10]$. This was also the case when including perceived threat by the Corona pandemic as covariate, $p = .116$.

Cell sizes are uneven ($n = 611$ in the MS condition and $n = 745$ in the dental pain condition). This is largely because the data collection software was unable to account for the unequal study withdrawal rates: 63 withdrawals more on the page with the two MS question (vs. the two questions on dental pain). Another factor refers to our exclusion criteria regarding the content of the two open-ended questions. To reduce as much error variance as possible, we excluded participants if one of the two answers were coded as invalid (according to our coding criteria). The number of such invalid cases were more than four times higher in the MS condition than in the dental pain condition. Most of these cases (about 60%) wrote “no idea” or “I don’t know.” To account for potential selection issues, we re-ran the main analyses on the sample by including all ambiguous cases (note that some of these cases were nevertheless excluded due to other exclusion criteria). Results of a one-way ANOVA showed no significant effect of MS, $F(1, 1444) = 2.77, p = .096, \eta^2 = .002, f = 0.04$, 95% CI $f = [-0.01, 0.10]$. This was also the case when including perceived threat by the Corona pandemic as covariate, $p = .098$.

We re-ran the main analyses on the whole sample ($N = 1908$), that is, without any exclusions. Results of a one-way ANOVA showed no significant effect of MS, $F(1, 1906) = 2.79, p = .083, \eta^2 = .002, f = 0.04$, 95% CI $f = [-0.01, 0.09]$. This was also the case when including perceived threat by the Corona pandemic as covariate, $p = .082$. Bayesian analyses revealed a BF_{10} of 0.23, suggesting moderate evidence for the null hypothesis.

Discussion

With this study, we tested the worldview defense hypothesis in a large sample with 95% power to detect a small effect of $f = .10$. We relied on a validated essay opposing

universal norms and values of our target population. To reduce error variance, we excluded about 550 participants according to preregistered criteria. Results of the main analyses revealed no significant effect of MS (with $p < 0.05$ as preregistered). Bayesian analyses favored the null hypothesis. Exploratory analyses did not reveal moderation effects of delay time between the MS manipulation and the dependent measure or the time participants spent on writing about death. Machiavellianism significantly predicted worldview defense but did not significantly moderate the MS effect. Surprisingly, evaluations were significantly lower in the MS (vs. control) condition when Machiavellianism was included as covariate, supporting the MS hypothesis. However, several aspects should be taken into account: first, the effect was not a priori registered. Adjusting the large significant p value of .035 with the Bonferroni-Holm method only by considering the p value of the main analysis ($p = .144$) revealed an adjusted nonsignificant p value of .070. Second, Bayesian analyses favored the model with Machiavellianism as single predictor. Third, we a priori predicted that MS reactions depend on individual differences in Machiavellianism, but it remains theoretically unclear why the MS effect should get stronger when extracting variance that is explained by Machiavellianism. Therefore, we cannot fully exclude the possibility that the significant effect occurred by chance, because any covariate could reduce error variance by chance; nevertheless, including Machiavellianism did remove non-MS related variance and reduced the standard error, finally increasing the sensitivity of the test.

Four further issues should be addressed at this point. First, three analyses revealed an MS effect with $p < .1$, namely, when using only the three items on author evaluation as dependent variable, when adding ambiguous cases regarding the quality of the given answers on the two open-ended questions, and when analyzing the whole sample without any exclusions. Although we preregistered F -tests—which are already directional (one-sided) with 5% error rate—given the directional hypothesis, it is correct to interpret these effects as

significant when applying one-sided t -tests (i.e., halving the p values). However, Bayesian analyses constantly favored the null hypothesis.

Second, while the first two experiments were conducted in 2019, data collection for the proposed experiment took place in the midst of the Corona pandemic. One might speculate that in these times, concerns about mortality are generally heightened leading to problems regarding a proper control condition. However, there are good reasons why a null finding is informative and speaks against the MS hypothesis. First, during the seven days of data collection, the infection numbers were in fact increasing, but the situation was always under control in Germany: the numbers of related deaths remained low and therefore did not prove to be a prominent topic in the media. Corroborating this claim, the mean score of perceived threat ($M = 3.70$, $SD = 1.60$) was significantly lower than the mid-point of the scale (4), $t(1355) = -7.01$, $p < .001$ so there is no evidence to assume a strong link between the pandemic and mortality concerns. Even if the Corona pandemic would induce states of loss of control or uncertainty, according to TMT, MS effects are supposed to be unique and to differ from such aversive treatments. We further argue that particularly during a time of crisis like this, thinking about death (vs. dental pain) might produce even stronger effects than in normal times where people are safe and can easily cope with a threat like MS, especially given that the MS manipulation can be seen as a rather subtle threat induction (cf. Pyszczynski et al., 2015). In times of crisis, people are probably more sensitive to death and mortality, so that reactions by the typical MS manipulation can be more easily triggered. In addition, even *after* the pandemic (whenever that may be), people will be confronted in the news with threatening information about death, war, and violence. From this perspective, we can never be sure about a proper non-threatening control group, making impossible a critical test of the MS hypothesis. However, these external events may play only a minor factor in experimental settings where most people have a different focus. Nevertheless, we excluded all participants ($n = 256$) who reported to having thoughts about the Corona pandemic during the study, and

we excluded participants who used pandemic-related words in the dental pain condition ($n = 2$). Including all participants did not reveal a significant effect. In addition, using perceived threat by the pandemic as covariate or as moderator did not reveal any significant effects. In sum, we are confident that the influence of the Corona pandemic can be neglected.

The third issue refers to online data collection. We chose to collect data online for several reasons: First, we could obtain larger sample sizes compared to on-campus recruiting. Furthermore, online studies have become popular (Sassenberg & Ditrich, 2019) and it is important for future research to know if and how findings can be replicated. Last but not least, data collection in the lab was currently impossible due to the pandemic. One could argue that effects like MS are sensitive to contexts and thus should only be conducted in the lab (i.e., highly controlled setting) to keep error variance low; however, producing preregistered MS effects online is in fact possible when taking measures to ensure data quality (e.g., Schindler et al., 2019a; Vail et al., 2019). We therefore only included participants who met our preregistered selection criteria for ensuring data quality. In addition to taking such measures, recently detected problems with data quality via MTurk (Chmielewski & Kucker, 2020) led us to use Respondi as a recruiting platform. Ultimately, we are unaware of a convincing theoretical argument for why MS effects should not occur in online studies.

Fourth, cell sizes are uneven in this study. This is largely because the data collection software was unable to account for the unequal study withdrawal rates in the MS and the dental pain condition. We can only speculate about the reasons for the abortions: Given that we already excluded more than 100 participants in the present sample because they indicated having heard of TMT, it seems possible that many participants were already familiar with the MS induction and withdrew from the study because of boredom or to avoid biasing the data. Another possibility is that participants felt uneasy in answering questions about their mortality. This would raise concerns of selection bias and thus of successful randomization.

However, this remains speculative, and given the large sample size overall, the unequal cell sizes should not be overstated.

Internal Meta-Analysis

To get a more precise estimate on worldview defense under MS in our studies, we performed a meta-analysis on the three studies using the effect sizes on worldview defense in the worldview-opposing essay condition. We calculated Hedges' g for the effect of MS (vs. control condition). The total number of participants across the three samples was $N = 1625$ ($n_{MS} = 745$ and $n_{control} = 880$). A small, nonsignificant effect of MS occurred, Hedges' $g = 0.10$, $SE = 0.05$, $p = .058$, 95% CI = [-0.00, 0.19].

General Discussion

The present studies tested the validity of an established social psychological idea, namely that MS enhances the motivation to defend one's worldview. Based on available knowledge from the TMT literature but also from personal communication with original TMT experts, we conducted three preregistered conceptual replications that provided fair and strict tests of the worldview defense hypothesis in the context of justification. This seems especially important in light of the limitations of recently failed replication attempts (Klein et al., 2019; Sætrevik & Sjøstad, 2019).

Relevance for the Context of Justification

To adequately assess to what degree “replications” of MS studies can increase or decrease confidence in the validity of the MS hypothesis, it is important to know the standard procedure in the literature. Our studies applied the classic worldview defense paradigm but varied in their closeness to the original studies by Greenberg et al. (1992, 1994). Notable divergences referred to the used worldview aspect (refugees in Studies 1 and 2, dishonesty and reckless behavior in Study 3) and credibility attribution as the dependent measure (in Studies 1 and 2). However, the used essays were successfully pretested and the expected effects on credibility attribution were highly intuitive regarding worldview defense via person

evaluation. Thus, our studies were designed in a way that outcomes consistent with a prior claim increase confidence in the claim, while outcomes inconsistent with a prior claim would decrease confidence in the claim (cf. Nosek & Errington, 2020). In this regard, and in contrast to the studies of Sætrevik and Sjøstad (2019), our studies are relevant in a justification context.

No Strong Support for the Worldview Defense Hypothesis

The presented three studies failed to provide strong support of the worldview defense hypothesis in terms of levels of significance: There was no significant interaction between MS and type of essay in the first two studies and no significant main effect of MS in the third study. An internal meta-analysis on the three studies using the effect sizes on worldview defense for the worldview-opposing essay revealed a small, nonsignificant effect of MS. However, the p value approached a conventional level of significance, pointing to the existence of a small effect (see below). Significant effects of MS emerged when considering order effects (Study 1) and when controlling for Machiavellianism (Study 3). These effects were not expected a priori. In Study 3, halving the p values—according to the directional hypothesis—revealed three significant MS effects in exploratory analyses, supporting the MS hypothesis. Adjusting the p values for the number of analyses would render these effects to nonsignificance. Bayesian analyses in Study 3 clearly favored the null hypothesis.

Possible Limitations

Given the large number of studies in the TMT literature that provided support for the MS hypothesis, why did our studies fail to provide clear and strong evidence?

Bad Operationalization?

In all studies, we applied the classic worldview defense paradigm: the classic MS manipulation, a typical control group, typical delay tasks providing sufficient time between the manipulation and the dependent measure, and theoretically straightforward (Studies 1 and 2) or classic worldview defense items (Study 3). For the essays, we referred to refugees and

dishonesty/reckless behavior as worldview aspects. Both essays were pretested by using a sample from the target population as this is relevant for adequately testing a worldview-relevant reaction. We assumed the essays were valid in terms of high and low ratings in reference to the midpoint of the scale. One could now argue that the ratings on the worldview-opposing essay were low, but not low enough, so that the motivation to react upon this essay in order to cope with MS was too weak. On the other hand, if people by default strongly dislike a certain opinion, it is empirically likely to get null effects because of floor or ceiling effects. Here, clarifying specific criteria for valid worldview defense material would be beneficial for developing clear falsification criteria for the MS hypothesis. At this point, assessing our essay material as invalid seems empirically and theoretically not justified, because if people have the tendency to oppose a certain worldview, MS should reinforce this tendency.

Bad Data Collection?

The first two studies were conducted in laboratory settings. Only Study 3 was conducted online. As mentioned above, we avoided collecting data via MTurk and ensured data quality by excluding nearly 550 participants according to several preregistered measures. It is possible that participants dealt differently with the two-open ended questions about death during the decades. However, as far as we know, TMT remains silent about the question regarding *how* people should deal with the MS manipulation to trigger worldview defense reactions. The time participants spent in the experimental conditions had no effect on our studies; we even checked for the quality of the answers on the two open questions and excluded potentially problematic cases. This is typically not done in MS research. In fact, to our knowledge, participants' answers on the MS questions have never been systematically analyzed. This is surprising because analyzing and categorizing these answers might lead to theoretical development and potentially to crucial moderators (Kastenbaum & Heflick, 2011). It seems plausible, for example, that people who write about the sadness of their family might

react differently compared to participants writing that they don't care about their own death, because different concepts are activated.

Problematic Context Effects?

One of the major issues discussed regarding the findings of ML4 is data quality, because the data before and after the presidential election of Donald Trump possibly influences responses to essays that praise or criticize the U.S. (Chatard et al., 2020). Taking into account participants' national identification, political orientation, and voting behavior should help address this issue. Data collection for Study 3 took place during the Corona pandemic, potentially implying problems regarding a non-death related control condition. However, as outlined above, there is little empirical evidence to assume a strong link between the pandemic and heightened mortality concerns in Germany during the days of data collection. It might even be that especially during the pandemic, thinking about death (vs. dental pain) might produce stronger effects than in normal times. We empirically addressed potential context effects through the Corona pandemic by excluding all participants who reported having thought about the Corona pandemic during the study. In addition, using perceived threat by the pandemic as covariate or as moderator did not alter findings. Lastly, in Study 3 we used an essay promoting a worldview that opposes universal norms and values and is therefore less dependent on specific target populations and contexts (other than patriotism and national identification). In sum, context effects cannot be excluded but are unlikely to account for the present results.

Underpowered Studies?

The most comprehensive meta-analysis to date yielded a moderate to strong effect of MS ($f = .37$; Burke et al., 2010). A conservative adjustment for publication bias still revealed a small effect of $f = .16$, while a liberal adjustment estimated $f = 0.31$ (Burke et al., 2018). Sample sizes in these 277 experiments ranged from 17 to 343, with a mean of 87.3 ($SD = 50.8$). In Study 1 ($N = 135$), we had 80% power to detect a small to medium effect ($f = 0.20$)

of a 2 (within) $\times$ 2 (between) interaction. In Study 2 ($N = 265$), we had 90% power to detect a small to medium effect ($f = .20$) of a 2 (between) $\times$ 2 (between) interaction. This seems adequate looking at the average sample size and the effect sizes of the meta-analysis of Burke et al. (2010) and especially regarding the low cell sizes (between 11 and 14) in the studies of Greenberg et al. (1992, 1994). However, these studies were underpowered regarding small effects, especially when considering the nature of interaction effects (Giner-Sorolla, 2018). In Study 3 ($N = 1356$), we had 95% power to detect a small MS effect of $f = 0.10$ and still 80% power to detect an effect of $f = 0.08$. To our knowledge, no MS study so far has used such a large sample (except ML4 when including the non-expert samples). Taken together, our set of studies provide well powered tests regarding the typical sample size in MS studies.

Hidden Moderators?

As the original TMT authors write: “the effects of MS are never really main effects” (Pyszczynski et al., 2015, p. 34). Worldviews are complex constructs—different aspects can be contradicting even within one person. Consequently, Pyszczynski et al. (2015) stated that it is “often difficult to predict how people will respond to reminders of death” (p. 35). We addressed this issue by validating our essay material. Nevertheless, personality differences in self-esteem, personal need for structure, or attachment style have been documented to moderate MS reactions. Including Machiavellianism in Study 3 did, however, fail to moderate the MS effect. In addition, if the MS hypothesis is primarily about defending the *cultural* worldview (as TMT suggests), an essay opposing a cultural value like honesty should be relevant for most of the people. In this case, predicting a main effect seems justified.

One further moderator that might explain the null findings in the present studies refers to the idea that MS reactions depend on the social norms and on values that are momentarily salient (Jonas et al., 2008; Schindler et al., 2013, 2019b; Schindler & Reinhard, 2015a, 2015b). Accordingly, it has been found that devaluation of opposing others under MS was buffered when tolerance was previously activated (Greenberg et al., 1992; Vail et al., 2019).

That is, if tolerance would have been a salient value in the samples of Studies 1 and 2—whom we indeed assumed as tolerant towards refugees—then the expected MS effect on worldview defense is unlikely to occur. In the same way, one could further argue that in Study 3—parallel to the studies of Schindler et al. (2019b) on cheating—it would have needed concept priming of honesty to render honesty a salient value. Several problems, however, emerge with these explanations: First, it is unlikely that the value of tolerance likewise holds towards people with intolerant worldviews (anti-refugee or Machiavellian essay), and it remains unclear why an additional honesty prime is necessary when the essay obviously opposes dishonesty, thus, activating the concept of honesty. In addition, a recent meta-analysis on studies investigating the interplay between MS and norm salience revealed that evidence for this idea is weak and inconclusive when adjusting for publication bias (Schindler et al. 2020).

Another potentially hidden moderator refers to the mode of thinking. Simon et al. (1997) reported three studies showing that participants engaged in worldview defense after MS only if they are in an experiential mode of thinking but not in a rational mode. For this reason, we included a short relaxation exercise at the beginning of Studies 1 and 2. Moreover, parallel to the “experiential mode” induction by Simon et al. (1997, Study 2), and as typically done in MS studies, we always emphasized that we are looking for people’s gut-level reactions before our MS manipulations. Available evidence for the role of thinking mode is so far based on a few small-sample studies; given its potential importance for understanding how the MS manipulation works, this presents yet another case for studies in the context of justification.

Implications of Small Effects

According to results of the internal meta-analysis, it can be argued that there is a small effect of $f = 0.05$ —with an upper value of the 95% confidence interval of $f = .10$ (explaining about 1% of all variance). Assuming small MS effects in experiments seems justified given the rather subtle manipulation and the assessment of strong (worldview-related) attitudes.

However, the documented average sample size in MS studies was 88 participants (Burke, et al., 2010). With such a sample size, only a moderate effect of $f = .27$ between two independent groups can be found with sufficient power (80%) in a one-sided t -test. Thus, assuming $f < .27$ implies that most MS studies were probably underpowered. One might argue that studies with small N are conducted a) over a shorter period of time (less context effects), b) with greater care, and c) more expertise, that is, factors reducing error variance and in fact leading to stronger effects. The present work, however, contradicts this notion: a) data collection in Study 3 took no longer than seven days, b) the present studies were conducted with great care and according to common standards in MS studies, and c) the experience (i.e., the h-index) of 100 scientists was found to be unrelated to replication success (Protzko & Schooler, 2020). In addition, the first author brings over ten years of expertise in TMT research (also in terms of numerous published articles). So, evidence for an influential role of these factors is weak. There is less doubt that past literature in many fields of psychology is substantially affected by questionable research practices (John et al., 2012; Simonsohn et al., 2014). The present difficulties in providing strong evidence for the classic worldview defense effect underline the need for further studies in the context of justification.

Let's assume there is a true, but very small effect of MS on worldview defense. In line with traditional interpretations (Cohen, 1988), one could argue that such an effect size is theoretically uninteresting. Some scholars argue, however, that effect sizes obtained in experiments are generally meaningless for predicting real-world effects because effect sizes in experiments are artificially inflated or deflated in comparison with the same causal process outside the laboratory (Baumeister, 2020). One could further argue that even small effects can have relevant real-world consequences because they can accumulate over time (Funder & Ozer, 2019). Thus, small effects of MS in experiments do not necessarily imply that TMT or death are irrelevant for explaining real-world behavior. However, no matter what position one takes, small MS effects as we found them at least allow the question whether MS is actually

the central mainspring of worldview defense or human activity in general that TMT claims it to be. In any case, effect sizes certainly can provide important information for the required sample size to replicate an effect and thus for generating empirical arguments for or against an idea. The effect sizes of our studies suggest that most of the studies in the MS literature are underpowered and that very large samples are needed to adequately test MS predictions.

Conclusion

The studies in this registered report can be seen as conceptual replications in the context of justification testing the worldview defense hypothesis. On one hand, significance tests do not provide strong support for an MS effect on worldview defense, and Bayesian analyses in Study 3 clearly favor the null hypothesis. On the other hand, the data point to the existence of a MS effect, but a very small one. Altogether, the presented studies reveal challenges in providing strong evidence for the worldview defense hypothesis, underlining the need for preregistered, high-powered, properly designed studies in the context of justification.

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