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Health consequences of a death threat: How terrorist attacks impact drinking

Franziska Pradel[1,2] | **Sebastian Sattler**[2,3,4]

[1]Department of Governance, School of Social Sciences and Technology, Technical University of Munich, Munich, Germany

[2]Faculty of Management, Economics and Social Sciences, Institute for Sociology and Social Psychology, University of Cologne, Cologne, Germany

[3]Faculty of Sociology, Bielefeld University, Bielefeld, Germany

[4]Institut de recherches cliniques de Montréal, Montréal, Québec, Canada

Correspondence
Franziska Pradel, Department of Governance, School of Social Sciences and Technology, Technical University of Munich, Munich, Germany.
Email: franziska.pradel@tum.de
Sebastian Sattler, Faculty of Sociology, Bielefeld University, Bielefeld, Germany.
Email: sebastian.sattler@uni-bielefeld.de

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Abstract

Terrorist attacks, war, violent acts, and their media coverage remind us of our own mortality, which may provoke stress and coping mechanisms. The terror management health model (TMHM) proposes that even subliminal thoughts about existential threats trigger worldview defense and self-esteem-related behaviors. Based on the TMHM, our field experiment (N = 228) examines the impact of a terrorist attack on death-thought accessibility, the choice between alcoholic and nonalcoholic beverages, and if the impact on this choice is moderated by the importance of alcohol to one's self-esteem (i.e., alcohol-based self-esteem), and the consciousness of the terrorist attack. Results show that thoughts about the terrorist attack increased death-thought accessibility. The salience of the terrorist attack had no main effect on beverage choice, but alcohol-based self-esteem predicted choosing an alcoholic beverage. However, in the unconscious thought condition, participants who had low alcohol-based self-esteem and were provoked with death-related thoughts about terrorism were more likely to choose an alcoholic beverage. In the conscious thought condition, participants who had high alcohol-based self-esteem were less likely to choose

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alcohol. This study suggests that thoughts about terrorism and, therefore, the threat of death, can be provoked in everyday situations and affect substance use behaviors with potentially adverse health consequences.

INTRODUCTION

The use of media and social media makes it likely that people will encounter information, images, and videos that evoke conscious or unconscious thoughts about death (Pyszczynski et al., 2021; Vail et al., 2012). These include vivid coverage of or communication about COVID-19; the Russo-Ukrainian war; terrorist attacks, such as the September 11, 2001 attacks, the attacks in Paris, and the German Christmas market attack; as well as increasing threats of right-wing terrorism (Hoffman et al., 2020; Neria, Yuval et al., 2006; Pyszczynski et al., 2021). Even subliminal reminders about other's or one's own mortality can create intense existential fears (e.g., Solomon et al., 2015; Pyszczynski et al., 1999).

People react differently to such thoughts and the negative emotions related to them. Some people engage in worldview defense (Ein-Dor et al., 2014; for a review, see Leung et al., 2022; Wisman et al., 2015); that is, they identify more strongly with cultural beliefs, ideologies, and the devaluation of other people's worldviews (Echebarria-Echabe & Fernández-Guede, 2006). Others people engage in unhealthy behavior, such as smoking (Hansen et al., 2010), or reckless behavior, such as risky driving (Taubman–Ben-Ari & Skvirsky, 2019), to cope with the stress induced by death-related thoughts.

Previous experimental studies have revealed fundamental insights into how people respond to thoughts of death. In many of these studies, people were made to think about their own mortality or specific health risks. In the present research, we induced mortality salience by making participants think about a terrorist attack. Terrorist attacks are special because they represent attacks on people's culture, which plays an important role in giving people a sense of belonging and meaning and has a fear-buffering effect. We examine how individuals respond to death-related thoughts triggered by terrorism salience and if their responses are similar to conventional mortality salience triggers.

People's concerns about terrorist attacks increase in the years after an attack. For example, the perceived threat of a potential terrorist attack increased by about 22 percentage points in Germany from 2015 to 2017, following the Berlin Christmas market attack of December 2016 (Steinbrecher et al., 2017, p. 29). Studies in other countries point to similarly high or increased levels of perceived threats of terrorist attacks in the aftermath of an attack, for instance, in Israel (Kutz & Dekel, 2006), France (Pelletier & Drozda-Senkowska, 2016), the United Kingdom (Rubin et al., 2007) and the United States (Nacos et al., 2007). Thus, a better understanding of how people deal with such threats is important from a health perspective.

Theoretical framework: Terror management theory and terror management health model

The terror management theory (TMT) (Greenberg et al., 1986; Pyszczynski et al., 2004; Solomon et al., 2015) and the terror management health model (TMHM) (Arndt & Goldenberg, 2017;

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Goldenberg & Arndt, 2008) provide a framework to understand how individuals react to reminders of their mortality, reminders that can be triggered in many ways, including through media exposure or through interpersonal communication. The TMHM focuses specifically on the effects of death threats in health-related contexts (Arndt & Goldenberg, 2017; Goldenberg & Arndt, 2008). TMT researchers originally analyzed how individuals *manage*, or cope with, the *terror* that arises from the knowledge of being mortal, that we all will die one day (Greenberg et al., 1986; Pyszczynski et al., 2004). They concluded that, similar to animals, humans have an instinct to survive and flee from life-threatening danger; importantly, though, human intelligence makes them understand and be aware that death is inevitable for everyone. This knowledge and awareness, in turn, confronts humans with incomparable deep anxiety that needs to be managed.

The TMT and the TMHM put special emphasis on the role of consciousness and the role of self-esteem. They distinguish between responses to conscious and unconscious thoughts when being reminded of mortality, which has been formulated and concretized in the dual-process model that distinguishes proximal and distal defenses (Arndt & Goldenberg, 2017; Greenberg et al., 1994, 2000; Pyszczynski et al., 1999). TMT and TMHM theorists assume that cultural worldviews (e.g., religious, ideological) and self-esteem provide individuals with meaning and security, which buffers anxieties (e.g., Arndt & Goldenberg, 2017; Arndt et al., 1997; Greenberg et al., 1994; Pyszczynski et al., 2004). Therefore, it is assumed that individuals who are reminded of their inevitable death would unconsciously engage in strengthening their cultural worldviews and self-esteem, including by engaging in behavior that is important to their self-esteem (action-based self-esteem).

When death-related thoughts are conscious because of explicit mortality reminders, individuals are likely to engage in behavior connected to the threat that helps efficiently turn away or actively suppress anxieties, which has been termed *proximal defense strategies* (Greenberg et al., 2000; Pyszczynski et al., 1999). In contrast, individuals are likely to respond with *distal defense strategies* by engaging with worldview defense and striving for self-esteem when death-related thoughts are unconscious, a process that is either provoked through a subliminal trigger or when initially conscious thoughts gradually transition to an unconscious state after some time (e.g., Arndt et al., 2003; Greenberg et al., 2000).

Examining conscious and unconscious reactions to death-related thoughts

The assumptions of the dual-process model that takes into account different reactions to conscious versus unconscious death-related thoughts and the importance of self-esteem for coping with unconscious death-related thoughts are supported by the evidence from various experimental studies (Arndt et al., 2003; Ben-Ari et al., 1999; Greenberg et al., 1994, 2000; Hansen et al., 2010; Pyszczynski et al., 1999). In these studies, researchers typically ask participants to write down thoughts about their mortality while the control group is usually asked to write about other (neutral or negative but not death-related) thoughts.

To examine the assumption that this mortality writing task makes death-related thoughts immediately accessible on a conscious level that transcend to the subconscious after some delay, the consequences of the mortality inducement are usually assessed with and without delay tasks (Pyszczynski et al., 2004). Such studies have found increased levels of death-thought accessibility following mortality reminders (see Steinman & Updegraff, 2015, for a meta-analysis). These studies have also provided evidence that thoughts of one's own mortality hold a unique influence,

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surpassing other threats, like uncertainty or worries, in triggering anxiety and worldview defense (e.g., Greenberg et al., 1995; for an overview, see also p. 36 Pyszczynski et al., 2015).

The role of self-esteem in the reactions to death-related thoughts

Along with informative insights into the defense mechanisms and the role of the level of consciousness, studies have also emphasized the importance of the self-esteem in response to death-related thoughts (e.g., Ben-Ari et al., 1999; Hansen et al., 2010; Wisman et al., 2015). For example, a study by Taubman Ben-Ari, Victor, and Mikulincer (1999) revealed that individuals are more prone to risky driving behavior following reminders of death if the driving behavior is connected to their self-esteem. Moreover, it has been found that heightened death-thought accessibility—provoked by mortality salience—can be mitigated through self-esteem bolstering or worldview defense, providing further evidence for the importance of self-esteem in this process (Arndt et al., 1997; Hayes et al., 2008). Similar support for the importance of self-esteem and worldview defense has been provided by experimental studies that found increased death-thought accessibility following attacks on their self-esteem or worldview (Hayes et al., 2008; Schimel et al., 2007).

Insights on death threats and health-related behavior

The TMHM was developed by applying the TMT propositions and its dual-process component to the health context (Arndt & Goldenberg, 2017; Goldenberg & Arndt, 2008). The model sheds light on how individuals change their health-related attitudes and behaviors when they are confronted with a death threat. In particular, this means that people engage in more unhealthy behavior, like smoking (Hansen et al., 2010) or recklessness (Taubman–Ben-Ari & Skvirsky, 2019), when reminded of a specific death threat when the behavior is important for their self-esteem and self-worth and helps bolster their worldview. According to this theoretical rationale, people strengthen these attitudes and beliefs or increase these specific behaviors because they imbue people's lives with order, value, meaning, and belonging. As such, these attitudes and behaviors buffer the unique existential threats one is confronted with when reminded unconsciously about their death (Arndt & Goldenberg, 2017). Thus, distal defense strategies can either lead to positive or negative health attitudes and behavior; it is only important what brings sense and value to an individual's life, which is then strengthened for coping reasons.

Applying TMT and TMHM to terrorist attacks

While initial uses of the TMT generally concerned one's own mortality (without being explicit about the cause), the potential of the framework to also explain coping mechanisms triggered through terrorist attacks as a reminder of individuals' own death was later unveiled (Pyszczynski et al., 2003). Thus, mortality stimuli related to terrorist attacks, military events, or subliminal stimuli (like images) also function as death reminders and similarly evoke the need for worldview defense and behavior that are important to oneself (Das et al., 2009; Vail et al., 2012). In particular, being reminded of a previous salient terrorist attack, such as the September 11, 2001 attacks (Vail et al., 2012), and attacks on a comparatively smaller scale, such as the Berlin Christmas Market

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attack in Germany (Pradel & Sattler, 2022) or the murder of Theo van Gogh (Das et al., 2009), increased death-thought accessibility of people in the targeted countries in line with TMT.

In the aftermath of terrorist attacks, Pyszczynski et al. (2003) presented arguments that terrorist attacks may function similarly to mortality salience as a reminder of one's own mortality, and public responses to terrorist threats might be explained via the TMT. Importantly, what distinguishes terrorism salience from pure mortality salience is that terrorist attacks also constitute an attack on a community and its cultural symbols and worldviews. For instance, the World Trade Center represented a popular and important cultural symbol of New York City as a symbol of American economic power (for a similar argument, see also Cohen et al., 2005; Dewa et al., 2014; Landau et al., 2004; Pyszczynski et al., 2003). Moreover, along with these events, people are exposed to vivid coverage of destroyed buildings and injured and dead people, which function as a natural reminder of death (Pyszczynski et al., 2003). According to the TMT, culture, worldviews, and self-esteem are important components of coping with stress arising from such reminders of death as they give individuals a sense of meaning (Pyszczynski et al., 1999; Wisman et al., 2015). Therefore, thoughts about terrorist attacks—although being statistically a less likely cause of death—even invoke stronger symbolic defenses and behavior that is important to one's self-esteem (Pyszczynski et al., 2003).

Relatedly, studies suggest that terrorism salience increases worldview defense, like support for military actions (e.g., Pyszczynski et al., 2006; Vail et al., 2020), and higher levels of reported patriotism among insecure individuals (Huddy et al., 2007). Moreover, there is evidence that the population's health is also negatively affected across multiple dimensions in the aftermath of terrorist attacks (for instance, substance use), which is essential to understand further. Notably, along with large-scale terrorist attacks, numerous studies have demonstrated the negative effects of terrorist attacks on mental health, revealing heightened levels of anxiety and psychological stress disorders among direct and indirect victims, rescue and emergency personnel, as well as affected communities (for a review see Paz García-Vera et al., 2016; Whalley & Brewin, 2007). Moreover, studies have also found heightened levels of substance use in the aftermath of such terrorist attacks (for a meta-analysis, see DiMaggio et al., 2009). For example, alcohol, cigarette, and marijuana consumption among New York residents, survivors, and witnesses increased after the September 11, 2001 terrorist attacks, along with a higher likelihood of experiencing post-traumatic stress disorder or depression (Gargano et al., 2017; Grieger et al., 2003; Simons et al., 2005).

However, a systematic review article on existing empirical studies on the broader implications for mental health highlights considerable variation in the negative health effects following violent extremism, indicating the need for further research to identify the contextual and individual factors that contribute to different responses, and to be able to develop targeted interventions (Gill et al., 2021). Particularly, more profound insights into the mechanisms that may cause increases in substance use as one important facet of health-related behaviors and the most affected groups are scarce.

Examining the link between terrorism and alcohol-related choices

Besides evidence on the correlation between terrorist attacks and substance use, related studies on TMT and TMHM studies on substance use point to potential negative health effects caused by a terrorist attack—but only for a specific group of people. Experiments with the original mortality salience treatment found an increase in the willingness to binge drink alcohol when it was important to self-esteem (e.g., Jessop & Wade, 2008) or an increase in actual alcohol consumption

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when the general (i.e., global) self-esteem was low because the general self-esteem has a natural anxiety-buffering function (Wisman et al., 2015, Study 5). However, there has been less attention to the effects of terrorist attacks on alcohol consumption. This is a crucial gap, because people are frequently reminded of such events. It remains under-researched to what extent threatening events like terrorist attacks trigger coping with alcohol in ways similar to traditional reminders of mortality and consistent with the TMT and TMHM. Analyzing the consequences of thoughts about a terrorist attack with both theoretical perspectives can help understand which groups are most vulnerable by showing a propensity to consume substances, such as alcohol, when reminded of terrorism and violent events.

Previous research suggests that implicit attitudes toward alcohol (measured with an implicit association test) become more positive for individuals who had low alcohol-based self-esteem and were thinking unconsciously about a terrorist attack than implicit attitudes in individuals in a control group who were thinking unconsciously about another negative event (Pradel & Sattler, 2022). Having low alcohol-based self-esteem implies that alcohol is less important to one's self-esteem than those with high alcohol-based self-esteem. However, we do not know how thoughts about terrorist attacks translate into actual behavior, such as choosing to drink alcoholic over nonalcoholic drinks. Similar to other behaviors that can be detrimental to an individual's health and even lead to death (Ben-Ari et al., 1999, p. 36; Taubman–Ben-Ari & Skvirsky, 2019), alcohol consumption can be a source of excitement and arousal. Drinking in a group can increase people's social recognition, validation, and a sense of belonging. Thus, "people may engage in [such] risky behavior because they overemphasize the self-relevant gains" (Taubman–Ben-Ari & Skvirsky, 2019, p. 561). It can be assumed that people are more likely to consume alcohol if they see it as a way to increase their self-confidence and improve their self-image. This might especially true when people are attempting to buffer the fear of death that comes from thinking about a terrorist attack, something that that can happen anywhere and anytime and might therefore be more likely to induce anxiety compared to more conventional causes of death.

While the little existing research has investigated the link between thoughts of a terrorist attack using a TMT-lens on implicit attitudes toward alcohol, the exact mechanism of actual drinking behavior still requires further investigation (Pradel & Sattler, 2022). Particularly, implicit attitudes measured with an implicit association test could also portray cultural knowledge, like alcohol as something "bad" rather than portray attitudes (Karpinski & Hilton, 2001; Pradel & Sattler, 2022). Therefore, it is necessary to further discover how thoughts about a terrorist attack manifest into actual drinking tendencies. To our knowledge, there has not been any research thus far that focuses on the link between a terrorist attack, alcohol-related behavior, and the role of striving for increased self-esteem in such a context. However, in times of frequent coverage of terrorist attacks and war-related events in traditional and social media, knowledge about such processes and how different groups of individuals react to these anxiety triggers with unhealthy decisions can be particularly important for efficiently organizing health interventions.

THE CURRENT STUDY

This study takes a TMT and TMHM perspective (Arndt & Goldenberg, 2017; Goldenberg & Arndt, 2008) to explain how thoughts about terrorist attacks can manifest in negative health decisions. Previous TMT and TMHM studies that consider self-esteem have primarily focused on traditional mortality reminders or specific health-related threats, neglecting the potential effects of terrorist attacks in the health context. As such, this study uses a novel approach.

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As outlined earlier, TMT and the TMHM suggest that terrorism salience triggers thoughts of mortality and existential fears that individuals attempt to manage (Arndt & Goldenberg, 2017; Greenberg & Arndt, 2012). By investigating the relationship between thoughts about a past terrorist attack and actual alcohol-related behavior, we aim to uncover the mechanisms underlying unhealthy behavior in response to typical anxiety triggers, which is particularly relevant in a media-saturated world where such events are frequently encountered.

Therefore, we examine the effects of conscious and unconscious thoughts about a terrorist attack on an indicator for potentially unhealthy behavior and how it is affected by the self-esteem related to this behavior. Specifically, we test whether asking participants to think and write about the 2016 extreme-Islamist terrorist attack on a popular Christmas market in Berlin, Germany (Pradel & Sattler, 2022; Samaan & Jacobs, 2020) affects their desire for alcoholic over nonalcoholic beverages. We examine whether the beverage choice depends on delayed or immediate effects of the terror-related thoughts of death and on how beneficial alcohol is to the respondents' self-esteem.

The investigated terrorist attack is a suitable test case for the theoretical propositions of the TMT and TMHM. It may also be practically important since it presumably affected the lives of many people in and outside Germany. This attack, for which the Islamic State claimed responsibility (Samaan & Jacobs, 2020), took 13[1] lives and injured dozens more at the Kaiser Wilhelm Memorial Church in Berlin. The attack was widely discussed and led to several security measures in its aftermath (BBC News, 2021; see also for more details Pradel & Sattler, 2022; Samaan & Jacobs, 2020). In addition to the tragic loss of life, the terrorist event represents an attack on a specific part of Germany's culture. Christmas markets comprise a century-old tradition, and not only attract a large number of visitors annually but also play a vital role in German society and culture. With between 2,500 and 3,000 Christmas markets across German towns and cities and that attract large numbers of visitors (Spennemann & Parker, 2021), these vibrant gatherings are "are not solely about the mercantile dimension, or more recently, tourism, but form an essential part of the history and culture of the cities and villages that host them" (Spennemann & Parker, 2021, p. 4). Some historians even argue that these "markets should be inscribed on UNESCO's intangible cultural heritage list" (McKeever, 2021). It also needs to be highlighted that the attack occurred at the Kaiser Wilhelm Memorial Church, which holds great cultural significance and is a popular site in Germany. The church was largely destroyed during World War II in a bombing raid. Now, it is a reminder against war and destruction and it commemorates peace between nations. Thus, it became one of the most important churches in Berlin with a rich historical heritage and is a frequently visited tourist attraction (Zill, 2011).[2] This further underscores the cultural significance of the attack. As terrorism also attacks cultural symbols, we expect that being confronted with thoughts about the attack makes individuals more likely to strive for worldview defense and behavior that bolsters self-esteem. Drinking alcoholic beverages (particularly beer) is widespread in Germany and is part of the German culture (Hupkens et al., 1993; Meussdoerffer, 2011). For instance, craft beer brewing is listed as immaterial German cultural heritage by the German Commission for UNESCO (Deutsche UNESCO-Kommision, 2023, p. 62). The importance of beer in the German culture is further visible in the existence of the German Purity Law that strictly regulates the ingredients in beer, and the fact that Germany is by far the largest beer producer in Europe (Statista, 2019).

[1] One of the helpers at the Christmas market attack died five years after the attack due to injuries and long-term illness, resulting in a total of thirteen people dead five years later (see BBC News, 2021).

[2] For more insights into the cultural significance of the Kaiser Wilhelm Memorial Church in Germany, see also https://www.berlin.de/en/attractions-and-sights/3561433-3104052-kaiser-wilhelm-memorial-church.en.html.

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As drinking can make individuals feel more valuable and increase their sense of self-worth (Lac & Brack, 2018; Pradel & Sattler, 2022), being reminded of a terrorist attack—particularly when it was attacking important cultural symbols as in the case of the Berlin Christmas market—TMT and TMHM can help explain behavioral changes in preferences for alcoholic beverages. In line with the TMT and TMHM, we expect that, for individuals for whom alcohol is important to their self-esteem, behavioral preferences for alcohol increase when confronted with unconscious thoughts about the terrorist attack (i.e., terrorism salience). By examining this hypothesis, we provide insight into the cognitive process caused by the threat of an unnatural death and how it may affect alcohol consumption and other unhealthy behavior. Understanding this process in different groups of society can be also useful to inform the development of targeted health interventions. Thus, this study differs from previous TMT and TMHM research by going beyond conventional mortality primes to examine the impact of a terrorist attack that is closely interwoven with a significant cultural context while also assessing the impact on health-related behaviors and considering individual self-esteem concerning health behaviors.

METHOD

Participants

For this field experiment, we recruited participants who had German citizenship and were a minimum age of 18 years in Cologne. A total of 244 participants completed the study and were rewarded with a beverage of their choice (approximately worth 1 EUR when buying in a supermarket, equaling approximately 1 USD). Participants who failed the attention test, did not want to choose a beverage, or were pregnant or lactating were excluded from the analyses. After these exclusions, the analytical sample consisted of 228 participants (50.9% females) with a mean age of 24.14 (range: 18–40).

The study was preregistered at AsPredicted (https://aspredicted.org/zg963.pdf)[3] and approval was obtained from the ethics committee of the University of Cologne (approval number: 17–317).

Materials and procedure

Participants were recruited at a central cafeteria of the University of Cologne. They were approached by the first author, who asked if they would like to take part in a scientific study about new survey methods. After they agreed to participate, they were provided with a tablet to complete a web survey. On the first page of the online experiment, they were informed about the study, which emphasized that participation is voluntary, and were asked to provide informed consent. First, respondents were asked about the importance of alcohol to their individual self-esteem (alcohol-based self-esteem). Then, they were randomly assigned to one of the experimental conditions of the 2-by-2 between-subjects design, combining a terrorism salience factor (terrorism vs. control) and a delay factor (delay vs. no delay). Participants responded to questions that made either thoughts about terrorism or the control condition salient. Half the participants were allocated to a delay task that would trigger either a conscious or unconscious processing of the

[3] When pre-registering the study, we intended to have 320 completed cases. Due to budget and time constraints in the face of increased cost (>10%), we were unable to achieve these numbers.

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salient thoughts while the other half were not. Then, participants conducted a word completion task to assess their death-thought accessibility. Finally, they were given a choice between an alcoholic or nonalcoholic beverage in thanks for their participation. At the end, participants were debriefed.

Alcohol-based self-esteem: In line with other TMT and TMHM research investigating the role of action-based self-esteem (e.g., Hansen et al., 2010; Pradel & Sattler, 2020; Wong et al., 2017), we asked participants how much alcohol is tied to their self-esteem. To do so, we used the alcohol-based self-esteem scale with a six-point Likert scale ranging from 1 (*not at all)* to 6 (*very much*; for more details see Pradel & Sattler, 2022). We adapted items from the *Driving as Relevant to Self-Esteem Scale* (Ben-Ari et al., 1999) and the German version of the *Rosenberg Self-Esteem Scale* (von Collani & Herzberg, 2003) by modifying the terms in relation to drinking alcohol and translating them to German. Moreover, we also used items from research about *functional drinking* (Belitz-Weihmann & Metzler, 1997). Exemplary items are "*When I drink alcohol, I am satisfied with myself*"; "*When I drink, I feel valued by others*"; and *"When I drink, I have a positive attitude toward myself*." After a step-wise exclusion of items that are only weakly correlated with the other items of the scales, that is, following the procedure for summative score construction (De Vaus, 2014), eight items remained.[4] Their internal reliability was good (Cronbach's $\alpha = .846$) and an additional factor analysis suggested unidimensionality by revealing a single-factor solution (*Eigenvalue* = 4.053, all *factor loading*≥.6). The mean scores were standardized; higher scores indicated a higher importance of drinking alcohol to individual self-esteem.

Terrorism salience (TS): Typically for TMT and TMHM research on terrorism salience (e.g., Dewa et al., 2014; Landau et al., 2004 (Study 3); Pyszczynski et al., 2006 (Study 2)), we randomly assigned half the participants to a writing task to make terrorism salient. Specifically, in the TS group they should describe their feelings and what they think happened on the 2016 Berlin attack with the following prompt: *"Please describe the emotions that the thought of the terrorist attack on December 19, 2016, at the Berlin Christmas market arises in you."* And *"Write down as specifically as you can what happened during the terrorist attack on December 19, 2016 at the Berlin Christmas market."* Additionally, the participants were asked whether they know a person who was in Berlin during the attack. Participants in the control group were asked to write down their thoughts and feelings to similar prompts referring to dental pain, which is a common control prompt used to exclude the alternative explanation that the effects emerged solely due to the negativity of the question (Burke et al., 2010).

Delay task: Half the participants answered the German version of the Positive and Negative Affect Schedule (PANAS; see Breyer and Bluemke (2016) for the German translation), which is frequently used as a delay task (Steinman & Updegraff, 2015). A delay allows death-related thoughts to transcend to the unconscious level, where such thoughts can continue affecting individuals. Studies have shown that delay tasks, like PANAS, make death-related thoughts more accessible in the unconscious mind (Arndt & Goldenberg, 2017; Steinman & Updegraff, 2015).

Death-thought accessibility: To measure the accessibility of death-related thoughts and test whether the manipulation worked as proposed by the theory, we used a word fragmentation task that has been traditionally used in related research (e.g., Greenberg et al., 1994; Hayes et al., 2010). In this task, participants completed word fragments by filling in the blanks. Some of the words could be interpreted as death-related or neutral words. For example, in the English version "COFF_ _" can be completed as "coffin" or "coffee" (e.g., Schimel et al., 2007). The instructions

[4] We retained all items of the scale after the pretest because we intended to create the final scale based on the final sample and not on the smaller convenience sample from the pretest.

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TABLE 1 Predicting the probability of preferring an alcoholic beverage over a nonalcoholic beverage with multiple logistic regression analyses (*Number of observations* = 228).

	Model 1		Model 2		Model 3	
	OR	***SE***	***OR***	***SE***	***OR***	***SE***
Terrorism salience (ref. control)	.890	.261	.661	.286	.818	.399
Delay (ref. control)	1.014	.297	.700	.297	.956	.455
Alcohol-based self-esteem (ABS)	1.559**	.249	2.232**	.654	3.924**	1.813
Terrorism salience x delay			2.182	1.310	1.607	1.029
Terrorism salience x ABS			.540	.176	.225**	.122
ABS x delay			.918	.298	.359	.199
Terrorism salience x Delay x ABS					5.077*	3.601

Notes: OR = odds ratios, SE = standard error.
*$p < .05$, **$p < .01$, ***$p < .001$.

asked participants to complete, as quickly as possible, all words with the first word that came to their minds. Nine of the 21 word fragments could be completed as death-related words (the German words for ash, blood, coffin, corpse, dead, grave, grief, murder, and tombstone were used here), while the other words could be completed as neutral words. Time was limited to 150 seconds, as suggested by our pretest (see below). We constructed a death thought accessibility score for each participant by summing the number of completed death-related words.

Beverage choice: One of the last screens on the tablets showed pictures of a bottle of a local beer, "Früh Kölsch" containing alcohol and a bottle of water from a German spring, "ViO." Participants were told they could choose one bottle as a thank you for their contribution, which would be given at the end of the study. This choice was part of the study and should reveal differences in preferences for alcohol (coded as "1" for beer and "0" for water).

Pretesting: We tested the comprehensibility of questions, the writing task, and experimental procedures by conducting a cognitive pretest ($N = 4$) and a quantitative pretest with a convenience sample ($N = 47$). The results suggested sufficient comprehensibility, but that the main study should set a time limit for the word completion task (i.e., testing death-thought accessibility), because participants might consciously suppress death-related words and come up with alternatives, as well as spend a varying amount of time on the survey page. Based on the pretest, we set a time limit for the word-completion task in the main experiment and highlighted in the instructions the importance of filling in the first word that comes to participants' minds.

RESULTS

Results of an independent *t*-test show a statistically significant higher death-thought accessibility score for the participants in the terrorism salience group ($M = 2.037$, $SD = 1.112$) compared to the dental pain salience group ($M = 1.756$, $SD = 1.360$, $t = 1.71$, $p = .044$). Balance tests indicate that participants in all experimental groups and their interaction did not differ significantly from each other in their alcohol-based self-esteem scores ($p > .05$). Moreover, single *t*-tests and joint tests of orthogonality suggest balanced experimental groups ($p > .05$).

Alcohol was chosen by 31.1% of the respondents. Model 1 in Table 1 provides results from a logistic regression model showing that neither terrorism salience treatment ($p = .691$) nor the

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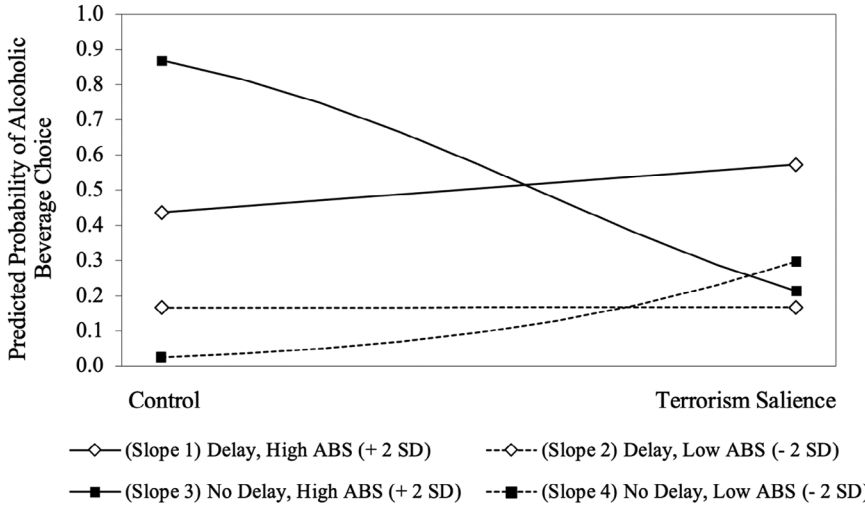

FIGURE 1 Predicted probability of choosing an alcoholic beverage instead of a nonalcoholic beverage as a function of standardized alcohol-based self-esteem (ABS), the experimental treatments terrorism salience, delay, and all interactions (based on Model 3 in Table 1).

delay task ($p = .961$) has statistically significant main effects. As indicated by the statistically significant positive odds ratio of 1.559 ($p = .002$), the likelihood of choosing an alcoholic beverage instead of a nonalcoholic one increases if alcohol is seen as more beneficial to one's self-esteem. In Model 2, the conditional main effect of alcohol-based self-esteem is still statistically significant ($p = .006$) and reveals that for respondents in the control group without a delay task, an increased alcohol-based self-esteem leads to a higher likelihood of choosing an alcoholic beverage over a nonalcoholic beverage. However, in the terrorism salience treatment group, this effect tends to vanish ($p = .059$); but the interaction effect was only marginally statistically significant. Model 3 shows a statistically significant three-way interaction between terrorism salience, delay, and alcohol-based self-esteem ($p = .022$).

We explored this significant interaction further with simple slope tests and simple slope difference tests (Aiken & West, 1991; Dawson & Richter, 2006). The simple slope tests show that for individuals in the delay task and with higher alcohol-based self-esteem scores, the likelihood of choosing alcohol did not differ between the terrorism salience and the control group (see Slope 1 in Figure 1; $B = .135$, $p = .565$). This is also true for individuals in the delay task with lower alcohol-based self-esteem scores (Slope 2; $B = .001$, $p = .995$). However, the likelihood of choosing alcohol decreased for participants in the no-delay task with higher alcohol-based self-esteem scores in the terrorism salience group compared to the control group (Slope 3, $B = -.655$, $p < .001$). Conversely, this likelihood slightly increased for participants in the low delay task with lower alcohol-based self-esteem scores when comparing the terrorism salience to the control group (see Slope 4, $B = .276$, $p = .040$).

Simple slope differences revealed a statistically significant difference between Slope 3 for individuals with higher alcohol-based self-esteem scores assigned to no delay task and Slope 1 for individuals with higher alcohol-based self-esteem scores assigned to the delay task ($z = 2.87$, $p = .004$). Thus, a delay task seems to play a crucial role. We also found a statistically significant difference ($p < .001$, $t = 3.83$) between Slope 1 and Slope 4 for participants with lower alcohol-based self-esteem scores assigned to no delay task. In addition, Slope 3 also significantly differs from

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Slope 2 for participants with lower alcohol-based self-esteem scores and delay task ($z = -3.21$, $p = .001$). Importantly, when terrorism is salient (see right side of Figure 1), the probability of choosing alcohol is highest overall (57.4%) among individuals with high alcohol-based self-esteem exposed to a delay task that allows thoughts to transcend to the unconscious level.

DISCUSSION

Based on assumptions from TMT and the TMHM, the current study investigated whether terrorism salience affects unhealthy behavioral choices. Therefore, we investigated whether thinking about a very salient terrorist attack in Germany activates death-related thoughts. We also tested how such thoughts consciously and unconsciously affect unhealthy behavioral choices with a strong symbolic meaning in this particular cultural context (i.e., alcohol-related behavior). Moreover, we examined the conditioning role of alcohol-based self-esteem. Thereby, this study contributes to the limited understanding of how violent events can function as a reminder of death and trigger unhealthy behavior.

The results of this study show that thoughts about the Berlin Christmas market attack increased the death-thought accessibility. Prior research on the effect of terrorism primes on death-thoughts accessibility is, however, mixed. While no effect was found in a study (Ullrich & Cohrs, 2007) that tested whether international terrorism primes (e.g., 9/11 attack) affect death thoughts in participants in Germany, studies (including ours) testing the effect of an attack in the same country participants live in and, thus, are much more proximate to (e.g., Landau, 2004; Pradel & Sattler, 2022), found increased death-thought accessibility. In other words, this may suggest that thoughts about a proximate terrorist attack evoke feelings of threat, while international terrorist attacks do not necessarily function as a reminder of death, especially when they are not large scale.

Our finding could also reflect the concerns about terrorist attacks in Germany, which increased in the years after other terrorist incidents in Europe (Steinbrecher et al., 2017). Given the assumption that terrorist attacks will continue occurring (as indicated by almost 23,000 deaths resulting from terrorism in 2020 worldwide; Ritchie et al., 2022), the increasing fear of a terrorist attack occurring in proximity, and that terrorism has been used in Western Europe as a headline in the media (Kearns et al., 2019; Gideon Skinner, 2018), our finding underlines the need to help individuals cope with their death anxieties, especially if they become chronic. Types of support could be, for example, targeted counseling, such as trauma-focused cognitive-behavioral therapy (Rigutto et al., 2021).

While we expected that alcoholic beverages would most likely be chosen by participants with higher alcohol-based self-esteem levels when death-thoughts are unconscious (i.e., in the group with a delayed effect of the terrorism salience treatment), the likelihood of choosing alcohol was only slightly higher in the terrorism salience group compared to the control group, but this effect was not statistically significant. Still, within the terrorism salience group, respondents with high alcohol-based self-esteem levels and unconscious death-related thoughts showed the highest predicted probability of choosing an alcoholic beverage compared to most other groups. Compared to the control group, a higher likelihood of choosing alcohol was, surprisingly, only found among participants with lower alcohol-based self-esteem levels with conscious death-related thoughts. No effect of terrorism salience (in comparison to the control group) was found when alcohol-based self-esteem was low and death-related thoughts were delayed. Interestingly, terrorism salience decreased the likelihood of choosing alcohol for participants who had high alcohol-based self-esteem scores when death-related thoughts about the terrorist attack were conscious (i.e., in the

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group without the delay task) when comparing them to the control group. The slope of this effect was statistically significantly different from all other slopes.

Our study provides experimental evidence indicating that the effect of terrorism salience on the preferences for alcohol varies with the consciousness of death-related thoughts, the importance of alcohol to the individual self-esteem, and their combined effect. These results provide further support for the importance of the dual-process component for understanding how individuals react to death- and other threat-related stimuli. Different from other TMHM research, this study showed a unique effect of terrorism salience for individuals with low alcohol-based self-esteem when death-related thoughts are conscious, as such individuals had a higher likelihood of choosing an alcoholic beverage over a nonalcoholoic beverage. Thus, death reminders by violent acts seem to have consequences for health-related behavior distinguishable from more general reminders of one's mortality.

One potential explanation for the partial or even negative effects of the terrorism salience treatment could be that in the control group, thinking about dental pain may make respondents more willing to choose an alcoholic beverage—especially by respondents with high alcohol-related self-esteem. Thus, a high cognitive accessibility of alcohol probably serves as a coping strategy for dental pain (due to the narcotic properties of alcohol). Moreover, other factors that possibly correlate with alcohol-based self-esteem (like global self-esteem or affective/impulsive personality (see e.g., Carey & Sarma, 2011; Wisman et al., 2015) could help explain findings that deviate from traditional TMHM effects. Still, terrorist attacks might also—although functioning as a death threat as our results show—induce different kinds of defense mechanisms in the health context than expected by traditional primes of TMHM.

Generally, alcohol-based self-esteem seems to be a relevant factor in choosing an alcoholic over a nonalcoholic beverage. First, it exerted a positive main effect on choosing alcohol. Thus, our study provides behavioral evidence that, for individuals with high alcohol-based self-esteem, alcohol seems to offer meaning and security. Second, our results suggest that, depending on alcohol-based self-esteem, individuals may react differently in different stressful situations. While individuals with high alcohol-based self-esteem were most likely to reach for the alcoholic beverage when thoughts of a stressful event (e.g., dental pain) were conscious (compared to unconscious thoughts), this was not transferable to defense mechanisms to the unique stress induced by terrorism. Here, low global self-esteem may be the most important driver of whether people cope with their drinking behavior when thoughts are conscious, and other factors may be secondary. However, when thoughts about the attack transcended to unconsciousness, those with high alcohol-based self-esteem were the ones most likely to choose an alcoholic beverage.

The study also has practical implications. Global- and action-based self-esteem could be used to predict substance use and other maladaptive coping behaviors in general and particularly in response to specific stressors. Thus, the study findings point to a promising avenue for future research on identifying vulnerable groups.

Strengths, limitations, and directions for future research

The study brings several strengths and contributions to the understanding of types of death-related reminders with a TMT and TMHM lens. We provide new evidence on the dual-process mechanisms in risk behavior with substances beyond classic death-related reminders in TMT and TMHM research, while also finding heightened levels of death-thought accessibility after terrorism salience. We show that violent events can have effects on substance use that are different

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than other death-related reminders. Furthermore, existing studies on terrorist attacks and health behavior consist of correlational data, not a controlled experimental setting that allows studying causal mechanisms (according to TMT and TMHM) in more detail.

The study also tested the new scale of alcohol-based self-esteem on actual drinking tendencies and found an association with risky substance behavior under different circumstances. Future studies may use this measure to identify individuals who are most vulnerable to alcohol consumption in different research contexts (e.g., studies examining the consequences of self-esteem and the effect of stress, as well as drinking behavior, alcohol abuse, or addiction). Moreover, our study has the advantage of a sample that is more diverse in its alcohol preference than those in previous studies in which respondents who go to a bar or nightclub (and who might be most likely to consume alcohol; e.g., Wisman et al., 2015 (Study 5)) were recruited.

While this study revealed interesting links between terrorism salience and preferences for alcoholic beverages, it also has limitations. Compared to similar research (Ein-Dor et al., 2014), the purpose of the beverage choice was less concealed. Participants in the present study chose the alcoholic beverage disguised as an incentive for participation directly after the study. Offering alcohol in public might have caused some pressure to choose the nonalcoholic beverage (regardless, 31.1% of the respondents chose alcohol), thus generally lowering the chance of the effects of the terrorism salience treatment from becoming stronger. The beverage choice in this study might, therefore, be more conscious and controllable than in studies on implicit attitudes (Pradel & Sattler, 2022) or where the alcoholic drinks might be embedded in a more natural research context (e.g., Wisman et al. study (2015) at a nightclub). Still, both the terrorism salience and the dental pain group should be affected the same due to randomization. To rule out any uncertainty, future research could benefit from concealing the beverage choice more strictly so that it appears fully unrelated to the study. Moreover, while only offering one alcoholic and one nonalcoholic drink, future studies may include other beverages (such as wine, spirits, tea, or coffee) since some individuals inclined to cope with death thoughts via substance use may not like the offered options of beer and water. Future studies should also investigate other control groups by using emotionally negative topics to think and write about to exclude the possibility that the effects of the terrorism salience only emerge due to the negativity of the framing instead of death-related thoughts (Burke et al., 2010). These control groups should also be dissociated from alcohol (e.g., uncertainty through an unforeseeable negative event). Our results imply that, similar to the study by Ullrich and Cohrs (2007), the investigation of different *types of death-related threats* could be a fruitful direction for future research.

In order to examine the generalizability of the findings, future research could also aim for a cross-country study, and examine the possible effects and potential variations of reminders of terrorist attacks in different societal, historical, cultural, and political contexts in, for instance, the USA and European and nonwestern countries.

Practical implications of the findings

Policymakers should be aware of the potential implications and take appropriate actions in light of the research findings. Witnessing, even indirectly, violent attacks and the intense coverage of terrorist attacks through traditional and social media can influence individuals' stress levels and coping behavior. Thus, policymakers can elevate public health awareness by educating people about the importance of minimizing engagement with such coverage. Furthermore, they can inform journalists, media outlets, and platforms about the potential impact of different reporting

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styles to encourage responsible coverage while bypassing anxiety-provoking and vivid coverage. Simultaneously, policymakers can support interventions that promote healthier coping behavior and mitigate the harmful effects of terrorism salience and other death threats.

Likewise, promoting awareness among individuals about the unconscious effects of terrorist attacks could be helpful. It is important to note that trigger warnings should be implemented carefully based on empirical evidence, as research suggests that warnings can backfire for some groups under certain circumstances, potentially leading to unintended consequences (Hansen et al., 2010). Lastly, policymakers can play an essential role in encouraging and facilitating further research (through funding initiatives) that is needed to explore the consequences of different types of terrorist attacks on various groups and to identify successful interventions, including evidence-based approaches to trigger warnings, to mitigate potential adverse health effects.

CONCLUSION

This study extends existing knowledge by examining the consequences of a specific and relevant death threat from a terrorist attack within a dual-process model. Compared with previous studies on the effects of mortality sensitivity on health, this study uses a new manipulation of mortality sensitivity by examining how thoughts of a terrorist attack can trigger actual behavior. Terrorist attacks are unique in that they not only make death-related thoughts accessible but also operate within the framework of cultural context, often attacking cultural symbols. The attack on culture and worldviews alone has the ability to trigger profound stress and coping mechanisms, which is why terrorism salience is set apart from conventional mortality salience by potentially having a dual-layered impact on individuals. Moreover, this study contributes to the scholarship by applying the study of terrorist attacks as a reminder of mortality in the alcohol context and has the advantage of measuring alcohol-related behavior outside the lab.

The study shows how terrorism salience affects unhealthy behavioral choices under two conditioning factors: the *level of consciousness* of the salience and *alcohol-related self-esteem*. By taking a terror management perspective, we demonstrate how thoughts about the 2016 Berlin Christmas market attack could manifest in culturally embedded negative health-affecting decisions, that is, preferences for drinking alcoholic beverages. We provide experimental insight into the effect of the possible cognitive processes causing changes in behavior towards alcohol by reminding individuals about this attack.

Similar to studies on the September 11, 2001 terrorist attacks, our results suggest that thoughts about the Christmas market attack can increase death-thought accessibility. They also show that individuals who had low alcohol-based self-esteem and were provoked with terrorism salience, leading to conscious death-related thoughts, were more likely to choose an alcoholic beverage compared to the control group; for those who had high alcohol-based self-esteem and were exposed to the same prime, the likelihood of choosing an alcoholic beverage decreased. Notably, for behavioral reactions to terrorist attacks, it is important whether thoughts are conscious. Overall, our research has demonstrated that those with high alcohol-based self-esteem are more likely to turn to substance use in stressful situations, such as being confronted with terrorism, as their thoughts shift from conscious to unconscious. The alcohol-based self-esteem scale can serve as a tool for identifying these individuals, and it can be adapted for other substances.

We conclude that the TMT, as well as the TMHM in the context of health, provides a suitable framework that can help elucidate how individuals react to different reminders of their mortality, including thoughts about terrorist attacks. We, therefore, encourage further research on this topic

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since events that can remind people of existential threats are appearing to become more salient, be it through violent military events, terrorist attacks, war, violent acts, or events like the COVID-19 pandemic. Media coverage, discussions offline, and social media, are often underpinned by images of destruction and death, bringing thoughts of death very close. Events like terrorist attacks are hard for the public to predict, and they often violate important cultural symbols of a community. They also affect many individuals simultaneously and involve intense intergroup conflict, possibly surpassing other death threats in fears and coping behaviors (on behavioral reactions of Americans to 9/11, see also Gigerenzer, 2006) and could, thus, be detrimental to public health beyond individuals immediately affected by such attacks.

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CONFLICT OF INTEREST STATEMENT

The authors do not feel any conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the first author [FP] upon request.

PRE-REGISTRATION

The study has been preregistered at As Predicted (https://aspredicted.org/zg963.pdf).

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