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**He Dies, He Scores: Evidence that Reminders of Death Motivate Improved Performance in
Basketball**

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Abstract

This research applied insights from terror management theory (TMT; Greenberg, Pyszczynski, & Solomon, 1986) to the world of sport. According to TMT, self-esteem buffers against the potential for death anxiety. Because sport allows people to attain self-esteem, reminders of death may improve performance in sport. In Study 1, a mortality salience induction led to improved performance in a “one-on-one” basketball game. In Study 2, a subtle death prime led to higher scores on a basketball shooting task, which was associated with increased task related self-esteem. These results may promote our understanding of sport and provide a novel potential way to improve athletic performance.

Keywords: sport, terror management, motivation, mortality salience, self-esteem.

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"Some people believe football is a matter of life and death. I'm very disappointed with that attitude. I can assure you it is much, much more important than that."

– Bill Shankly, English soccer manager.

Motivation to excel in sport may stem from a variety of sources, such as love of the game or monetary benefits (e.g., Vallerand, 2004). The present research assessed whether it also may arise from existential concerns (e.g., Greenberg & Weise, 2010; Schmitt & Leonard, 1986).

The theoretical framework of terror management theory (TMT; Greenberg, Pyszczynski, & Solomon, 1986) can be particularly useful for understanding this potential psychological function of sport. According to the theory, part of the basic human motivation to participate in culture and pursue self-esteem is to quell concerns about mortality and gain a sense of protection from and transcendence of death. The present research utilized TMT to test whether reminders of death among individuals who derive a sense of self worth from sports and enjoying playing them can improve actual athletic performance in sport.

Building on the writings of Ernest Becker (e.g., 1973), TMT was proposed to account for the basic, well-documented human need to achieve self-esteem. TMT argues that the human awareness of personal mortality conflicts with basic biological predispositions toward continuing survival, thereby creating a *potential* for overwhelming anxiety. To manage this problem and not feel this anxiety, cultural worldviews allow people to feel that they are valuable members of a meaningful and lasting universe rather than mere material animals fated only to perish upon death. Self-esteem, according to TMT, is the feeling that one is living up to the standards of their cultural worldview and that one *is* a valuable member of the cultural meaning system. The more

an individual validates their cultural worldview and bolsters their sense of self-worth, the more they can minimize the potential to experience anxiety engendered by the awareness of mortality. In other words, self-esteem and cultural worldviews are anxiety buffers (e.g., Greenberg et al., 1992; Solomon, Greenberg, & Pyszczynski, 2015).

Over five hundred studies supporting TMT have shown that reminding people of their mortality (mortality salience; MS) leads to judgments and behaviors that validate their cultural worldviews and bolster their self-worth (for reviews see Greenberg, Vail, & Pyszczynski, 2014; Solomon et al., 2015). Moreover, research demonstrates that undermining the validity of an individual's cultural worldviews or threatening their sense of self-esteem increases the cognitive accessibility of death related thoughts (death thought accessibility; DTA; see Hayes, Schimel, Faucher, & Williams, 2008; Schimel, Hayes, Williams, & Jahrig, 2007). In complementary fashion, augmenting the validity of people's self-esteem and cultural worldviews can reduce anxiety and death thought accessibility (e.g., Greenberg et al., 1992; Harmon-Jones et al., 1997).

Importantly, although direct encounters with death or vivid death imagery can indeed cause anxiety (e.g., Greenberg et al., 1992), the effects of the MS induction or other "mild" death-related primes do not involve arousal or elevate anxiety (e.g., Burke, Martens, & Faucher, 2010; Greenberg, Pyszczynski, Solomon, Simon, & Breus, 1994), at least not among people with normal levels of self-esteem (e.g., Juhl & Routledge, 2016). Terror management responses to explicit MS primes are thought to occur through a dual process, in which "proximal defenses" first help push death related content out of consciousness through denial or rationalizing. After a delay period, "distal defenses" motivate people to try and gain a buffering sense of immortality by enhancing self-esteem, identifying with groups, and so forth (for reviews see: Arndt, Cook, & Routledge, 2004; Pyszczynski, Greenberg, & Solomon, 1999). MS effects are therefore theorized

to be “affect free”: they are not processed consciously (e.g., Arndt, Greenberg, Pyszczynski, & Solomon, 1997), do not increase negative affect, and are not mediated by anxiety, arousal, or affect (e.g., Arndt, Allen, & Greenberg, 2001; Greenberg et al., 1994).

More germane to the present studies, research shows that MS motivates behaviors that enhance self-esteem. For example, MS increases donations to charities and doing so reduces DTA (e.g., Jonas, Schimel, Greenberg, & Pyszczynski, 2002). One way in which culture allows people to attain self-esteem is through sport. Studies show that those who participate in sport report higher levels of self-esteem (e.g., Ekeland, Heian, & Hagen, 2005) and that perceived competence in sport is positively associated with self-esteem (e.g., Slutzky & Simpkins, 2009). Of course, these findings may result from high self-esteem leading to sports participation and success as well to sports success contributing to higher self-esteem. Consistent with this latter causal link, participation in sport may serve as a psychological buffer from depression and suicidal ideation through increases in an athlete’s self-esteem (Babiss & Gangwisch, 2009).

Given that sport offers individuals a way of attaining self-esteem, thinking about death motivates people to pursue self-esteem, and motivation to perform better can improve actual performance (e.g., Nicholls, 1984), individuals who are invested in sport should be more motivated to excel in sport, and therefore actually perform better when they are reminded of their personal mortality. A number of prior studies have supported related hypotheses. Taubman-Ben-Ari, Florian, and Mikulincer (1999) found that after MS, Israeli soldiers who derived their self-worth partly from their driving skill drove more boldly on a driving simulator whereas soldiers who did not derive self-worth from driving skill did not show this effect. Moreover, supporting the role of motivation to bolster self-esteem in this effect, soldiers who were given positive feedback about their driving skill no longer drove more boldly on the driving simulator. Peters,

Greenberg, Williams, and Schneider (2005) found that participants who valued strength training squeezed a hand dynamometer (a device that measures grip strength) harder after thinking about their mortality compared to a control condition, and compared to those who did not value strength training. Moreover research has also found that MS increases intentions to do physical exercise in people who value their fitness (Arndt, Schimel, & Goldenberg, 2003).

The purpose of the present set of studies was to assess whether MS does indeed improve actual individual sport performance. Our hypothesis was that death primes would improve actual basketball performance among people who gain a sense of self-worth from sports and enjoy playing basketball. In Study 1, we tested whether MS would improve performance in a “one-on-one” basketball game against a confederate. In Study 2, we examined if exposure to a subtle death prime would lead to better performance in a basketball shooting task relative to a control condition. In these studies, we used only male participants to simplify our procedures and analyses (e.g., we used only a male confederate and ball and court dimensions for collegiate men’s basketball). In addition, because these were costly studies in terms of time and resources, and prior research (e.g., Peters et al., 2005; Taubman-Ben-Ari et al., 1999) has shown that MS does not affect performance for people who do not value the domain of behavior being assessed, these studies only used individuals who valued sports and basketball.

Study 1

In the first experiment, we tested whether a MS induction would improve performance in basketball among those who like basketball and value their identity as an athlete. To do this, we had participants play two games against a confederate, and in between the games randomly assigned them to either think about their mortality or to think of a neutral control topic (playing basketball). We predicted that participants who think about their mortality would perform better

in a “one-on-one” basketball game than participants in a control condition who do not think of death, while controlling for the participant’s baseline performance. We also predicted that MS would improve performance in the second game compared to the first game. In addition, we recorded different game statistics (e.g., shot percentage, rebounds, steals) using a video camera to explore which aspect of the game would be most influenced by the MS induction.

Method

Participants. Thirty-five male University of Arizona undergraduates participated for partial fulfillment of course credit. To ensure that participants valued basketball and cared about their performance we invited only students who noted on a pre-screening mass survey that they liked playing basketball and cared about their performance in sports (reporting a 7 or above on 9-point scales). Specifically, participants responded to the questions: “How much do you like playing basketball?” and “How important is it to your sense of self-worth to be good at sports?” (*1 = Not at all, 9 = Extremely*). Data collection lasted for 3 consecutive semesters, in which there were a total of 392 eligible participants in the subject pools. One participant was dropped for suspicion and three others could not complete the procedures properly, thus data from 31 participants were analyzed ($M_{age} = 18.62, SD = .78$).¹

Procedure and Materials. Participants were run individually in an on-campus indoor basketball court (with no more than two sessions per day). To make the games comparable, all the participants played against the same confederate, who was ostensibly another participant. The confederate was 69 inches tall, of medium build, and was instructed to play at his best.

The experiment was introduced as a study about personality and basketball playing ability. Upon arrival to the court, the participant and the confederate were told that they would play a game of “one-on-one” basketball, fill out a packet of personality questionnaires, and then

play a second game of “one-on-one” basketball. After signing an informed consent, a video recording consent, and an injury liability form, the participant and the confederate stretched and practiced shooting the basketball for a 10 minute warm up period.

The games were conducted on half of a regulation National Collegiate Athletic Association (NCAA) men’s basketball court with a men’s college regulation size basketball using the same game rules to govern fouls and turnovers stipulated by the NCAA (see www.ncaa.org). Participants could score points by making a 3 point shot or a 2 point shot. After a basket was made the possession of the ball changed. The experimenter called all fouls and turnovers. The first player to score 12 or more points won the game.

After the first game, the participant and the confederate rested for 2-3 minutes and afterwards were given a questionnaire packet that included either an MS or control manipulation (the confederate simulated filling out a control packet). Packets were shuffled before the study so that both the experimenter and the confederate remained blind to conditions. Participants then played a second game according to the same rules. At the end of the experiment, participants were probed for suspicion and fully debriefed. Games were video recorded by the experimenter. The materials are listed below in the order of their presentation.

Personality fillers. To aid with the cover story, participants first completed the short version of the 20-item PANAS questionnaire (Watson, Clark & Tellegen, 1988), and the Marlowe-Crowne social desirability questionnaire (Crowne, & Marlowe, 1960).

Mortality salience and control inductions. Participants were randomly assigned to the MS or control condition. Participants in the MS condition were asked the prototypical open-ended questions regarding their mortality: “Please briefly describe the thoughts and emotions that the thought of your own death arouses in you” and “Jot down as specifically as you can, what you

think will happen to you as you physically die and once you are physically dead” (e.g., Rosenblatt et al., 1989). In the control condition, participants responded to parallel questions about playing basketball: “Please briefly describe the thoughts and emotions that the thought of playing basketball arouses in you” and “Jot down as specifically as you can, what you think will happen to you as you play basketball”. Since the purpose of these questionnaires was to make participants think about their mortality, the participant's answers were not used in any way.

We had participants write about playing basketball in the control condition to see if MS would enhance performance in comparison to a neutral state of mind that focuses on basketball rather than compared to a negative state of mind, which may hinder the participant’s performance, as previous studies have shown (e.g., Wilson, Vine, & Wood, 2009). Importantly, previous studies in the framework of TMT show that that the MS effect on self-esteem striving and worldview defense does not involve explicit anxiety or negative affect (e.g., Arndt et al., 2001), and are stronger when death related cognitions are not in focal awareness (e.g., Burke et al., 2010; Greenberg et al., 1994). Furthermore, studies show that both neutral conditions (e.g., thinking about watching T.V.) and other aversive control conditions (e.g., thinking about experiencing pain or uncertainty) both differ from MS inductions in regard to initiating terror management processes (e.g., Greenberg et al., 1994; Martens, Burke, Schimel, & Faucher, 2011).

Personality filler and delay. Following previous TMT research (e.g., Greenberg et al., 1994), participants completed the Mindful Attention Awareness Scale (Brown & Ryan, 2003) and the Morningness-Eveningness questionnaire (Horne & Ostberg, 1975).

Game stats. Two independent coders blind to the experimental conditions reviewed the videos and recorded the participant and confederate’s performance in each game. The coders tallied the number of 2 point shots attempted/made, 3 point shots attempted/made, free throws

attempted/made, rebounds, steals, blocks, turnovers, and fouls. There was high consistency among the coders (average $K = .97$). Averages were used for the few disagreements.

Results

Preliminary analyses. Preliminary analysis indicated that there were no differences between the experimental groups in: points scored in the first game (pre-manipulation); the confederate's points scored in either the first game, second game, or overall; the total time of either game; and the participant's reported attitudes towards sports or basketball, age, positive and negative affect, mindfulness, or social desirability (all $t_s < 1.5$, all $p_s > .33$).

Notably, the confederate's total points scored was related to the number of games he played, *Spearman's rho* = .52, $p < .01$, indicating that his performance improved as the study progressed. Therefore, we also controlled for the experimental session number in our analyses.

Primary analyses. To test if MS improved performance compared to the control condition, we conducted a one way ANCOVA for differences between MS and control in points scored in the second game, while controlling for the participant's points in the first game, the confederate's improvement over the course of the study (via session number), and the winner of the first game. We ran this analysis with 5,000 resamples via bootstrapping. The overall ANCOVA model was significant, $F(4, 26) = 11.79$, $p < .001$, $R^2_{Adj} = .59$. There was a significant difference between groups, $F(1, 26) = 10.38$, $p = .003$, $\eta p^2 = .29$. As predicted, participants in the MS condition scored more points in the second game ($M_{Adj} = 9.80$, 95% CI [8.11, 11.32]) compared to participants in the control condition ($M_{Adj} = 6.81$, 95% CI [5.16, 8.41]).²

We also tested whether the participants improved from the first game to the second game in the MS and control conditions using a 2 (points scored in first game vs. in second game) \times 2 (MS vs. control) mixed factorial ANCOVA, while controlling for the confederate's improvement

and the winner of the first game. This analysis yielded a significant interaction between the game played and the experimental condition, $F(1, 27) = 10.91, p = .003, \eta p^2 = .29$ (see Figure 1). To unpack this interaction, we conducted paired t tests with 5,000 resamples via bootstrapping for points participants score between the second game and first game separately for each experimental condition. Participants in the MS condition scored more points in the second game ($M = 9.07, 95\% \text{ CI } [7.25, 10.80]$) compared to the first game ($M = 6.33, 95\% \text{ CI } [4.19, 8.64]$), $t(14) = 3.34, p = .005, \text{Cohen's } d = .86$. There were no such differences among participants in the control condition, $t(15) = .37, p = .720$, suggesting that our control condition was neutral in the sense that it neither helped nor hindered performance.

Exploratory analyses. To further explore which specific aspects of the game improved under the MS condition, we ran an additional MANCOVA test (to reduce the chance of a type 1 error). The independent variable in the analysis was the type of prime (MS vs control), and the dependent variables were: 2 point shots made, 3 point shots made, rebounds, blocks, fouls, and turnovers (see Supplemental Materials for the descriptive statistics and additional analysis).³ The covariates were the confederate's improvement during the study (experimental session number), the winner of the first game, and the participant's points in the first game. We also added time of the second game as a covariate since some stats (rebounds, blocks, and turnovers) were related to that factor. The differences was significant on the multivariate level, $F(6, 20) = 3.26, p = .021, \eta p^2 = .49$. On the univariate level, the difference in 3 point shots made was significant, $F(1, 25) = 12.63, p = .002, \eta p^2 = .33$ (this difference would still be significant after using a Bonferroni correction for 6 comparisons at $\alpha = .008$). No other game statistic was significantly different, $F_s < 1.15, p_s > .440$. A subsequent bootstrap test with 5,000 resamples, showed that MS participants scored more 3 point shots in the second game ($M = 1.65, 95\% \text{ CI } [1.03, 2.16]$), compared to the

control condition ($M = .65$, 95% CI [.14, 1.23]), $F(1, 29) = 5.69$, $p = .025$, $\eta p^2 = .16$. We also conducted a series of within-subject paired t tests using bootstrapping with 5,000 resamples for differences in the participant's secondary statistics between the first and second game, separately for each experimental condition. In the MS condition, only the difference in 3 point shots scored between the two games was statistically significant, $t(14) = 2.48$, $p = .027$, *Cohen's d* = .64. Participants in the MS condition scored more 3 point shots in the second game ($M = 1.65$, 95% CI [1.03, 2.25]) compared to the first game ($M = .73$, 95% CI [.36, 1.13]). No other within-subject differences in the MS condition were statistically significant, $ts < 1.92$, all $ps > .070$. Importantly, there were no differences between the first and second game in the control condition, all $ts < 1$, all $ps > .420$. The descriptive statistics and significance tests of these variables are reported in the supplemental materials.

Discussion

The results of Study 1 showed that MS improved athletic performance among people who derive a sense of self-worth from sports and value basketball. MS caused an increase of more than 20% in the average points scored in the basketball game between the groups and 40% increase from Game 1 to Game 2 within subjects. These results support our hypothesis that MS motivates better performance in sport. Interestingly, the results revealed an effect of MS on scoring points rather than other aspects of playing basketball such as rebounds, blocks, turnovers, and fouls. We speculate that this is because MS may influence the most relevant aspects of sport performance that directly affect the primary objective of the game, such as shooting.

One issue that may warrant consideration is whether the specific control condition used had a role these findings. It might be that writing about basketball led participants to explicitly monitor their performance, which can hinder sport performance under stress (e.g., Beilock, Carr,

MacMahon, & Starkes, 2002; Liao & Masters, 2002). However, a number of facts render this possibility unlikely. For instance, in addition to MS leading to more scoring than the control condition, participants improved from before the MS induction to after it. In contrast, control participants performed the same after writing about basketball as they did prior to that induction. Further, the prior research showing a deleterious effect of performance monitoring involved asking participants to be aware of certain aspects of themselves (e.g., their movement), *during* the task (e.g., Baumeister, 1984; Gucciardi & Dimmock, 2008; Jackson, Ashford, & Norsworthy, 2006). Our control condition did not ask participants to do anything during the task and there were two delay tasks before the participants began to warm up for the second game. Thus, we do not believe that our control condition was comparable to the kinds of debilitating self-focusing and performance monitoring inductions that research has shown can hinder performance. To further rule out any possible impact of Study 1's control condition, we conducted a second study using a different MS induction, a purer neutral control condition, and a different basketball task.

Study 2

The goal of Study 2 was to replicate the results from Study 1 using a basketball task that would not require using a confederate and an elaborate video coding scheme. First, considering that in Study 1 MS affected the number of points scored in the game, in Study 2 we designed a basketball shooting task that focused on scoring rather than other aspects (e.g., rebounds, fouls, or blocks). Second, in order to run multiple participants in each session, we switched the MS induction to a subtle death prime (described below), which the control condition simply lacked. This manipulation also allowed us to have multiple participants in each session while keeping the delay period between the priming and the shooting task constant across all the participants.

In addition, we utilized this study to further investigate the psychological function of the effect by testing whether a higher score in the shooting task would affect the participant's task related self-esteem. If the effect is indeed driven by the need to attain self-esteem it should increase the degree that the participants feel good about themselves after the shooting task.

As in Study 1, we hypothesized that exposure to the death prime would lead to better performance in the task. Specifically, we predicted that participants primed with death will score more points in the task compared to participants in the control condition. We also hypothesized that this higher score in the death prime condition would be associated with higher task related self-esteem. We predicted that exposure to the subtle death prime will indirectly increase participant's satisfaction with themselves through the number of points they scored in the game.

Method

Participants. Forty-four male University of Arizona undergraduates, who noted on our pre-screening mass survey that they like playing basketball at a level of 7 or above on a 9-point scale, and that being good at basketball is important for their sense of self-worth ("How important is it to your self-worth to be good at basketball?", $1 = \text{Not at all}$ to $9 = \text{Extremely}$) at a level of 6 or above on a 9-point scale (there were a total of 109 eligible participants). Because we had a smaller sample for the survey the semester we ran this second study, we used a 6 instead of 7 on this item. We did not believe that slightly lowering participant criterion for this item would be detrimental being that the basketball task in Study 2 is less demanding on participant's ability than Study 1 (e.g., they do not have to defend, or play against defense), and we still recruited participants who reported above the mean on this item (the corresponding Z score of the value 6 was .81). After removing the results of two participants because of suspicion and one because of an injury issue, data from 41 participants were analyzed ($M_{age} = 18.62$, $SD = .78$).⁴

Procedure and Materials. Recruitment of the participants was done as in Study 1. Participants were brought in groups of two to five to the same basketball court used in Study 1 and were told a similar cover story. To ensure that the participants were not affected by each other's performance, they were taken to a separate seating location outside of the court and were brought into the basketball court individually to complete the shooting task (Experimenter 1 monitored participants in the seating location outside of the court). The order of the shooting was determined randomly by drawing numbers from a hat. A second experimenter (Experimenter 2) implemented the death prime using a T-shirt with a skull and the word "death" printed on it while introducing the task. The task itself was then completed with a third experimenter (Experimenter 3) who was blind to the participant's condition. After the basketball shooting task, participants were led back to the initial seating location outside of the basketball court and completed a questionnaire that contained a measure of task-related self-esteem, several filler items, and demographic information. At the end of the study, the participants were thoroughly debriefed and probed for suspension. The materials and task description are listed below.

Priming induction. To prime death we used a T-shirt with an image of a skull consisting of the word "death" printed on it multiple times. Primes with images of skulls and the word "death" have produced similar effects to the MS manipulation (e.g., Arndt et al., 1997; Chopik, & Edelstein, 2014). Unlike MS induction, subtle death primes do not require a delay prior to the dependent variable for the effect to emerge (e.g., Arndt et al., 2004; Pyszczynski et al., 1999).

Participants were assigned to prime condition using a coin flip prior to entering the court. Experimenter 2 either unzipped his jacket to expose the T-shirt prime to participants or zipped up his jacket in the control condition to conceal it. The priming took place inside the court from the time the participants met with Experimenter 2 and throughout the initial presentation of the task

instructions. Experimenter 3, who recorded the participant's performance, had his back turned to the participant and Experimenter 2, ostensibly sorting papers during the initial instructions, to remain blind to conditions. Experimenter 2 then left the basketball court area while Experimenter 3 reiterated the task instructions and recorded the participant's performance on the task.⁵

Basketball shooting task. The goal of the task was to score as many points as possible in 60 seconds. Participants were able to score points three different ways: a 3 point shot taken from behind a 20 foot 9 inch (6.32 meter) arc from the basket, a 2 point shot taken from behind a 17 foot 10 inch (5.43 meter) arc, or a 1 point shot which was defined as any shot taken inside the 2 point arc. To increase the difficulty of the task and the variability in the type of shots taken, participants were not allowed to take the same type of shot twice in a row. Participants were instructed to rebound their own shot. Only one ball was used during the task. The participants were allowed three warm up shots (one from each point location) before completing the task.

Task-related self-esteem. Participant's task related self-esteem was measured using five questions that measured the degree to which participants felt good about themselves in relation to the task (e.g., "During the basketball task, I felt satisfied with myself" on a scale from 1 = *Not at all* to 7 = *very much so*). The items showed high reliability ($\alpha = .93$) so a mean composite score was computed. Higher scores represent higher levels of task related self-esteem.

Filler personality questions. To aid the cover story, at the end of the study participants completed the social desirability and Morningness-Eveningness questionnaires.

Results

Preliminary analyses. There were no differences between the experimental groups in the participant's reports of how important it is for their self-worth to be good at basketball and how much they like playing it, as well as in age, height, weight or BMI, all $F_s < .67$, $p_s > .410$.

Primary analysis. To test our hypothesis, we conducted a between subject *t* test for differences in total points scored in the task between the death prime and the control condition, with 10,000 resamples via bootstrapping. The analysis showed that there was a significant difference between the groups, $t(39) = 2.22, p = .033, \text{Cohen's } d = .69$, such that participants who were primed with death scored more points in the task ($M = 11.85, 95\% \text{ CI } [9.76, 14.00]$) compared to participants in the control condition ($M = 8.33, 95\% \text{ CI } [6.11, 10.65]$).

Task related self-esteem. We tested our hypothesis that the death prime would indirectly increase task-related self-esteem through performance. The independent variable was the prime (prime = 1, control = 0), the mediator was points scored in the task, and the dependent variable was the participant's mean task related self-esteem. The 95% confidence intervals for the indirect effect were estimated via bootstrapping from 10,000 resamples using *PROCESS* (Hayes, 2012). Path coefficients were computed using hierarchical regression analyses.

The models predicting points from condition and task related self-esteem from condition and points were statistically significant, $F(1, 39) = 4.90, p = .033, R^2_{adj} = .11$, and $F(1, 38) = 9.83, p < .001, R^2_{adj} = .34$. As predicted, the indirect effect was positive and significantly different from zero, $M \text{ effect} = .53, 95\% \text{ CI } [.07, 1.13]$. Examining the specific paths (see Figure 2), the prime increased the amount of points scored (A path), $t(39) = 2.22, p = .033, \beta = .33$, and the number of points scored was related to task-related self-esteem (B path), $t(38) = 4.35, p < .001, \beta = .61$. The prime was not related to self-esteem (C path), $t(39) = .72, p = .467, \beta = .12$. Controlling for points scored (C' path) did not change the result, $t(38) = .66, p = .530, \beta = -.06$.

Discussion

Our findings in Study 2 showed that participants exposed to a brief subtle death prime performed better in the shooting task than participants in the control condition by approximately

30%. These results provide additional evidence supporting our hypothesis that thoughts about death can increase athletic performance in sport. Moreover, the finding that thinking about death indirectly increased self-esteem through the increasing of number of points scored in the task, supports our TMT based reasoning that performance in sport may serve the psychological purpose of maintaining a positive self-image to buffer against death related thoughts.

General Discussion

The goal of our research was to apply TMT to the world of sport in order to further understand its psychological function and to utilize this understanding to improve athletic performance in sport among those who value it. Building on research on TMT showing that people need self-esteem to buffer against the potentially anxiety provoking awareness of mortality (e.g., Greenberg et al., 1992), and considering that sport allows people to have self-esteem (e.g., Ekeland et al., 2005), we hypothesized that reminders of death would motivate improved performance in sport. This hypothesis was supported in two experiments. In Study 1, a MS induction caused a considerable improvement in the participant's performance in a "one-on-one" basketball game (approximately 20% more points scored), compared to participants in a control condition and compared to their own baseline level (approximately 40% more points scored). In Study 2, brief exposure to a subtle death prime led to a 30% higher score on a basketball shooting task compared to participants who were not exposed to a death prime. In addition, results revealed an indirect effect of reminders about death increasing task related self-esteem through an increase in points scored. These results illustrate that performance in sport, as has been found with many other cultural activities, can serve a terror management function. Furthermore, our research illustrates, for the first time, how the need to manage death awareness can cause improvement in relatively complex athletic settings, such as an actual sport.

Limitations. This research has several limitations. First, we only investigated this effect in the sport of basketball. Nevertheless, we believe that the possibility that this effect is unique to basketball is highly unlikely, as basketball includes various athletic and cognitive abilities (e.g., running, jumping, aiming, throwing, anticipating an opponent's movement, etc.) that are involved in many other sports. In addition, it is unclear how long the effect of death primes last. Based on the results of Study 1, we can speculate that that the effect lasts for about 8 minutes because we had 2 short delay tasks and the average time of the second game was about 5 minutes. However, future studies should empirically investigate the duration of this effect.

Another limitation is that our sample only consisted of males and it is presently unknown if there are gender differences in this effect. However, we believe this is not likely, as women's sports are highly developed and lauded in many cultures, and they too gain self-esteem from increased performance (e.g., Pedersen & Seidman, 2004). Moreover, in the study by Peters et al. (2005) both women and men exerted more physical force after MS, despite the fact that physical force per se is traditionally associated with more masculinity. Regardless, future studies should seek to replicate our current findings among women.

Considering that these two studies required a great deal of time, effort, and resources, we aimed for between 15 and 20 participants per cell (a standard in many TMT studies, e.g., Greenberg, et al., 1994; Jonas, et al., 2002; Peters, et al., 2005; Rosenblatt, et al., 1989). A G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) post-hoc analysis indicated that, given the large effect size, Study 1 had more than sufficient power at $p = .05$ using a one-tailed test to detect the difference between groups (.93) as well as within groups (.94). Study 2 was slightly underpowered (.70) to detect the between group effects. However, based on the results of Study 1, the a-priori power of Study 2 was very high (.97 for a two-tailed test). Although large samples

would of course be optimal, we believe these power analyses, combined with the large number of prior MS findings using similar cell sizes, and the fact that the two studies using different priming inductions and different measures (including a mixed within-between study design in Study 1), while converging on the same conclusion, support the value of the current findings. Furthermore, the chances the effect is a type 1 error is reduced because we found similar effects of death primes on points scored in two separate experiments.

Another limitation is that these studies only tested the effect among individual players, rather than in groups. MS may have a different effect for team performance, in which cooperation is typically involved. It could disrupt team performance if it motivates a desire only for individual glory; a player on a basketball team could try to maximize his or her own scoring rather than maximize the chances for the team to win. On the other hand, MS may even have a stronger effect among teams as it is likely to increase adherence to in-group norms and improve social relations within the ingroup (e.g., Jonas et al., 2002; McPherson & Joireman, 2009).

A final limitation is that these studies used undergraduates rather than collegiate or professional athletes. It is possible that more serious athletes would not be as affected by MS because they are already close to maximally motivated. Alternatively, from a TMT perspective, athletes with ambitious goals may be even more motivated by reminders of mortality since at the professional level sport can provide people with symbolic immortality through fame and history making (e.g., Dechesne, Greenberg, Arndt, & Schimel, 2000; Greenberg & Weise, 2010; Lifton, 1979; Pisk, 2012; Schmitt & Leonard, 1986). Indeed, research shows that MS increases the desire for lasting fame (Greenberg, Kosloff, Solomon, Cohen, & Landau, 2010). The ancient Greeks, who integrated sport into their religious worldviews, believed that the winner of the Olympic Games represented the very best of mankind, and that successful athletes could achieve

the ultimate prize of glory and immortality (e.g., Guttman, 2000). Also in this modern age, some of the most lauded heroes across cultures are from the sport realm. For example, athletes such as Serena Williams, Diego Armando Maradona, Michael Jordan, and Nadia Comaneci are immortalized in the minds of millions people across the globe. Therefore, it seems likely that sport is an especially central vehicle for feeling transcendent of death for highly successful athletes and it may be very valuable to assess the effects of death primes on such individuals.

Implications. Before considering the potential implications of our findings, we want to acknowledge two broad points. First, we are not suggesting that defensive terror management concerns are the only motivators of sports performance. Clearly, sports performance is also often motivated by approach-oriented motives such as growth, competence, and self-expansion (e.g., Pelletier, Fortier, Vallerand, & Brière, 2001; Vallerand, 2004). Theorists and researchers have considered the interplay of the defensive motivation posited by TMT and the more growth-oriented motivation posited by self-determination (e.g., Greenberg, Pyszczynski, & Solomon, 1995; Vail et al., 2012) and have suggested that any given behavior could be driven entirely by defensive concerns, entirely by growth motivation, or by a combination of the two. For example, in the sports domain, an athlete could be motivated entirely to prove worth to self or others, to gain a lasting legacy in the sport, or to enjoy challenging oneself, growing, and becoming the best they can be at the sport, or (probably most often) by a combination of these motivations. Although well beyond the scope of any small set of studies, in the long run, such an integrative perspective on motivation to excel in sports will probably yield the most benefits.

Our second broad point is that these studies provide only initial steps in considering terror management processes in sports, and further progress toward full understanding and practical implications will require joint efforts from many researchers with different resources (e.g., some

work with professional athletes, others work with children, or older adults) conducting multiple experiments and field studies. But we hope these findings will help spark such efforts.

In this light, we think this research does have a variety of potential implications for both sport psychology and terror management research. To our knowledge no prior research has ever empirically shown that existential concerns play a role in athletic performance and no prior study has shown that MS can improve performance in a relatively complex task such as basketball.

While these studies move us forward, more research is needed before we could draw strong conclusions about the value of specific ways of implementing terror management related strategies. At the same time, we would note that some such strategies have undoubtedly been informally used over the years. For example, coaches who tell their team that this is a chance to make history are basically saying if you win, some aspect of yourself will be remembered long after your death. The actual efficacy of such strategies, and many other possible ones activating terror management motivation, can only be determined by additional research.

By revealing a terror management function of sports, we can apply another theoretical perspective to understanding why sports are so popular and so much is invested in them, as well as the psychological effects they may have on humans. The TMT perspective may also promote better understanding of how sports can help individuals deal with existential concerns in the realm of sport therapy and education. These results also show that TMT can be applied to improve actual performance in complex behaviors. Whether reminding athletes of mortality prior to games—and under what circumstances—is unclear pending further research, but there may indeed be contexts in which it could help motivate players. Further research will hopefully investigate these possibilities.

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Footnotes

¹ One participant thought that the confederate was not a real participant; one was excluded because the confederate was ill during the game; one arrived to the study with his girlfriend; and one participant did not know how to play basketball adequately.

² Participant's points in game 1 ($F = 15.76, p = .001, \eta p^2 = .38$) and the confederate's improvement ($F = 6.92, p < .05, \eta p^2 = .21$) were significant covariates, winner of Game 1 ($F = 3.10, p = .09, \eta p^2 = .11$) was marginally significant. These results held also if we did not include the confederate's improvement and the winner of game one as covariates ($ps < .05, \eta p^2s = .13$).

³ We tested the between subject design first because it allowed us to use bootstrapping to test for between subject differences while using covariates in the model.

³ Because some participants did not attempt a 3 point shot, the 3 point shot percentage statistic was not analyzed in the MANCOVA. Similarly, we did not include steals or free throw statistics in the MANCOVA because participants in the MS condition did not steal the ball or make any free throws in game 2 (only one person in the MS condition attempted free throws). We also tested for differences between the experimental groups in 2 point shot percent in a separate model to avoid multicollinearity. This model did not produce a significant effect, $F < 1$.

⁴ Two participants were suspicious that the study involved deception (they thought that they were being videotaped) and one participant was recovering from an injury.

⁵ Experimenter 3 repeated the instructions to ensure that the prime was not interfering with the participant's understanding of the instructions given by Experimenter 2.

⁶ As expected, because the death prime should not have directly increased self-esteem, the alternative causal model in which self-esteem was the mediator and points scored was the dependent variable did not produce an indirect effect different from zero, 95% CI [-.92, 3.06].

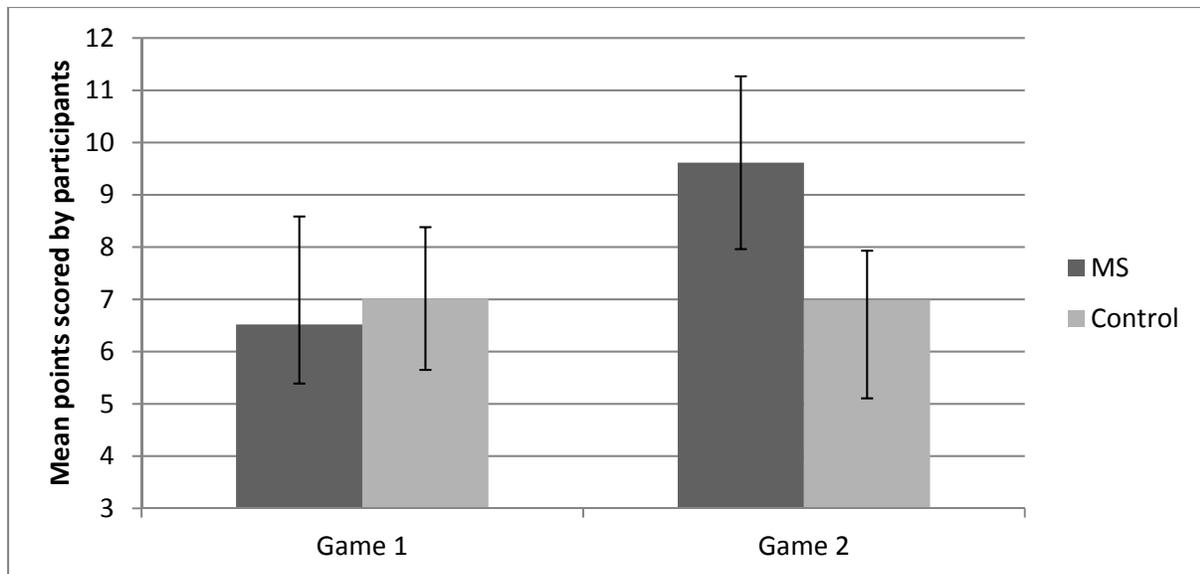


Figure 1. Differences in points scored in the games, according to the game number (Game 1 vs. Game 2) and the experimental conditions (MS vs. Control). Error bars represent 95% confidence intervals based on bootstrapping with 5,000 resamples. Covariates in the model are the confederate's improvement and the winner of the first game.

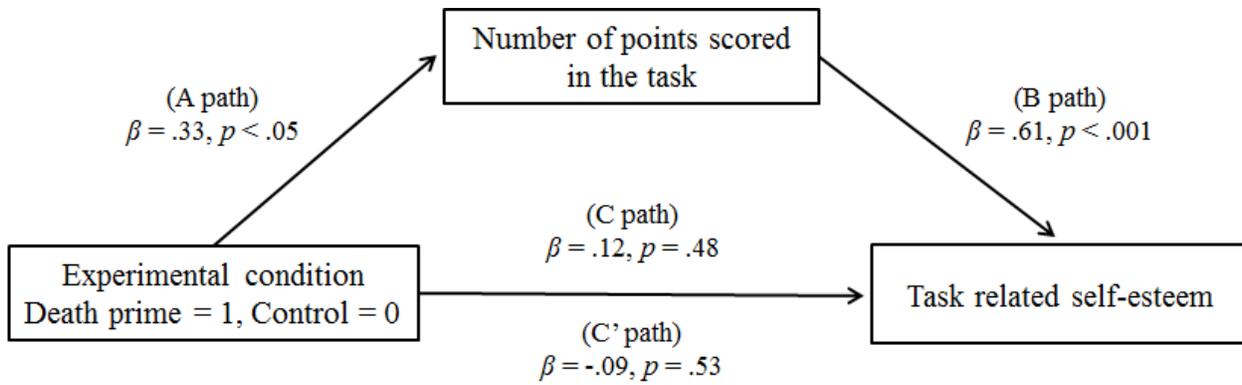


Figure 2. A model depicting the indirect effect of the death prime (prime = 1, no prime = 0), on task related self-esteem through the number of points scored in the task (N = 41).

95% CI for indirect effect based on 10,000 samples did not include zero [.07, 1.13].